CQ-TV

219

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Caption Competition.

Only three entries this time:

Dicky Howett:

'At least they've printed CQTV up the right way...'

Dave Holden's three suggestions:

".. and so Janet and John went with Daddy to the BATC rally"

".. I can't find the callsign W1NNIE in this book "

".. so that's how a PIC 16F817 8-bit microcontroller works !"

and Eric Edward's two suggestions:

"Who needs Winnie the Poo when you have this mag"

"Cor! I wish I was grown up"

With my last editorial breaths, I declare Eric to be this issues winner. Good try to the others, better luck next time. A BlackBoxCamera unit will be on it's way to you shortly Eric.

As nobody sent any pictures for this magazines competition, I left the box on the left rather blank. Neverthe less, entries about it are welcome. No comments on 'zero IRE reference signal' or lens caps please!

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Contents

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

Circuit Notebook 94

By John Lawrence. GW3JGA

Audio Test Burst Generator

Here is a circuit which will generate a sine wave signal in 8 steps of increasing amplitude. Each step lasts for 2 seconds with the sequence of steps repeating continuously. The circuit could be used for checking audio level meters, transmitters, limiters, compressors etc.

Circuit Description

The circuit is shown in Fig.1.

IC1 (74HC 4060) is a 14 stage Ripple Counter with Oscillator. The 1kHz (approx) signal is generated in the oscillator section of IC1 where the frequency is determined by R15 and C1. The square-wave signal is passed through a low-pass 1kHz filter consisting of IC2a and IC2b (LM358). After this filtering, the output from IC2b is a respectable sine wave. This is fed to the resistor chain R1 to R14. Its purpose is to provide 8 levels of signal including zero and maximum level.

Returning to IC1, the outputs from the last three counter stages (Q11, Q12 & Q13) provide a three line address which is connected to the select inputs of IC3 (74HC 4051) an Analogue Multiplexer. The eight signal inputs of the multiplexer are connected to points on the chain of resistors to select specific signal levels. One input is connected to zero level and another to maximum level. A diagram indicating the relationship between the three line address and signal level is shown in Fig.2. The diagram shows the signal level increasing in equal steps, this would be the case if all the resistors in the chain were of equal value.

However, the values of the resistors in the chain are selected to provide specific amplitude levels of the 1kHz signal. In the circuit shown, the resistor values are chosen to provide 3dB increments of signal level. To avoid 'difficult' resistor values, each required value is made up of two resistors selected and connected in series. Using 1% resistors, the overall error in signal level is likely to be less than 0.2dB. The resistor values for 3dB steps are shown in Table 1. and for 4dB steps in Table 2.

The sine wave amplitude at the top of the resistor chain is approximately 150mV and a final amplifier stage IC3 (ICL 7611) is provided to enable the maximum output signal to be increased to 0dBu (0.775v r.m.s., 2.2 V p-p). The ICL 7611 is a rail-to-rail op-amp which is needed to provide a 2.2V p-p output from a +5V supply. In use, the maximum output is set to 0dBu by means of the 'Set Level' control RV1. An alternative maximum level could be chosen, e.g. -10dBu, and the 3dB steps would then apply to the new level.

The oscillator frequency of nominally 1kHz (mine turned out to be 987 Hz) can be adjusted by replacing R15 with a 1M0 potentiometer and setting the frequency using a frequency counter. If

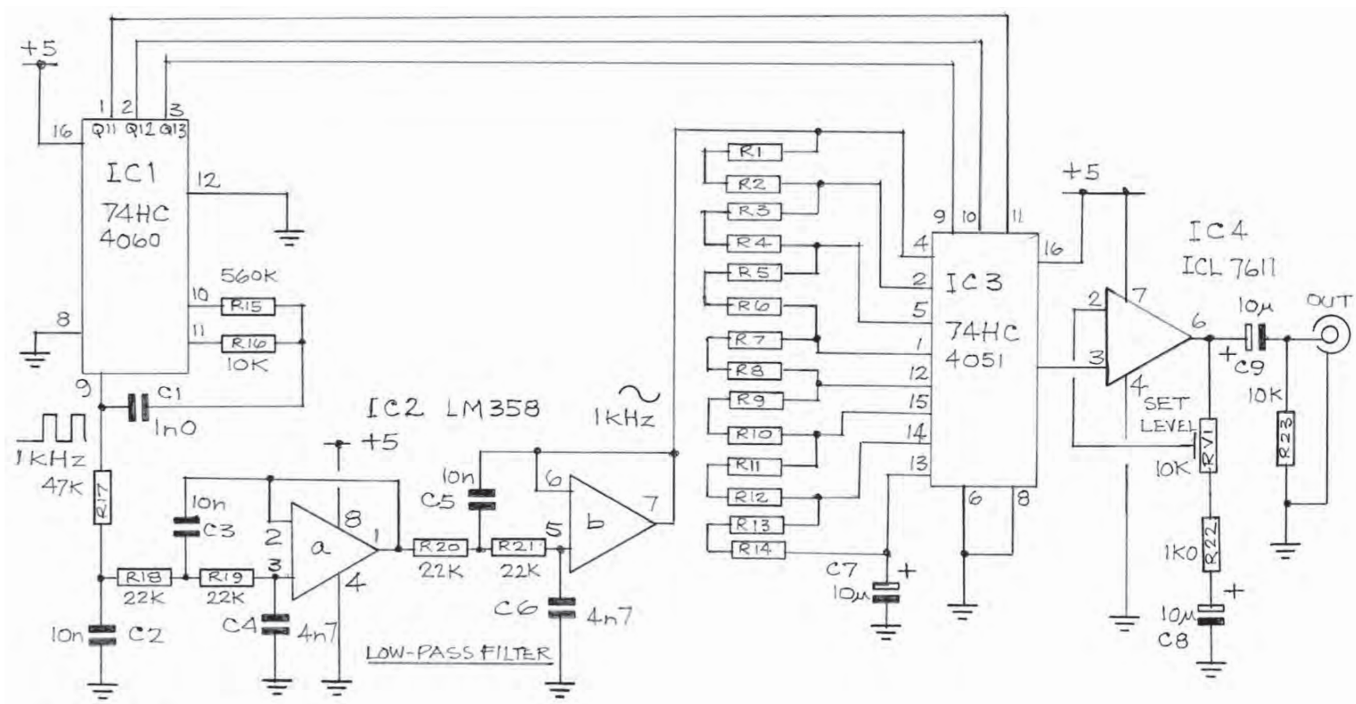


Fig. 1

the frequency is changed, by a significant amount, for example to 600Hz, then the component values in the low-pass filter will also need to changed.

An interesting dB-dBu-dBv Comparison Table is published in the Technical Data section of the Canford catalogue www.canford.co.uk and it is reproduced here in Table.3.

References;

74HC 4051 and 74HC 4060 data.
Mullard Technical Handbook No.4. Part 5.

Decibel Table
RSGB Radio Data Reference Book

G. R. Jessop, G6JP, Fifth Edition p.37

dB-dBu-dBV Comparison Table
www.canford.co.uk/technical

Source: BBC Designs Department Handbook No.3. 186 (1986)

TABLE 1	RESISTOR	VALUES		3dB STEPS
DECIBELS	RELATIVE	REQUIRED	R	R
	VOLTS	RESISTOR	NUMBER	OHMS
0	1			
		2920	R1	2700
-3	0.71		R2	220
		2080	R3	1800
-6	0.5		R4	270
		1450	R5	1200
-9	0.36		R6	270
		1040	R7	1000
-12	0.25		R8	39
		730	R9	680
-15	0.18		R10	47
		520	R11	470
-18	0.13		R12	47
		1260	R13	1200
INF	0		R14	56

TABLE 2	RESISTOR	VALUES		4dB STEPS
DECIBELS	RELATIVE	REQUIRED	R	R
	VOLTS	RESISTOR	NUMBER	OHMS
0	1			
		3690	R1	3300
-4	0.63		R2	390
		2330	R3	2200
-8	0.4		R4	120
		1470	R5	1200
-12	0.25		R6	270
		920	R7	820
-16	0.16		R8	100
		590	R9	560
-20	0.1		R10	33
		370	R11	270
-24	0.06		R12	100
		630	R13	560
INF	0		R14	68

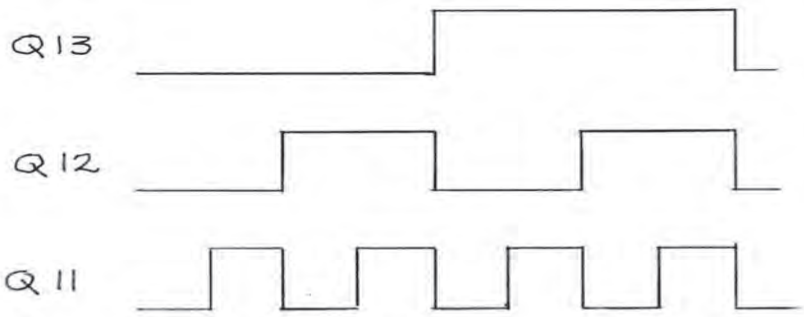


Fig. 2

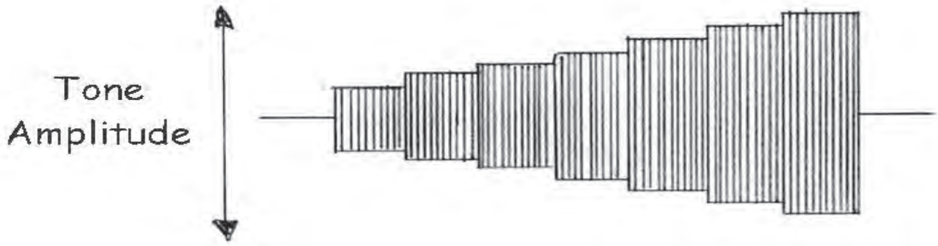


TABLE 3 . dB-dBu-dBV COMPARISON TABLE (www.canford.co.uk)						
MULTIPLIER	dB	dBu	dBV	PPM	PPM	VU
Relative to				UK scale	EBU scale	UK scale
reference V						
10	20	7.75V	10.0V			
4	12	3.08V	3.98V	7	12	
	8	1.95V	2.51V	6	8	4
	7	1.73V	2.24V			
2	6	1.55V	2.00V			2
	5	1.38V	1.78V			
	4	1.23V	1.59V	5	4	0
	3	1.09V	1.41V			
	2	975mV	1.26V			
	1	869mV	1.12V			
1	0	775mV	1.00V	4	0	-4
	-1	690mV	891mV			
	-2	615mV	794mV			
0.7	-3	548mV	708mV			-7
	-4	489mV	631mV	3	-4	-8
	-5	436mV	562mV			
0.5	-6	388mV	501mV			-10
	-8	308mV	398mV	2	-8	
0.25	-12	195mV	251mV	1	-12	
	-18	97.5mV	126mV			
	-24	48.9mV	63.1mV			
	-30	25.4mV	31.6mV			
0.01	-40	7.75mV	10.0mV			
	-50	2.45mV	3.16mV			
0	-60	774uV	1mV			
	-70	2.45uV	316uV			
dBu = 20 log V/0.775 where voltage is irrespective of impedanmce						
dBm = 20 log V/0.775 where voltage is measured across 600 ohms						
dBV = 20 log V/1						

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 33 - “Summer 1957”

One of the technical articles in this issue described a “fascinating little unit that will add much to the interest and amusement of your transmissions”. This video effects amplifier was a ‘device for chopping out part of the picture from one camera and inserting in its place the picture from another camera’. The block diagram shows that 2 video inputs, marked 1 and 2, are fed into a video changeover switch operated by the trigger circuits. The switch is operated by combinations of DC level changes and suitable AC waveforms, primarily derived from line and field syncs. The video signals were applied to the supressor grids of V4 and V5, arranged as a Schmitt trigger so that V5 would normally conduct unless the grid of V4 was taken higher than that of V5. As only one valve could conduct at a time, they have a common anode load, feeding the phase splitter V6A and cathode follower output, V6B. V3 is another Schmitt trigger , to ensure clean switching. Only 4 switch positions were shown, “but by applying some ingenuity and thought, almost any effect can be produced’. With no input from V1 or V2, V3A is controlled by the 250k manual potentiometer, or from the ‘operate’ switch - acting as a simple vision switch. V1 and V2 are simple integrators, producing line and field sawteeth. If, say, line sawtooth is added to the dc fed to V3, then by setting the manual control, the changeover will occur at any desired point in the line, and the resulting picture is as in figure (a). On ‘auto’, the vertical division moves across the picture, producing a horizontal wipe. Using the field sawtooth from V1, a horizontal division is produced, or a vertical wipe, as in figure (b). Adding the line and field sawtooth signals (ideally) produces a rectangular cut out (as in (c)), but in practice this becomes rounded and more lozenge shaped (figure (d)). An external input could be used to create other effects, such as a venetian blind (figure (e)), if a switching signal at a multiple of the field frequency is fed in./(Although created with valve technology of the time, the block diagram would still be applicable to a similar device made in a solid state form)./mateurs wishing to use a camera at that time had little choice other than to build it themselves. Vidicon type tubes were available via the Club (apart from to ‘Iron Curtain countries’), being tubes rejected by the makers for ‘minor blemishes’. Tubes cost £25 each - plus postage and insurance charges ‘send us the £25, and we will send the bill for the extra’.

The line coils were cemented into place with shellac as diametrically opposite as possible, and it was recommended that the field coils be attached to a thin paper former, so they could be rotated slightly to give a truly rectangular scan, and then secured permanently. The focus coil had to provide a field of 40 gauss, and was made of 6500 turns of 34swg enamelled wire, to pass 40mA of dc. The tube socket was considered much more difficult - a paxolin disc

Dim^n	Line Coils	Field Coils	Alignment Coils
A	2 3/16"	2"	1 1/4"
B	1 7/8"	2 5/16"	3/4"
(Tolerance on above: ± 1/16"; alignment coil dim^s are not critical).			
C	0.110"	0.06"	9/32"
P	15/16"	29/32"	3/8"
Q	1 1/4"	11/16"	7/8"
(Tolerance on P & Q: +1/32" - 0"; alignment coil jig not critical).			
R	0.55" approx	0.69" approx	1 3/4"
ohms/coil	1.6	82	70
mH/coil	0.62	17	22
Total L, series	1.35mH	41	44
Turns/coil	105	620	1000
SWG	26	38	34
(Lewmexbond T will be found to be easiest to work).			

Winding details

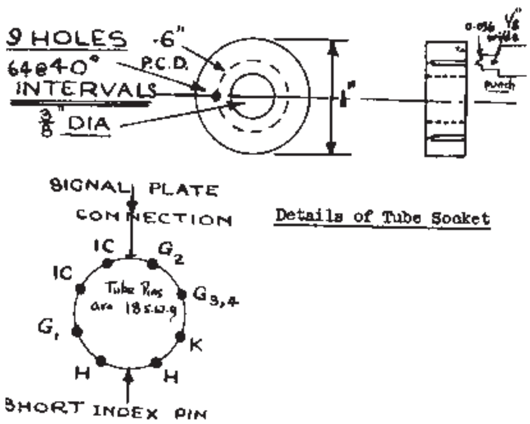
Line: Wind 26 turns, tie with thread; repeat twice (total 78); wind to 105 turns, finish off and tie. Bind sides with Sellotape and bend to shape.

Field: Wind 150 turns, insert pegs into first holes, or tie; repeat for 160, then 150t, then finish off to 620 turns. If Lewmexbond, pass 6.3V or heat to 150°C to bond wire, or tie. Form to shape.

Alignment: Not critical - wind on jig as preferred.

TABLE 6.1: COIL WINDING DATA

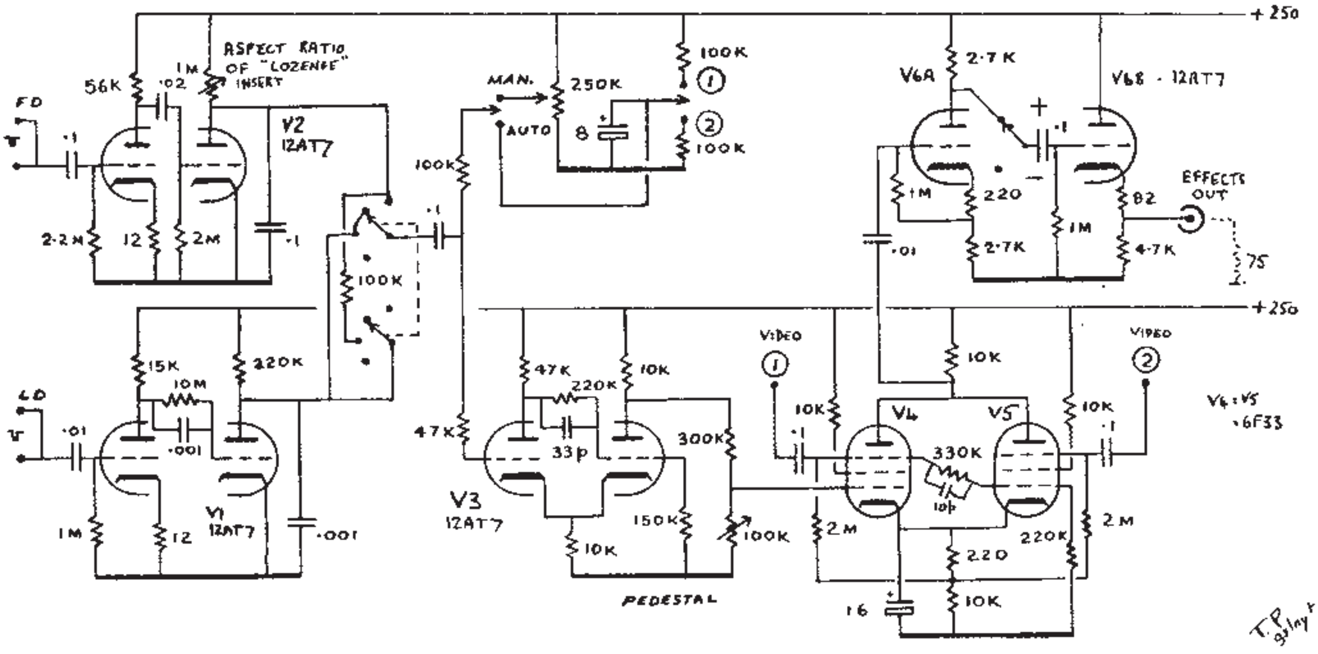
However, no tube bases or coils were then available, and so the magazine gave details of how to make your own. The accompanying diagrams and table gave most of the details. /(There is a note about “see text” about the ‘saw slots’ and ‘drill holes for pins’, but the text mentioned neither!!!)/ After the coils were wound, they were formed to shape round a 1 3/32” former for the line coils, and 1 3/8” for the field.

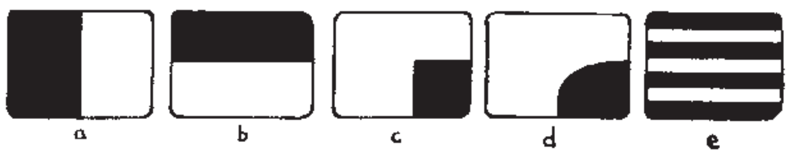


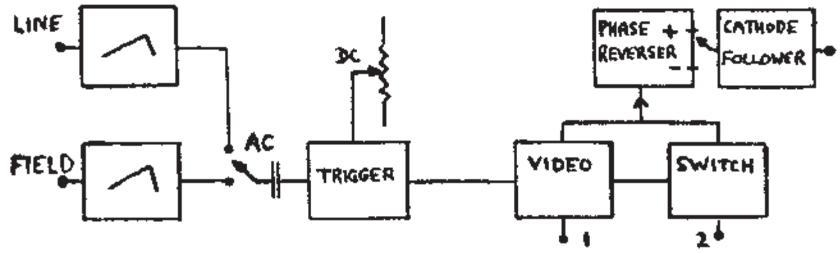
Details of Tube Socket

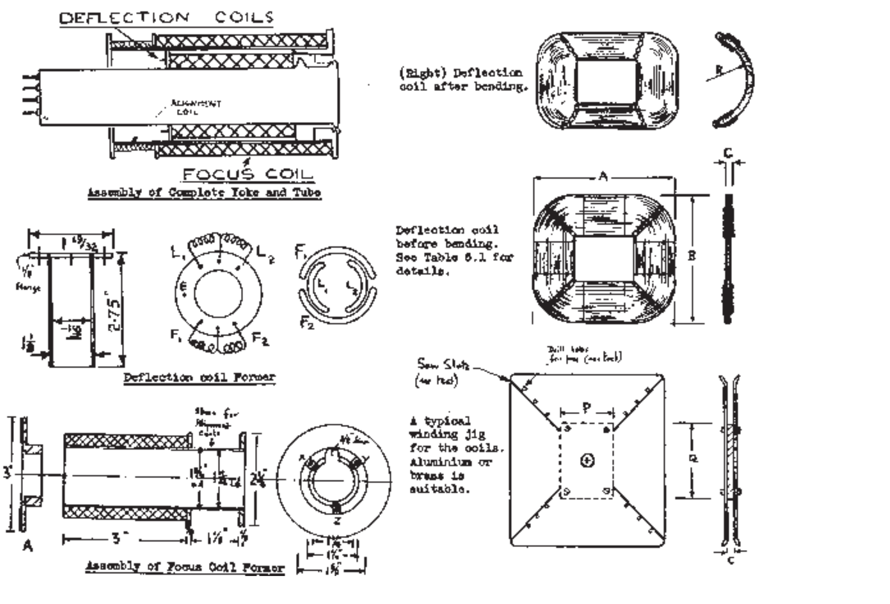
A VIDEO EFFECTS AMPLIFIER

By M.Barlow, G3CVO.









was drilled to accept pins salvaged from a valveholder. /(Vidicon scan coils in due course also became available through the Club).

/Amongst the other notes was a list of 'New Members' -- including J.T. Lawrence G3WGA, Perranporth, East Ave, Brynn Newydd, Prestatyn, Flintshire -- the same as on the envelope shown in John's article about transmissions from Winter Hill in the last CQ-TV!!. There was a question as to 'why lines?' - noting that no BATC member has yet experimented with spiral scanning! Mike Barlow - the Club's founder, by then in Canada - had a monoscope to generate a test card, which had "at great expense been overprinted with the call letters of "Barlow's Broadcasting Co" /(!!!),/ whilst Mike Cox - back in Beccles - had greatly improved his 'Pathe-Cox' telecine unit - using a 931A photomultiplier tube as the sensing device inside the lamphouse of the original projector, and a scanning crt about 2 ft infront of the projector (and using the optics 'backwards'. He was also building a transistorised pattern generator - transistor circuits being very novel at the time. The back page listed the 32 British amateur television transmitting stations in known to the club at that time.

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

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

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

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

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

The Ejector Seat

The best place to sit for a rapid exit! - Brian Kelly

About a year ago, at the BATC BGM at Stow-cum-Quy, a call was made for a new CQ-TV editor to step forward. The stampede for the door was pedictable and immediate. That was the exit door, not the entrance I hasten to add.

With nobody prepared to take on the job, I was 'volunteered' (coerced, even pleaded to!) to take over, despite my objections on the grounds of having no spare time on my hands. Evetually, and after repeatedly objecting, I said I would hold the position for one year, and no longer. That year is up. I have on numerous occasions hinted that some else has to take over but so far, instead of cries of "me, me, me" there has been an ominous silence.

It's crunch time, unless somebody volunteers to continue where I leave off, there will be no more CQ-TV.

So here is my plea, if you have spare time, and this would be an ideal job for a retired person, get in touch with us so we can discuss what needs to be done. If you can dedicate a few hours each week to the job, it should be fairly easy to do. Staying on top of the work is the key, regularly adding to the magazine as articles become available is much easier than trying to rush it all at the eleventh hour.

Sadly, my year has allowed me virtually no free time, from the beginning of March to the end of September I work 8:30am until 6:30pm , seven days a week on the 'regular' job and handle several projects in the remaining hours. One of them in Thailand with the obvious problems of time differences that causes. I've also had several months living on a building site, with me doing the building work and had to care for someone with severe dementia (not me or Pat- yet!)

That said, I should be able to offer two articles to the incoming new editor. they would have been in this CQ-TV but writing and editing with all the other work just didn't fit into 24 hours.

I hope I've managed to maintain the standard of CQ-TV for the past four issues and wish the new recruit the very best of luck. 73's Brian. GW6BWX.

The POOR MAN's DIGITAL ATV TRANSMITTER

Build this simple and cheap 70 MHz Exciter and start to transmit Digital Television !

by Jean-François FOURCADIER F4DAY

Digital television transmitters generally call upon a complex signal processing sequence. However, it is possible to simplify considerably the circuitry if we stick to the essentials. Thus, we describe here a small circuit able to generate a digital amateur TV signal from pre-recorded video sequences on a PC hard disk or on a "cartridge" containing an EPROM.

To keep a simple structure for the Nyquist filter, and to significantly improve the ISI (Inter Symbol Interference) performance, an original circuit has been developed specifically to achieve this goal in a way that is easy to implement using pre-distortion of the modulating signals.

Summary of Exciter Features

This exciter will deliver a 70 MHz signal which will be easy to transpose to the 23 cm amateur band (1240 MHz - 1300 MHz). This will make it compatible with FTA (Free To Air) digital receivers which use the common DVB-S satellite standard. The RF signal is modulated by means of a four- state phase modulation (QPSK) method. The binary rate is fixed at 2.048 Mbit/s (European binary rate E1 standardized in telecommunications). On the signal input side, a DB-25 connector receives the request to send data and the data itself to be transmitted from the signal source.

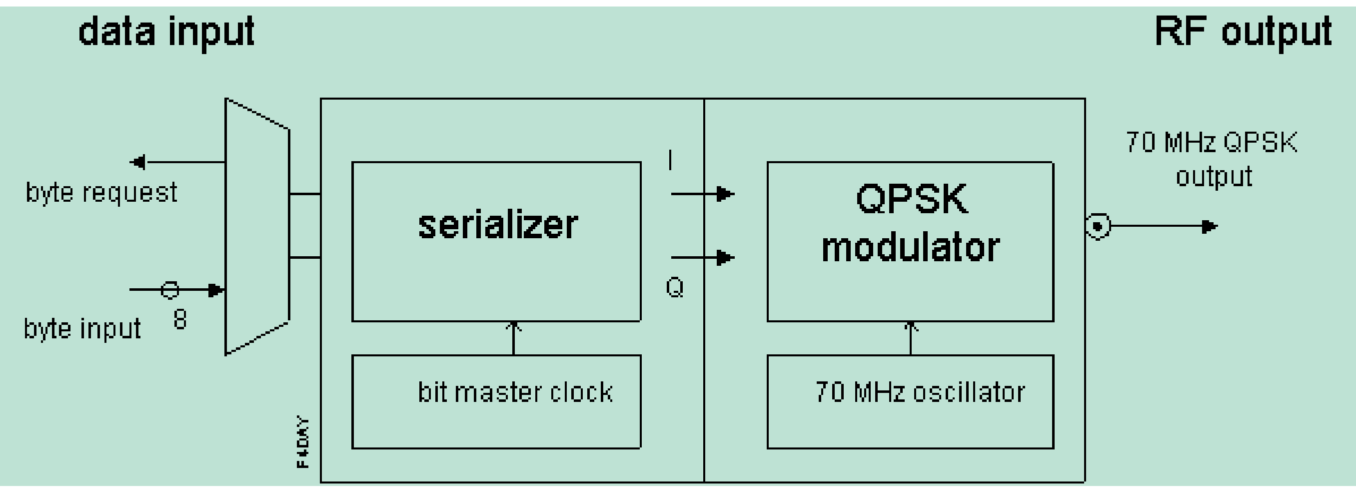
The data source could be one of the following three options:

1. A PC with direct connection via the parallel port. The computer can store several tens of MB of data enough to transmit animated video sequences with audio of several minutes duration.

2. A "cartridge" including an EPROM (and a counter to sweep the addresses). The EPROM can contain a test pattern with animation and an audio signal.

3. Ultimately, perhaps, a Compact Flash memory stick could be used to store more than fifteen minutes of uninterrupted video and audio.

The exciter can be placed in a metal case approximately 148 x74 x 30 mm. (One suitable item available in Europe is known as the Schubert box). The exciter is fed with 12 VDC and the current drain is about 180 mA.



The serializer

Features

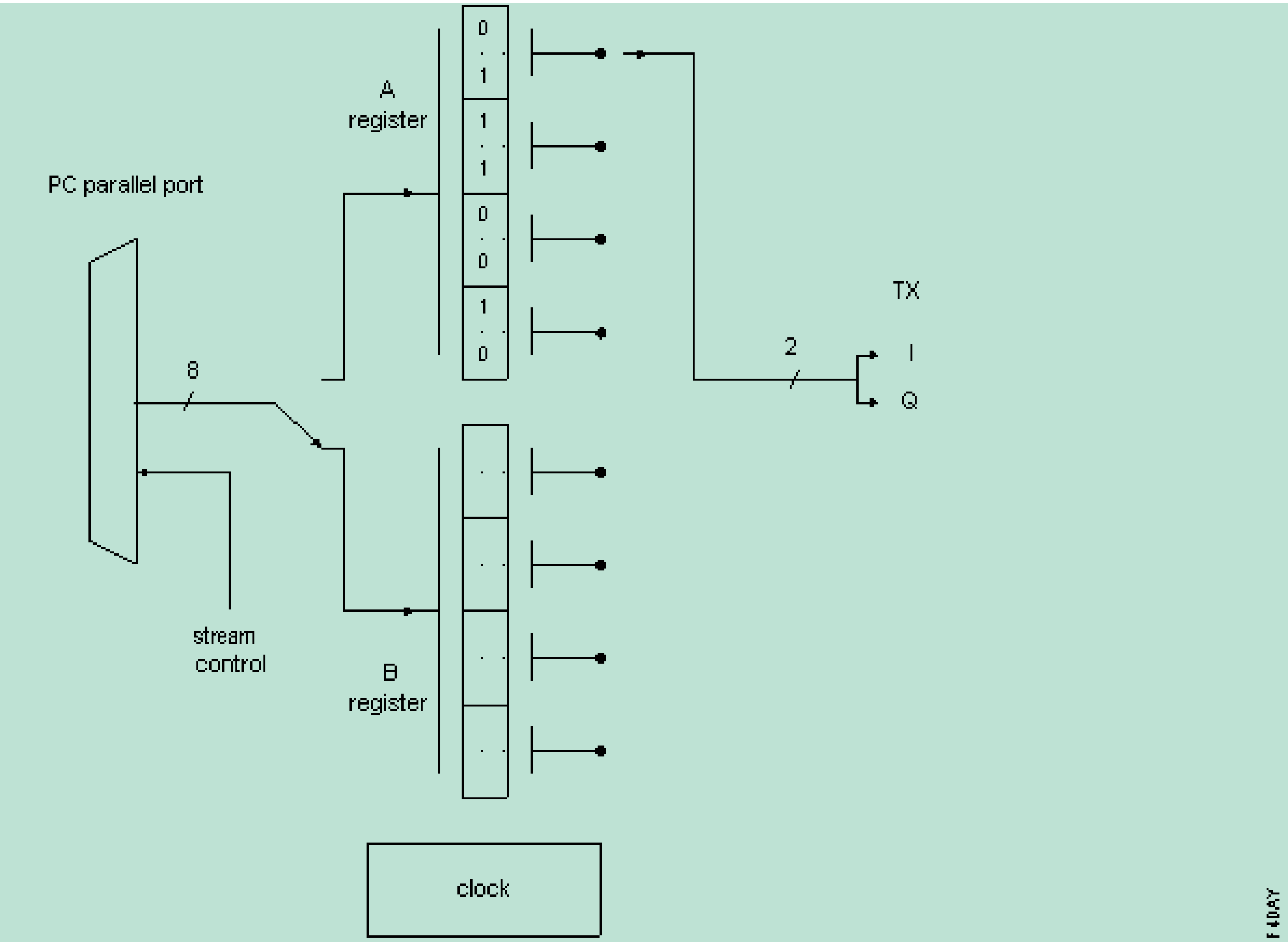
The serializer successively requests the data source (computer, cartridge, or compact flash memory stick) to send the bytes to be transmitted. These are sliced into packages of two bits (dibits) by the serializer in order to represent one point of four in the QPSK constellation. (One use of the word constellation is to suggest the several data points one sees on a scope, just as many stars are seen in a constellation). The serializer contains the main bit clock and generates the various secondary clocks needed by the system, that is: request for a new byte every 3.906 µs, output of a dibit every 0.977 µs to the QPSK modulator. The master clock, integrated in the serializer module, is fixed very precisely at 2.048 Mbit/s, the binary rate on the radio channel. This results in symbol rate of 1.024 MBaud.

The serializer includes useful additional features for the setting of the QPSK modulator and control of the modulation. It can, when requested, generate two I and Q signals of 90° lead or 90° lag, or pseudo-random modulating signals.

It is worth noting that the serializer provides, in addition to the I and Q modulating signals, two I* and Q* auxiliary signals for which the objective is to correct the step response of the summary Nyquist filters located on the printed circuit board of the QPSK modulator. It will be seen that one can thus obtain at a lower cost a substantial reduction in the inter-symbol interference (ISI).

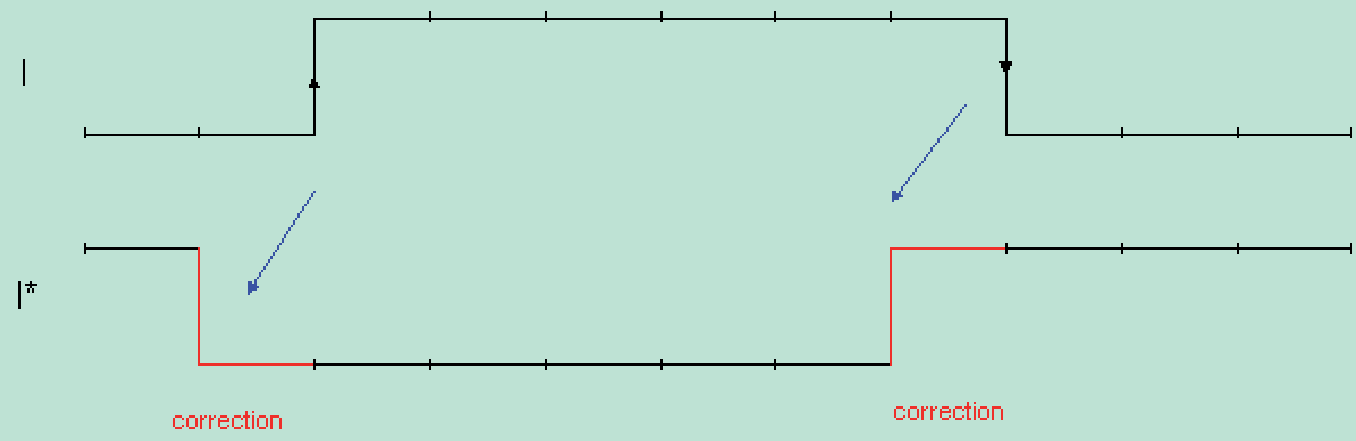
How tthe serializer operates

Two eight- bit registers A and B are connected alternatively, every 3.906 µs, to the parallel port of the PC. These registers store the data from the computer. These two registers are sequentially read, 2 bits by 2 bits, every 0.977 µs and the dibit thus obtained is sent to the QPSK modulator input to form one point among four of the constellation.



Improvement of the intersymbol interference by predistorsion of the I and Q modulating signals

To correct the total response of the channel filter (5th order Butterworth filter in the transmitter, plus root raised cosine filter in the receiver), it is necessary to create and apply to the QPSK modulator the dual pre-distortion signals I * and Q * which minimize the inter-symbol interference. After in-depth studies of this phenomenon, we see that the correction signals I * and Q * must be precursory signals with levels reversed compared to their references I and Q with an advance of one symbol duration.



We will see below that this provision is very simple to implement. It only uses two wires and two weighting resistors added to the assembly. It makes a spectacular improvement in the reduction of inter-symbol interference.

Practical serializer creation

- schematic diagram

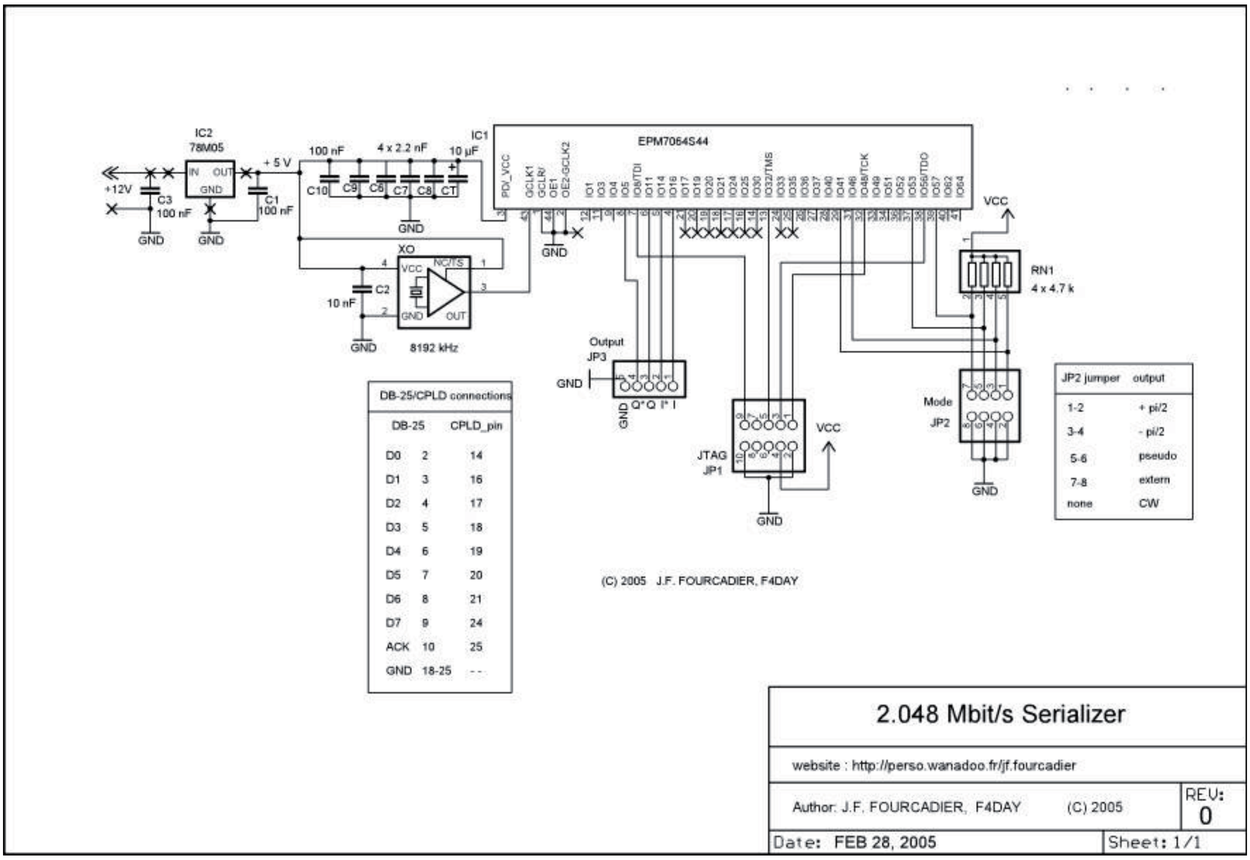
SMD capacitors of 2.2 nF and 100 nF. The printed circuit is designed like that of a high frequency circuit with a large ground mass and many places for through- the- board connections.

To simplify PCB building (1-1/2 sides), some connections will need to be made very carefully using small diameter insulated wire. A 5 V regulator ensures the stabilization of the supply

position switch for choosing the desired operating mode from the front panel of the transmitter. Pay attention to avoid reversal of the I* and Q* wires !

- printed circuit

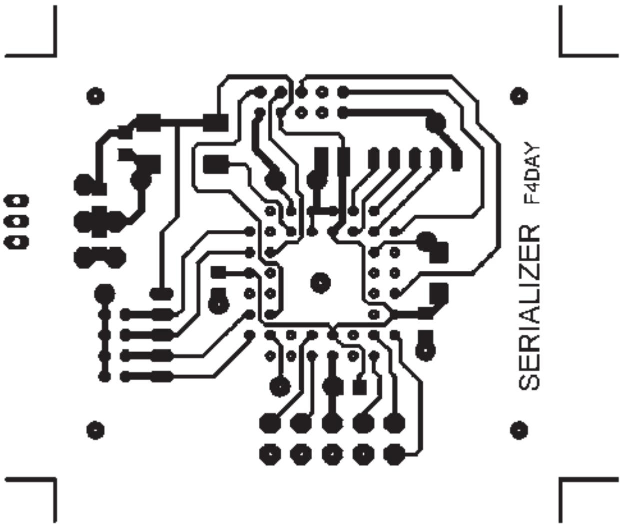
Logic diagram of the CPLD configuration

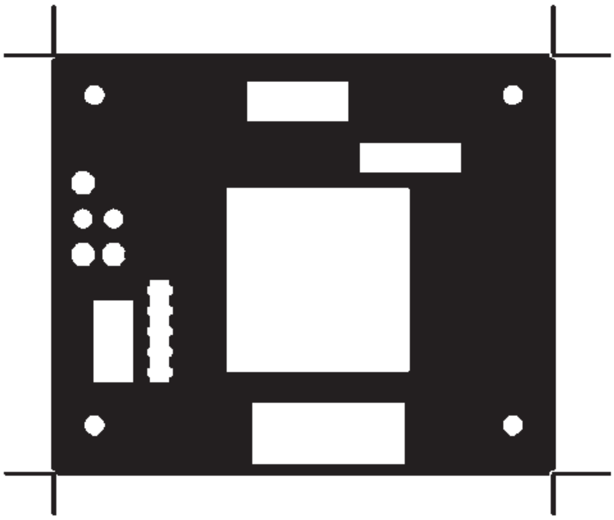


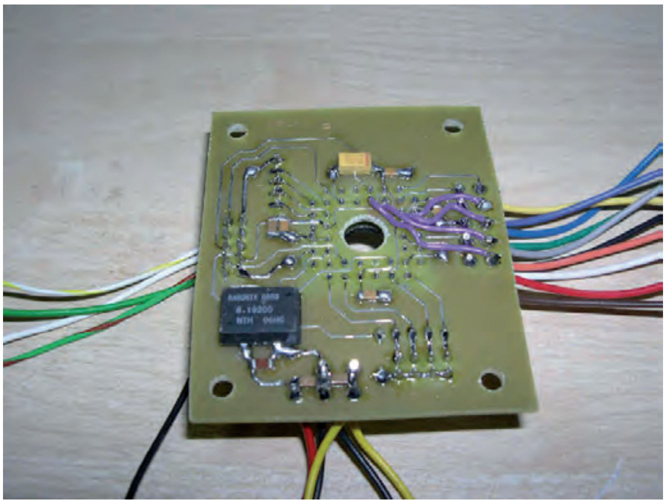
The diagram requires few comments. The principal components are two: a low cost CPLD Altera EPM7064SLC44-10 and a quartz crystal oscillator on 8.192 MHz. As the CPLD is very sensitive, one will endeavor to carefully decouple the power supply pins using several

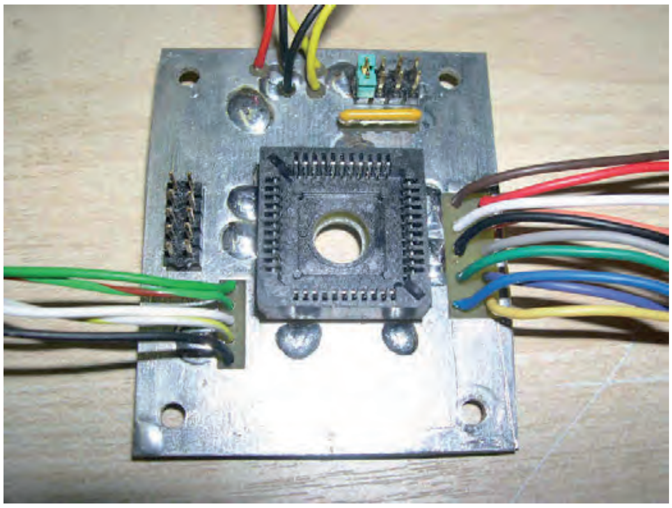
voltage. A jumper permits choosing 1 of 5 operating modes: three modes of adjustment (90° lead, 90° lag, pseudo-random generator), an operating mode (DB-25 external input) and a Continuous Wave (CW) mode, obtained by simply withdrawing the jumper. It may be possible to directly connect a 1 pole 5

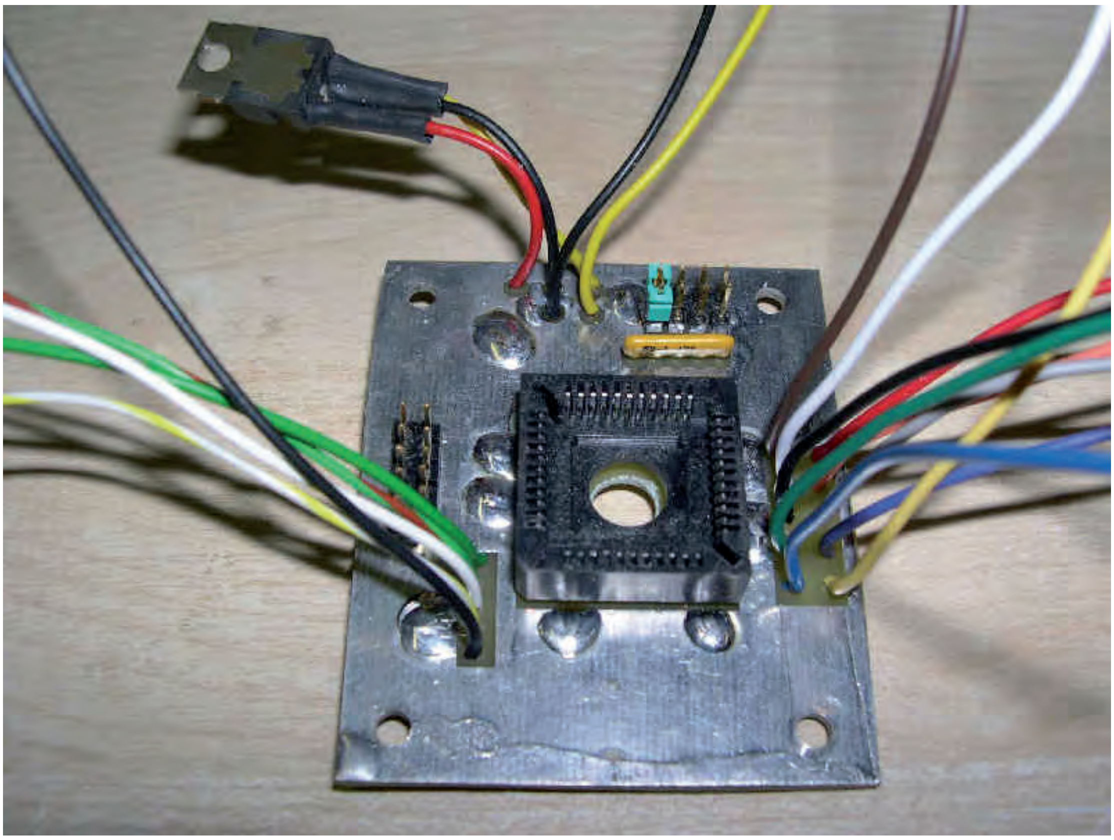
The logic diagram can be read by opening the file “serialisateur2.gdf”, provided below, by means of the Maxplus+ II software by Altera. The logic diagram comprises six major parts:
- a serializer whose central function is a double multiplexer with 8 inputs


SERIALIZER
F4DAY









and 2 outputs. The diagram shows the synoptic of the serializer,

- a pseudo-random data generator which provides in serial form a succession of 32767 bits. It is followed by a de-serializer which produces the groups of 2 bits IQ,

- a square signal generator for signals of 90° lead and 90° lag,

- a multiplexer with 5 inputs and one user selected output which makes it possible to select the data source or mode,

- two output D flip-flops which, by their synchronous operation, guarantee the precise timing of the output signals. The first D flip-flop is used to produce the logical pre-distortion signals I* and Q*, the other to deliver signals I and Q,

- and finally, a synchronous counter provides all the various clock signals necessary for unit operation

QPSK modulator

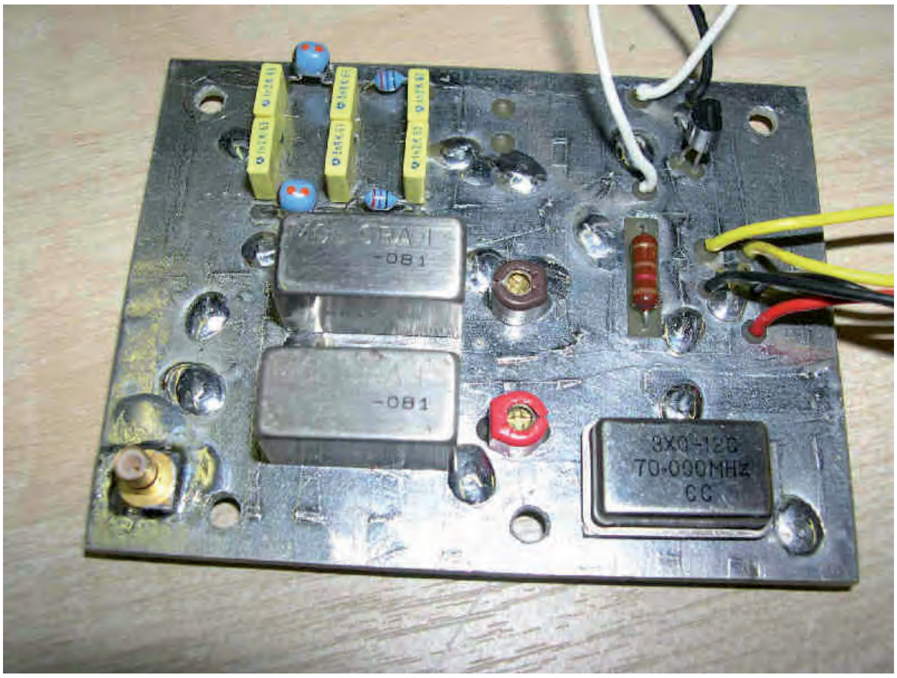
The QPSK modulator was already fully described (diagram, printed circuit, adjustments) in a previous article to which the reader is invited to refer.

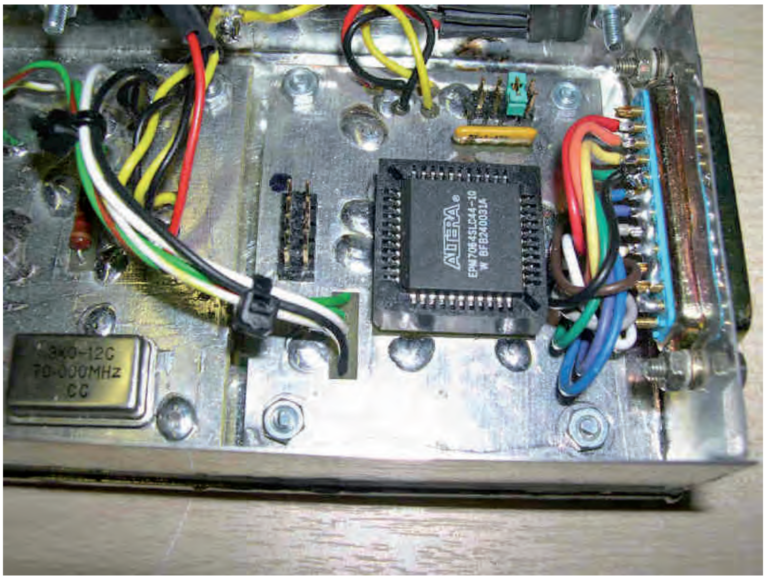
Building the exciter and making the interconnections between the circuits

The two printed circuits are fixed in an aluminum or metal box of 148 x 74 x 30 mm. In Europe, a Schubert box is available. The two 7805 voltage regulators are placed against the wall of the case which acts as a heat sink. A feed-through capacitor of 1 nF passes the + 12 VDC power to the circuit board.

A male DB-25 socket connects the transmission bytes which come either from a cartridge containing an EPROM, or from the parallel port of a PC. The DB-25 connector also links the control signal flow which is transmitted on the ACK wire. The wiring of the DB-25

Note: pay strict attention to avoid reversal of the wires transmitting the I* and Q* correction signals (and also to the I and Q wires to which they are referred). The correction could no longer be assured and the remedy would be even more painful.





The integrated test generator

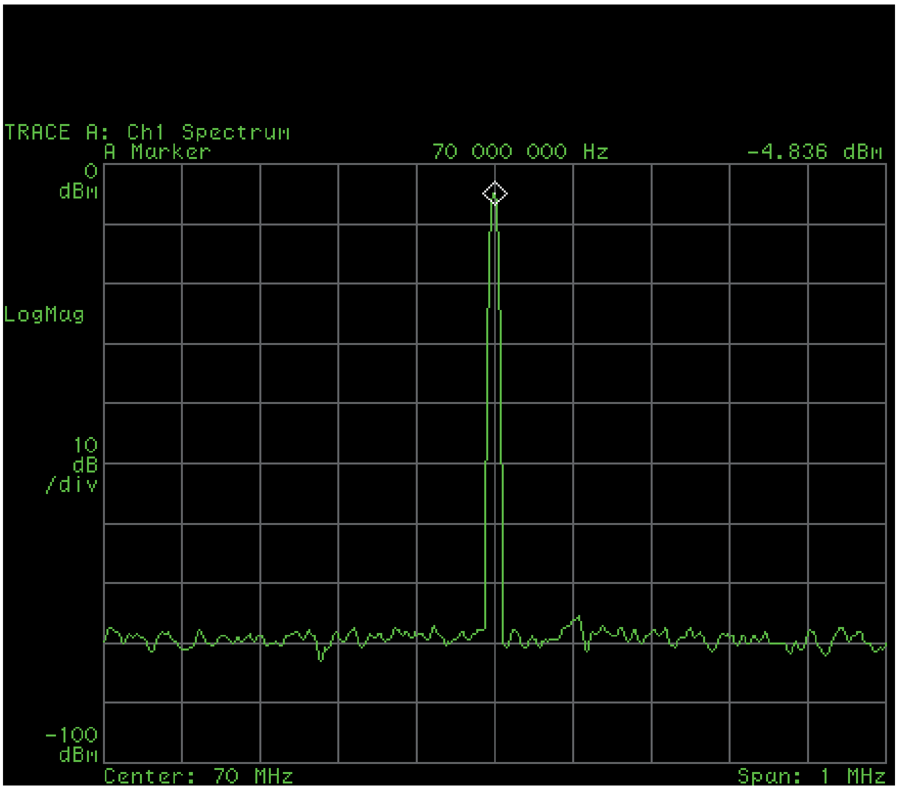
The absence of a jumper produces a pure carrier at 70 MHz.

The first two positions of the jumper correspond to adjustment signals of the QPSK modulator: 90° lead and 90° lag. Therefore one will see, under these conditions and good QPSK modulator setup, an output at 70.256 Mhz being + 256 kHz from the carrier (respectively 69.744 Mhz being - 256 kHz from the carrier). The carrier and the undesired sideband will be completely cancelled during the setup process (see more details on the QPSK modulator page).

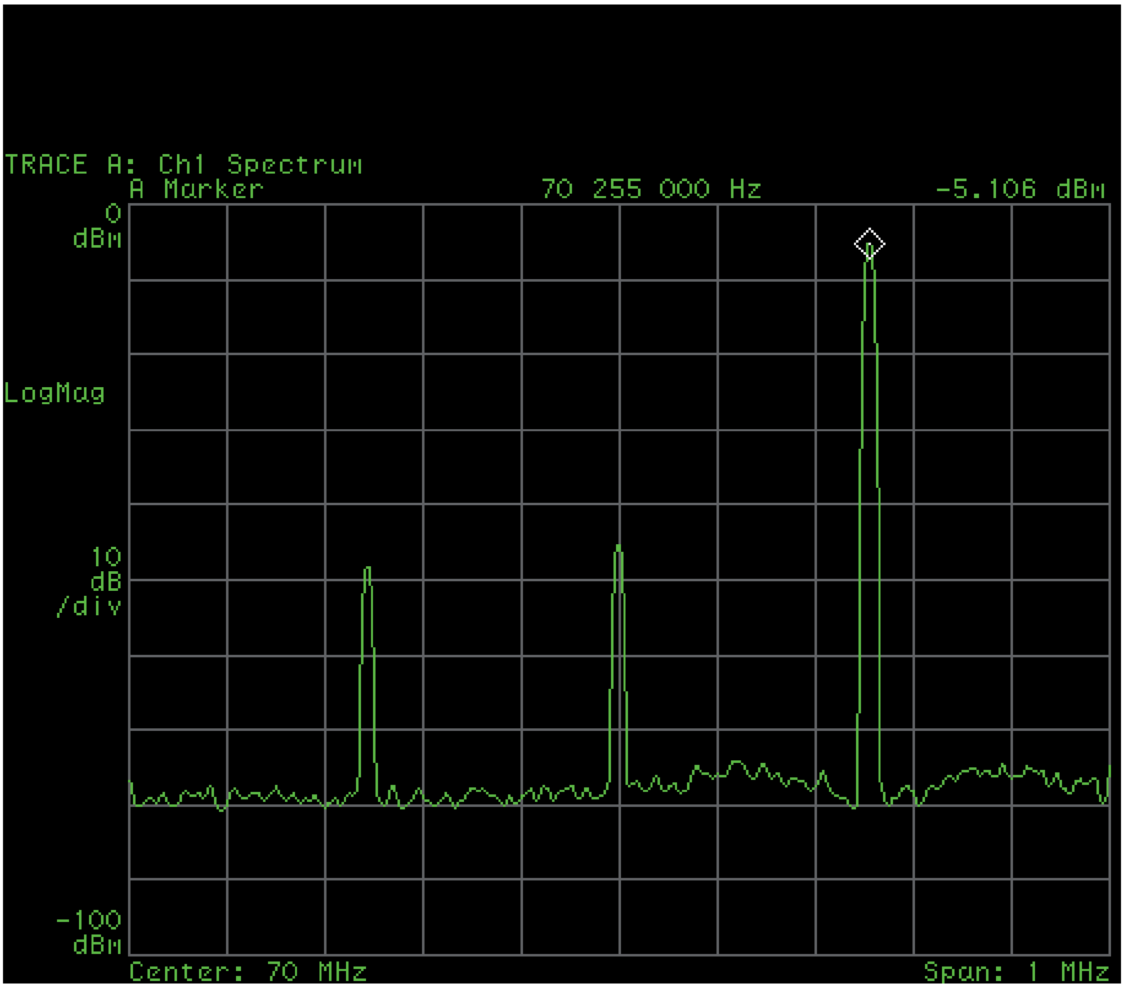
The next to last position produces a pseudo-random test signal, whose spectrum is similar to that of a digital television transmission. Finally, the 5th and last position authorizes the entry of the data to be transmitted to the DB-25 input connector.

The constellation

It was able to connect this 70 MHz QPSK exciter to a professional test equipment to visualize the constellation such as it is seen by a general public-use



digital satellite receiver with root raised cosine filtering where alpha = 0.35. By transmitting a pseudo-random sequence using the integrated test generator, one can see the constellation. Hereafter, the constellation is obtained without


TRACE A: Ch1 Spectrum
A Marker
70 255 000 Hz
-5.106 dBm
0
dBm
LogMag
10
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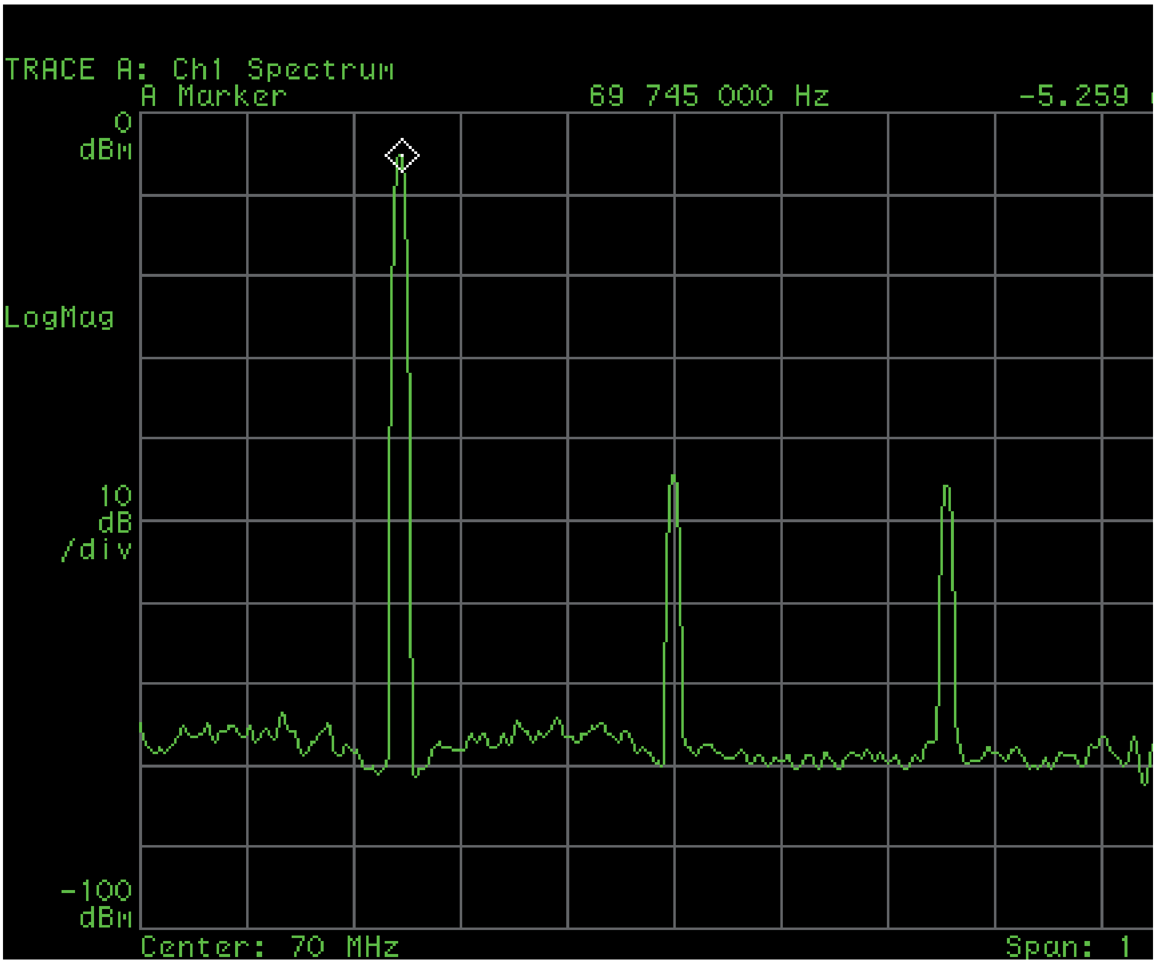
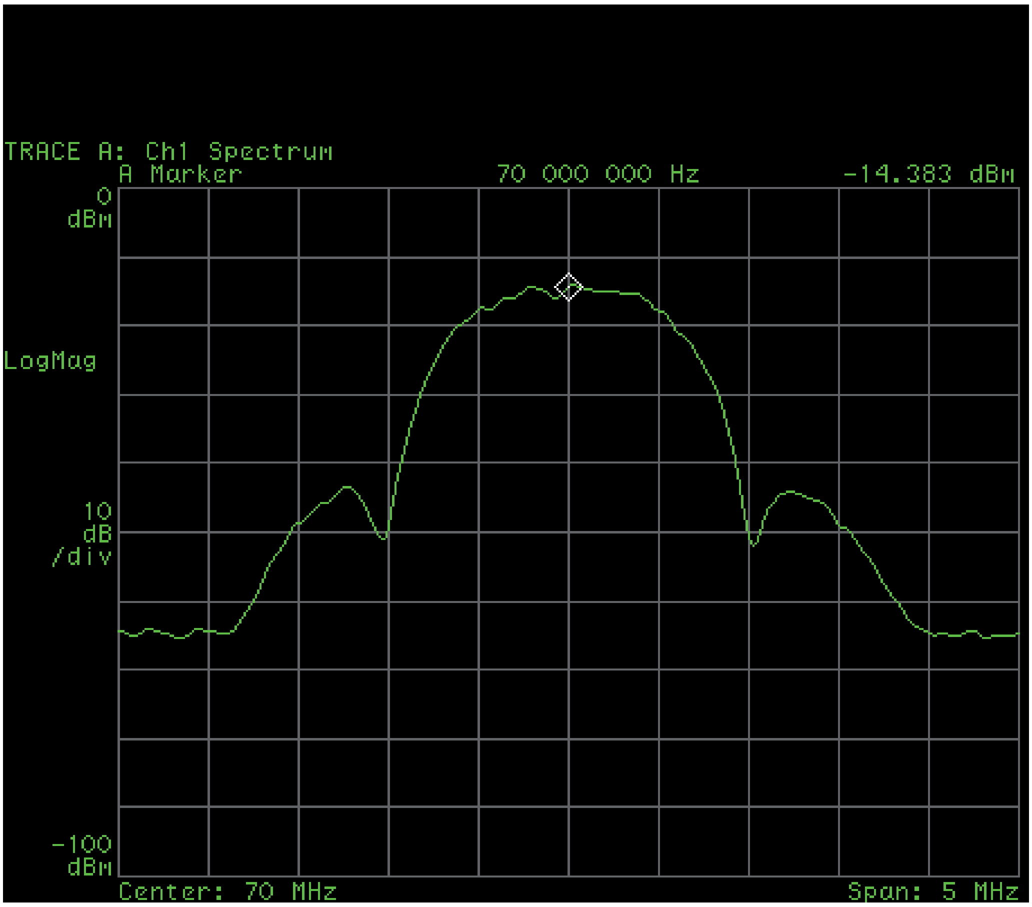
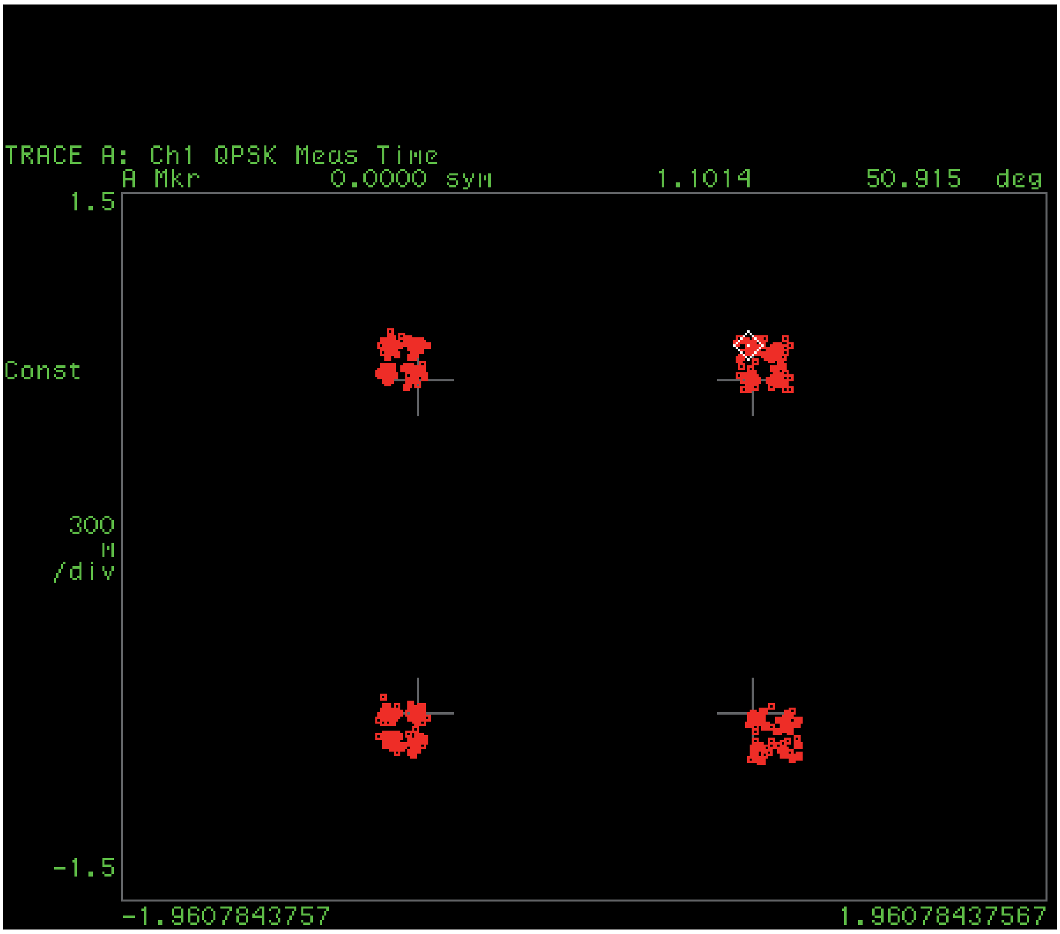
/div
-100
dBm
Center: 70 MHz
Span: 1 MHz


TRACE A: Ch1 Spectrum
A Marker
69 745 000 Hz
-5.259
0
dBm
LogMag
10
dB
/div
-100
dBm
Center: 70 MHz
Span: 1

using pre-distorsion, i.e. with I* and Q* inoperative (logical input I* connected to the I logical input and logical input Q* connected to the Q logical input):





Inter-symbol interference is relatively important issue. One can detect that each point of the constellation is in fact made up of four groups of points.

By connecting the pre-distortion now, that is, by connecting I * and Q * inputs at the dedicated outputs of the CPLD, one notes a spectacular improvement in the inter-symbol interference reduction:

The optimum result is obtained by adjusting the weighting resistances R29 and R30 on the QPSK modulator for the best constellation. The correct value for R29 and R30 is 1.5 kohm.

Connection to a computer

Connect to the PC parallel port using a short cable with CB-25 connectors. There is a male connector at one end and a female connector at the other end. The cable must contain at least 10 wires and its length should not exceed 60 cm to avoid affecting the transmission quality of the fast signals (indeed, a byte travels within the cable every 3.9 µs).

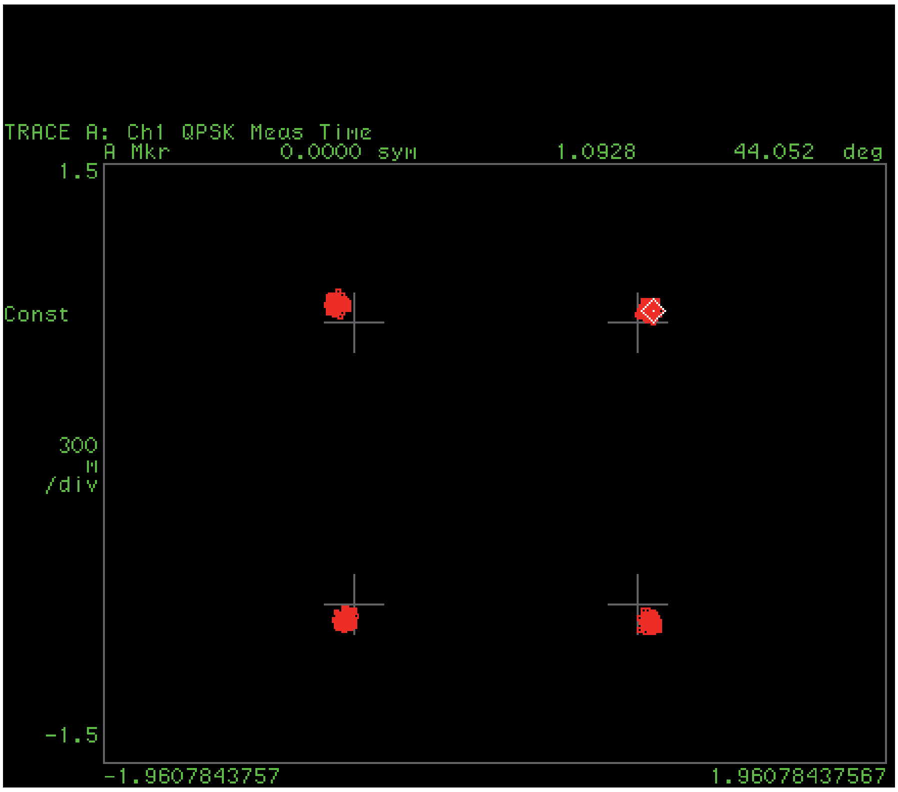
Software and files

The PC must store on its hard disk the data to be transmitted, then it needs for fast access to transfer the data to RAM before any transmission. In order to ensure control of the data flow, the PC must scan the ACK wire of its parallel port and present a new byte at each change of logic level on ACK. For these reasons, it is necessary to run a small management and dialog software in the PC. Information relating to the operating system and the software was given in a previous article.

The video files are developed using the Manzanita software (free in demo version) and the TS188ToIQ.exe software written by Evariste, F5OEO. The details of building the files were provided in a previous article.

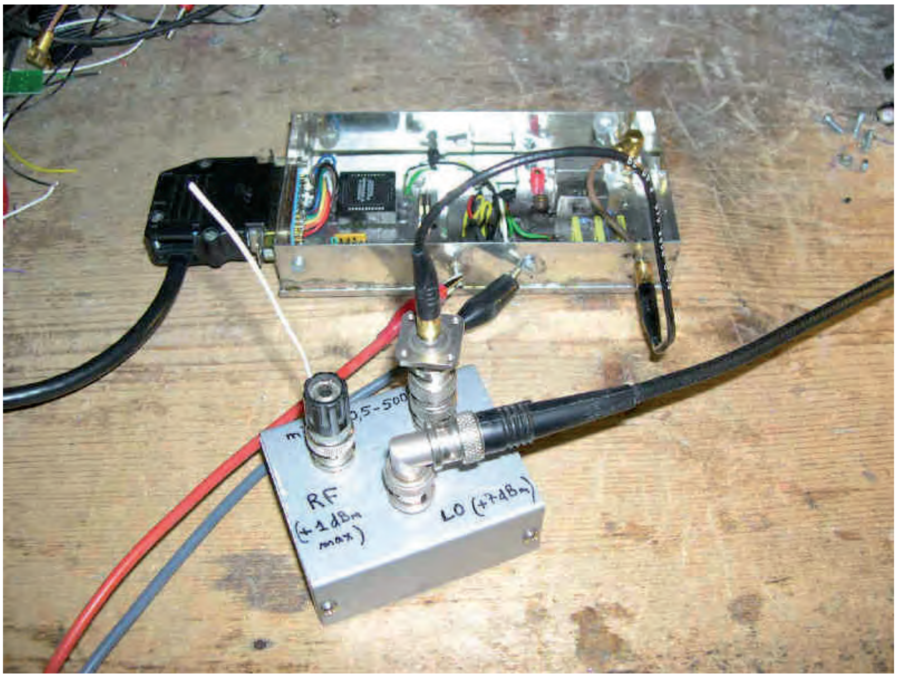
The reader in a hurry to visualize images will find hereafter an IQ file, ready- to-play, representing a bar test pattern.

Note: The above file provides IQ data ready to be injected into the serializer. It is planned for a binary rate of 2.048 Mbit/s on the radio channel, S/R = 1.024 MBaud, FEC = 1/2, PAL system, 25 frames/s. The video bit rate is 800 kbit/s. The file represents a bar test pattern with some animation to allow the detection of pictures freezes. Its duration is 2 seconds. For a continuous transmission, it is necessary to loop the end to the beginning with the PC software.



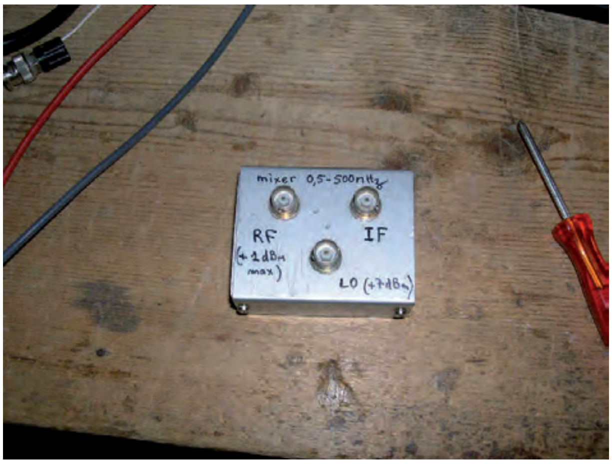
Transmission of digital television signals

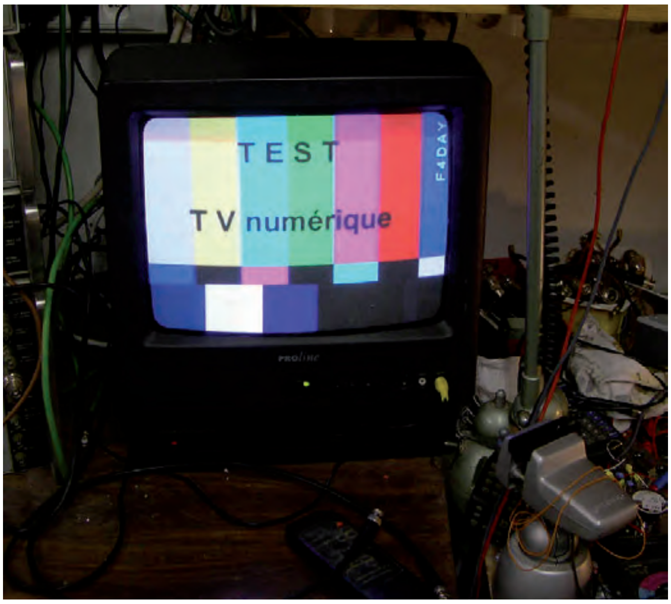
The final goal is of course to create a genuine digital transmitter which will use the present 70 MHz exciter, transposition, filtering and finally linear RF amplification. However, one can, as of now, start to visualize images by connecting the exciter output to a simple balanced mixer fed by an oscillator generating a local oscillation with F-70 MHz or one of its sub-multiples. Thus a 300 MHz oscillator with an output level of + 7 dBm will be able to beat with the 70 MHz signal from the exciter to generate a signal of (300x4) + 70 = 1270 MHz. The transmitted level is not very important, but a small antenna connected directly at the output of the mixer will make it possible to transmit the digital TV signal out to a range of several meters.



The aluminum case, provided above with three BNC connectors, contains a simple SRA-1 balanced mixer. It is a useful accessory!

So quick, let's connect the computer, let's setup the FTA digital receiver, and..... here is the result !





Conclusion

This little 70 MHz exciter, without any pretensions, calls only for readily available and inexpensive components. With a little care, building the printed circuits is entirely possible for anyone with amateur means, i.e. inkjet printer jet for the films, horizontal tub, and iron perchloride for etching. The result is a unit making it possible to start some very interesting personal experiments in the field of amateur digital signal transmission. The description of the data "cartridge" will be the subject of a forthcoming article. The unit will then be autonomous.

Gentlemen, start your soldering irons !

Translation from the French article with the friendly help and advice of John Jaminet, W3HMS

BA TC

Experimental Television

by CON WASSILIEFF ZL2AFP

ABOUT ten years ago I wrote a little article for *Break-In* titled "Mechanical Television",[1] describing my early experiments with transmitting and receiving mechanically-scanned low definition moving pictures in 24 lines, vertically scanned. At that time, mechanical scanning of a scene by means of a Nipkow disk, focussing the individual picture elements onto a photodiode, was the only practical means of obtaining low-resolution moving pictures that could be converted into amplitude modulation of an AM carrier and then transmitted through a conventional HF transmitter.

Direct amplitude modulation of an RF carrier produces pictures that suffer from phase shifts that distort the image badly, especially at the low frame rates (8 fps) used in my experimental transmissions. Figure 1 shows the effect of lack of low frequencies in the signal. It is only the movement that redeems the picture to any extent but as a usable method of sending moving pictures it is sub-optimal to say the least! However, this image has been re-recorded twice onto audio tape so there is more distortion than in the original received picture.

Poor low frequency response can be improved dramatically by using the picture signal to amplitude modulate an audio carrier. This technique is similar to that used in analogue slow-scan television (SSTV), except that amplitude rather than frequency modulation of the audio carrier was used. Demodulation of the received signal was performed by a simple computer program written in Quickbasic, running under DOS. Initially a 6-bit flash A/D converter connected to the parallel port was used to digitise the signal and the PC was used merely to demodulate the signal and display the received picture. Subsequently the PC soundcard was used as the digitiser. The resultant picture had none of the flicker that was very evident in the mechanically scanned receiver as the PC monitor screen was effectively an integrating display. As a result the frame rates could be reduced and the bandwidth used to increase the picture resolution.

Figure 1. A frame from a mechanically scanned picture of 24 lines transmitted as a baseband AM signal from Wellington to Auckland during the daytime on 40 m.

When soundcards changed from ISA to PCI, my original receiving program did not work anymore and I did not know how to adapt my source code to talk to PCI soundcards. I was thus forced into learning Windows programming, through which one "talks" to hardware (such as soundcards) via the Windows Application Programming Interface (API). As long as there is a driver for the hardware, Windows can talk to it. The hard work of setting bits and doing all sorts of gymnastics at the hardware level is all done for you by the API's.

Among these APIs is the "Video for Windows" (VFW) interface. This is a 16-bit system that has been around since Windows 3.1, and enables video capture cards and webcams to be used relatively easily. The VFW interface is compatible with all Windows versions up to Windows XP but I understand that it may not work with Windows Vista®, as 16-bit functionality will be removed altogether. I may have to learn some new programming skills.

The API functions open up a whole range of options that were simply not available under DOS. The most useful ones for television work are the Wave (audio), the VFW (video), and the MCI (Media Control Interface) APIs, not to mention bitmap manipulation functions to render the picture to (and from) the screen.

Figure 2. 60-line pictures sent between Auckland and Wellington during the daytime on 40 m.

Amplitude modulation of an audio subcarrier produces a picture that is susceptible to brightness variations as the signal suffers propagation distortions such as fades. Changing the modulation method to frequency modulation results in a picture whose brightness now depends only on the tuning offset. The method is now exactly like SSTV although, instead of sending and receiving a high resolution picture over a duration of sixty seconds or more, a low resolution picture of around one frame per second is sent. Not exactly "moving pictures" but near enough to compare with early Internet video frame rates.

The maximum detail that can be sent in a useful audio bandwidth of 2 kHz is 2000 pixels per second. An argument can be made that 4000 pixels per second can be accommodated in 2 kHz but either way, the time between pixels is in the order of only 0.5 milliseconds. As multipath propagation timing differences can easily be several milliseconds, severe "ghosting" of the received image can (and frequently does) occur. Figure 2 shows a montage of frames from a television signal sent and received over the 40 m band between my QTH in Wellington and that of Steve ZL2BKA in Auckland. Unlike the vertically-scanned picture in Figure 1, these ones are 60 lines horizontally scanned, with less than 30 pixels resolution per line, sent at 1.4 frames per second. Because the picture is easily distorted, line and frame sync pulses are of little use in maintaining a correctly framed picture and the picture is instead manually framed, a tedious process if the soundcards at the transmitter and receiving end have slightly different sample rates.

These multipath timing distortions can only be reduced by slowing down the pixel rate so that the time between pixels is now longer than the propagation timing differences. To avoid losing picture detail, several audio sub-carriers can be sent in parallel. This requires as many demodulators as there are carriers. Fortunately this is easy to do with our old friend the Fourier Transform, in particular its modern relation the Fast Fourier Transform (FFT). The FTT acts like a bank of parallel filters whose frequency separation depends upon the number of samples per transform. It must be remembered that the Soundcard sample rate can be anything from 8000 samples per second (8 kHz) up to 96 kHz for most computers. To speed up processing, the lowest sample rate is used, as long as this satisfies Nyquist criterion that the maximum signal frequency be no more than half of the sample rate. For a sample rate of 8 kHz, signals of up to 4 kHz can be demodulated without aliasing problems.

At a sample rate of 8000 Hz and 256 Soundcard samples per FFT operation, the frequency spacing between "bins" will be 31.25 Hz. If the transmitted signal consists of multiple parallel carriers spaced at exactly 31.25 Hz, then each carrier will be demodulated by the FFT independently of all of the others. At a sample rate of 8 kHz the time taken for the FFT to gather 256 samples is 32 milliseconds. Thus up to 31.25 pixels per line per second ($31.25 = \frac{1}{32}$ msec) can be resolved correctly. The carriers are said to be "orthogonal" to each other if the carrier spacing equals the data baud rate. In this case each baud is one pixel of picture information. This orthogonality criterion is the basis of MFSK modes such as MFSK 16 and DominoEX. If each carrier is modulated by the brightness of each line of the picture the demodulated output of the FFT reproduces the original picture exactly.

As the frequency of each of the FFT bins is fixed, fine tuning of the incoming signal can be achieved either by adjustment of the receiver dial or by mixing the signal with a numerically controlled oscillator (NCO) in software. The brightness of each pixel of each line of the picture to be sent is used to frequency modulate each of 48 carriers, either by an inverse FFT process or the phase-accumulation method. Either method works equally well. The deviation of each carrier must be kept small (less than about ±4 Hz) in order to avoid interference effects in the received picture.

The basic picture format in this "FFT-TV" is a monochrome 48×48 pixel picture, sent at 1 fps. Even at 1 fps motion in a "live" scene is still reasonably acceptable. This can be modified to a 32×24 pixel picture at 3 fps, or a colour picture of 36×48 pixels at 1 fps. This latter format uses the colour difference method to compress the colour. Thirty-six of 49 carriers are used for the luminance, $Y = (0.3R + 0.6G + 0.1B)$ with the remaining 13 carriers being used for chrominance difference signals (four for Y-B and nine for Y-R).

Figure 3. Pictures sent between Auckland and Wellington during the evening on 80 m, with frame rates from 3 fps (monochrome) to 0.2 fps (colour).

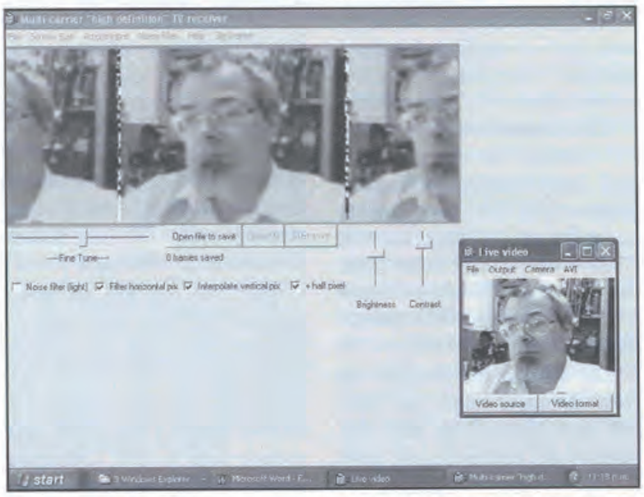


Figure 4. General appearance of the transmitting and receiving programs.

An RGB picture is sent as three separate red, green, and blue frames, and recombined into one colour frame at the receiver. A plain RGB colour picture cannot be compressed more than about 66 per cent before green and purple colour fringes appear, but the signal is easier to tune in. For instance, a television signal using colour difference has to be correctly tuned to within 1 Hz otherwise pronounced hue shifts occur, whereas mis-tuning an RGB signal merely changes the brightness of each colour evenly, resulting in a bright or dark (but correctly coloured) picture.

Figure 3 presents frames taken of pictures received from Murray ZL1BPU and Grant ZL1WTT. Some of these are colour pictures sent at a much slower rate of one frame every five seconds. However, the pictures are now 72×96 pixels which contain a lot more detail than the basic 48×48 pixel picture. These "high definition" formats are intended to be used to send individual frames of movies (AVI and MPEG format) although they can be used to give a "tour of the shack", as can be seen in some of the pictures. Apart from general noise the pictures do not display any of the distortions that are evident in a television picture modulated onto a single carrier.

The receiving program displays two consecutive frames together so that at least one is always complete. This avoids having to use any sort of frame synchronisation signal. Line sync is automatic as each line is represented by each single carrier and the location on the screen is determined by the receiver tuning.

Figure 4 shows the general appearance of one of the receiving programs, and also the transmitting program. The frame is captured from a webcam or video camera or an AVI or MPEG movie via the MCI interface, and displayed on the screen. Various bitmap manipulations are performed to take each pixel and use the brightness and colour to frequency modulate each audio subcarrier. One of the advantages of this method of accessing the pixels is that any window that is placed over the top of the capture screen will be captured and sent as a television picture. This can be useful if there is otherwise no webcam or movie file, for instance to send a thumbnail image or test pattern.

Each received frame can be saved sequentially to a movie file for subsequent replay. Noise may be reduced by a moving average of two or more adjacent frames. Figure 5 shows a single frame with diagonal noise lines due to selective fading, and the same frame averaged with several subsequent frames in a movie sequence. Although motion is smeared out somewhat, stationary details are much improved.

CONTINUED ON PAGE 6

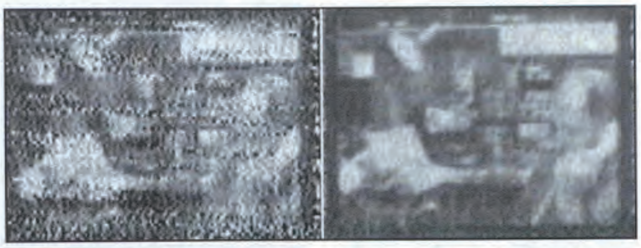


Figure 5. A single frame with noise (left picture), and the same frame averaged with several subsequent frames in a movie sequence (right picture). The frame rate is 0.4 frames per second.

CONTINUED FROM PAGE 5

Future developments will include a high definition version at faster frame rates, using the I & Q modulator/demodulator techniques used to send and receive DRM by Grant ZL1WTT. These employ a wider bandwidth of 10 kHz.

I hope to have some of the software on a web site at some stage in the near future but in the meantime if anyone wants further information I can be contacted by e-mail at <zl2afp@nzart.org.nz>.

References

(1) "Mechanical Television" *Break-In* (June 1997).

Thomas Telford 1757 – 1834, Engineer extraordinary

Special Event Station GB 250 TT.

Report by John Lawrence GW3JGA

Amateur Radio Special Event stations around the U.K. have been celebrating the 250th anniversary of Thomas Telford's birth date of August 9th 1757. One such station GB 250 TT was established at one end of Telford's Menai Straits suspension bridge which connects the Isle of Anglesey to the mainland coast of North Wales (Fig.1.).

The bridge was opened on January 30th 1834 and has a span of 580 feet, which was the longest span in the world at that time. It provided a much needed road route to Holyhead, the port which provides a link across the Irish Sea to Ireland.

The Special Event Station GB 250 TT was set up in a caravan at the southern end of the bridge by GW3PRL and members of the Dragon Amateur Radio Club (Fig.2). The station operated on the HF bands over a 24 hour period on Thursday August 9th 2007, 250 years to-the-day of Telford's birth. 175 contacts were made, 60% on SSB, the remainder on CW

In addition, Members of the GB3TM ATV repeater group were invited to take part in the event. On the Thursday morning, an ATV station on 23cms using the GB 250 TT call sign was established nearby by GW3JGA (in his car boot) (Figs.3 & 4.) and a mobile ATV station, operated by GW4KAZ and GW8FEY, with two Alford Slots on 23cms, took up position on the opposite side of the Straits (Fig.5.). Almost immediately, two-way ATV operation was established. The received signal from GB 250 TT is shown in Fig.6.

The mobile station GW4KAZ then travelled along the main A5 road, through Menai Bridge town eventually crossing the bridge itself, transmitting holiday-style pictures of the boats in the Straits below and the massive structure of the bridge supporting towers above.

A walkabout then took place by GW4KAZ carrying a low-power ATV TX in a rucksack with GW8FEY as cameraman. Several Vintage Cars crossing the bridge to a local car rally provided interesting subjects. A 'post mortem' on the ATV part of the event was held over lunch at the nearby Four Crosses Hotel, including a toast to Thomas Telford.

Kit.	GW3JGA	GW4KAZ
TX	Worthing	Worthing
TX Ant	Sevenside Yagi	Alford Slot
RX	Maspro Sat Rx with pre-amp	Maspro Sat Rx
RX Ant	Alford Slot	Alford Slot

Thanks go to the Dragon ARC for providing facilities and assistance during the event.

Due to the screened location it was not possible to relay pictures through GB3TM

For more information on Thomas Telford, go to: http://www.thomastelford250.org/timeline/static.php

Figures & Titles

Fig.1. Menai Bridge, Sketch by GW3JGA

Fig.2. GB250TT - HF, Ops. GW3GUX & GW3PRL

Fig.3. GB250TT – ATV, Menai Bridge

Fig.4. GB250TT – ATV (GW3JGA)

Fig.5. GW4KAZ – ATV. Menai Bridge in distance

Fig.6. Signal received at GW4KAZ - P


GB 250 TT/ATV

Contest News

Repeater Contest

The results for the BATC's first ever ATV Repeater Contest are below. Congratulations to John, GW3JGA and to all those involved with GB3TM. All repeater groups are encouraged to compete in the next Repeater Contest, which will be held on 8/9 December, from 1800 on Saturday until 1200 on Sunday. The rules are similar to a normal contest, but you should score the total distance from you to the repeater and then on to the other station. The full rules and a simple scoresheet are posted on the BATC website.

BATC Repeater Contest 2007 (24 - 25 March) Results

Participants

Place	Call Sign	Points	Locator	QSO	Rptr	Rptr Dist
1	GW3JGA	2020	IO83HI	6	GB3TM	61
2	GW4KAZ	1280	IO73VE	6	GB3TM	24
3	GW8FEY	1060	IO73XH	5	GB3TM	19
4	GW0ABL	816	IO73VF	4	GB3TM	19

Repeaters

Place	Call Sign	Points	Locator
1	GB3TM	5176	IO73UJ

Please try to compete and send me an entry for the December contest; John GW3JGA commented that the last contest had brought two stations back on the air that had been dormant for several years. Please try to make the December contest have the same effect in your area!

Summer Fun Contest

Congratulations to the Grimsby ATV Group: John G0ATW, Jason G7KPM and Colin G4PYD operating as G4PYD/P from the Lincolnshire Wolds. Although bemoaning the lack of stations to work, they were the clear winners. In second place came Roger GW4NOS who must be commended for taking kit for 3 bands out portable on his own.

BATC SummerFun 2007 (9th-10th June) Contest Results

70 CM

Place	Call Sign	Points	Locator	QSO	DX	DX Loc	Km
1	G4PYD/P	182	IO93WH	5	G7KPM	IO93WM	23

23 CM

Place	Call Sign	Points	Locator	QSO	DX	DX Loc	Km
1	G4PYD/P	1024	IO93WH	7	G0ACZ	IO93FD	96
2	GW4NOS/P	232	IO81FP	1	G1PIB	IO81LF	58

13 CM

Place	Call Sign	Points	Locator	QSO	DX	DX Loc	Km
1	G4PYD/P	980	IO93WH	5	G7AVU	IO93OJ	45

Overall Results

Place	Call Sign	70 CM	23 CM	13 CM	3 CM	Total Points
1	G4PYD/P	182	1024	980	0	2186
2	GW4NOS/P	-	232	0	0	232

Roger, GW4NOS requested that the next Summer Fun runs from 1200 Saturday to 1200 Sunday, so that portable stations get more daylight (and warmth). I will amend the times for next year.

September IARU Contest

The highlight of the Contest Calendar takes place from 1800 UTC on Saturday 8 September to 1200 UTC Sunday 9 September. Please make an effort to get on-air and put in an entry - it would be good to show just how many stations are out there! Rules are on the BATC Web Site.

December Repeater Contest

Don't forget, the next repeater contest is on 8 and 9 of December.

Conclusion

You will note that my address has changed (again); I am going to be living in the USA for a few years, but plan to remain in post as Contest Manager. 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.

CONTEST CALENDAR

2007

1800 UTC 8 September - 1200 UTC 9 September - International ATV Contest

1800 UTC 8 December - 1200 UTC 9 December - BATC Repeater Contest

2008

1800 UTC 22 March - 1200 UTC 23 March - BATC Repeater Contest

1200 UTC 7 June - 1200 UTC 8 June - BATC Summer Fun Contest

1800 UTC 13 September - 1200 UTC 14 September - International ATV Contest

1800 UTC 6 December - 1200 UTC 7 December - BATC Repeater Contest

COLOURFUL TIMES

Dicky Howett charts a few colour tv experiments and returns to the fervid days of early British colour tv.

Colour tv had been a dream of television engineers since John Logie was a Baird. These days, it's all relatively easy. For example, an all-dancing-all singing colour tv camera can fit comfortably within the folds of a belly button, and produce colour pictures of stunning clarity and resolution that would certainly have amazed and astounded the pre-war pioneers . The latest technology now enables newfangled 'high definition' telly to be universally available, digitally compressed into multi channels with colour pictures of remarkable chromatic fidelity

Of course nothing under the sun is really new. Way back in 1928 the prescient Scot, J.L.Baird demonstrated colour television, mechanically using sequential colour analysis and synthesis. His system worked, better in theory than in practice. Later, in 1941 the US broadcast network, CBS, inaugurated the 'world's first' scheduled colour tv service. This service- started mainly in order to pre-empt their deadly rivals RCA/NBC- was viewed by almost nobody. The CBS system adapted Baird's clumsy Field Sequential Colour process, using three coloured discs (Red. Green.Blue) spinning rapidly in front of a prototype Orthicon image tube. However, the system used too much radio bandwidth(by a factor of three) and only tv sets with complimentary spinning discs could receive the image, which displayed unacceptable colour fringing, especially when things moved suddenly sideways. Another problem was the presence of a slight but annoying buzz from the coloured disc as it whirred. On one notable occasion a switched on tv set equipped with a spinning disc disintegrated when moved. Not exactly something to encourage the guardians of health and safety. Thus the entire scheme was a dodgy technological dead-duck and soon faded from view.

Back in Merrie England, BBC Television in 1955 embarked on a series of live, experimental colour TV broadcasts from Studio A, Alexandra Palace using the established RCA dot matrix compatible system which the BBC's research department at Kingswood Warren had adapted to run from the US 525-line NTSC standard to the British tv standard of 4O5-Iines. This system was built in conjunction with Marconi`s who provided a couple of re-engineered RCA colour cameras.

Initially, slides and films were transmitted late night after normal programmes had ceased. These experimental images used the medium-power reserve transmitters at Alexandra Palace. Later, in November 1956 live-action shows beamed from the Channel 1 transmitter at Crystal Palace were broadcast..

The intention was to mount a 'normal' colour TV service in order to assess the quality of the transmitted image. Selected homes in the area were equipped either with 405 line colour sets, or asked to log the compatibility, or otherwise, of the black and white image on standard black and white sets. The live colour programmes were produced by BBC director Michael Leeston-Smith and these included drama, talks, ballet, music (The Hot Colour Club) and light entertainment.

A Marconi/RCA 405-line three-tube image orthicon colour camera, one of two used by BBC Television to 'test' the viability of a colour service. This 1960 scene was taken at White City Stadium, thus, not far to hump the lump.

Labouring under the fierce colour lights (a compliment of nine 5K spots, two 10K, twenty five 2K, six 500W and 52 1K scoops, phew!) in the cause of tv science were (amongst others) Cy Grant, Janie Marden, Carole Carr, Sylvia Peters, a dance troupe called the TV Silhouettes and Phillip Harben who demonstrated cooking. (Cookery was a tricky subject for the colour cameras, because it was discovered that food looks terribly unappetising if the colours are wrong. Fillet steak and cabbage proved a difficult test although, apparently, cheese photographed well.) In all cases these little programmes were mounted to establish the quality and stability of the system. There was no intention to explore production techniques. As a consequence, the technicians retained unprecedented overriding control of programme content.

Technically, the minimum Studio A line-up comprised two Marconi cameras (each with three 3" image orthicon tubes of RCA design) on pedestal mounts, each with four lenses (maximum aperture f4.5); one l6mm film or slide flying spot scanner; a 35mm Cintel film scanner; one simple vision mixing panel allowing cuts, mixes, fades and superimpositions from all channels; and three 2l" colour monitors.

Of the cameras themselves, it was reported that in spite of their weight and length (6ft 6in.) they proved quite manoeuvrable on their pedestals which had assisted elevation by means of hydraulic rams. The fixed (non-tilting) view-finders gave the cameramen some trouble which limited the height of shots to the height of the cameramen. The lens turrets were very quick to swing and were reasonably silent. They gave consistent results working at an aperture of f5.6. and at a scene illumination of approximately 300 ft candles. However. the picture definition was poor due mainly to the many dimensional registration problems, both in the three-tube cameras and the three-gun shadow mask monitors. To overcome these problems all shots were framed 15-20 per cent closer than normal monochrome practice. Matching of cameras was also a great problem. Colour response varied all the time. The valve-driven cameras suffered from overheating, with resultant loss of definition. They had to be allowed a few hours' cooling off time between rehearsal and transmission, (as no doubt did the performers). Other common faults occurred in colour registration, as well as shading (usually magenta or green) microphony and dichroic filter reflections within the cameras. To compound matters, the picture monitors (shadow mask type as well as a huge three-tube projection model) were very unstable at all times. It was also thought that panning and tilting the cameras through the Earth's magnetic field would mean constant re registration by test card. Fortunately, in practice this was not the case.

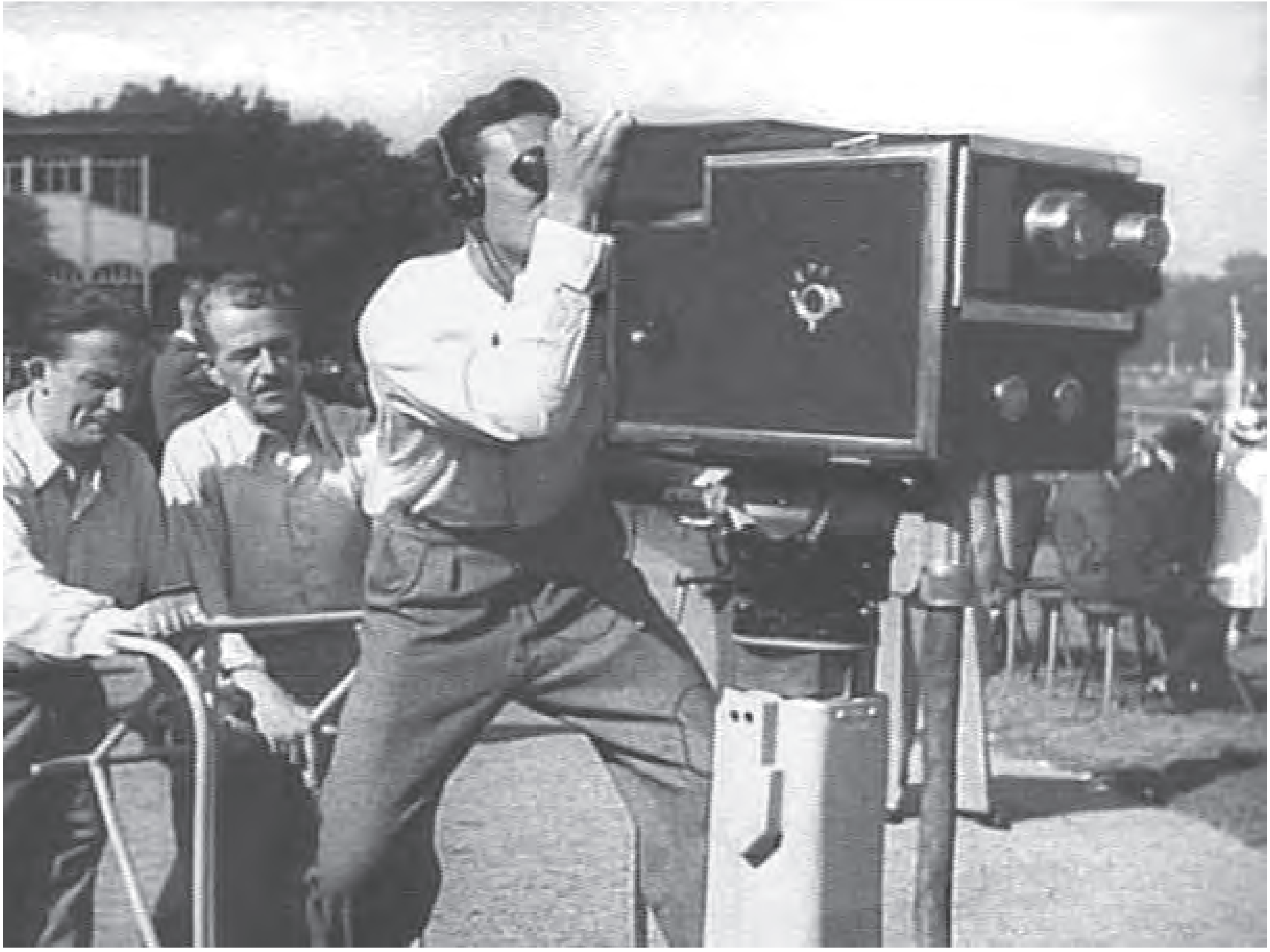
It was concluded in a report issued later that 'the BBC's 405-line NTSC system is undoubtedly capable of offering a most exciting improvement to present monochrome standards'. Even so, the report shrewdly suggested that before embarking on large scale colour television broadcasting the system would have to be capable of giving consistently improved horizontal and vertical definition. as well as even better colour.

In 1957, MPs at Westminster had the opportunity to view a half-hour light entertainment colour show. Six 2l-inch colour sets, and four black and white receivers were installed in Committee Room Number 4. Five of the colour sets were of a type designed by the BBC's Research Department. The sixth was supplied to special order. The four black and white receivers were standard commercial models. As reported in the Daily Express, the black and white pictures looked pretty glum. On the other hand, the colour pictures looked a bit too florid, like an over-dressed, over-painted woman. But the MPs were enthusiastic. What did they see? Some "quite beautiful" close-ups of flowers and bees, butterflies and dancing girls. In the studio, Carole Carr sang Smoke Gets In Your Eyes against a changing background of harsh greens and blues. She appeared later in an Edwardian get-up which showed off excellently a golden dress and vividly flowered hat. But Members must have reserved their opinions about making political appearances in TV colour when they saw naturalist James Fisher and Dr W.E Swinton showing off crystals and art objects. Here, the colour was at its worst, with the men's faces a plum shade and hands a deep salmon pink. Up at Alexandra Palace, one of the cameras broke down for two hours. An official said: "We were all mucking in with soldering irons and a plan on the floor". Such is history.

But does anything visual survive of these experimental BBC colour broadcasts? Actually, yes, but not a lot. Apart from a brief sequence of Studio "A" filmed in colour for the otherwise black and white 1959 BBC documentary "This Is The BBC", there are a few production stills, some taken by director Michael Leeston-Smith. His colour slides include shots of the performers and the 'teapot' caption which opened the tests every night. Leeston-Smith told the present writer that his colour programmes were actually tele-recorded by the research department for later assessment. Investigations have shown that nothing of Leeston-Smith`s productions survive as specifically colour recordings, however there are some monochrome recordings of the 1957 demonstration programme to MP's.

Subsequently, after residing at Alexandra Palace, the BBC's experimental colour kit trundled along to studio H at Lime Grove. During 1966, a visiting cameraman shot on 8mm colour, a closed circuit production of 'The Black and White Minstrel Show'. Despite many hours of colour trials in Studio H, this film is the only known pictorial record of BBC 405-line colour television from that studio.

FATHERLAND TV



A German twin lens Fernseh Iconoscope television camera.

Dicky Howett writes, ‘This snippet, written by Wilhelm E. Schrage, is from a pre-war US magazine called ‘Radio News’, and is a contemporary report on German Television in the mid 1930s’. Note that the cost of tv receivers is quite high,butaccording to most subsequent accounts, they were never on sale to the general German public. Initially, a tv receiver in the US, UK or Germany, cost as much as a small car.’

While America is still of the belief that television has not advanced sufficiently for general use, England and Germany are now endeavoring, through the aid of their respective governments, to make television as popular as sound broadcasting. Other European countries are following in their footsteps, and it can be truthfully said that Europe is now in the throes of ‘television fever’.

Four hundred and fifty-three feet in the air, rising slightly above the top of the well known Berlin radio tower, with its famous restaurant, two copper rings appear to be growing in the sky. Each has a diameter of about ten feet, and their surfaces shine in the early spring sun like spun gold. They are symbolic of a new era--television is no longer a mere technical problem, but is being made available for the use of the general public. The golden rings are the antennas of the Berlin Television Station. From these high points, far above the surrounding buildings, radio waves of a special kind--ultra-short waves, as the technicians term them, are radiated into the air by a force of 15 kilowatts, covering an area of about 50 miles in diameter. Each of these television stations has two ultra-short-wave transmitters. One radiates the sound impulses, as usual, while the other one delivers the picture impulses to be shown in the home transmitter. The radio listener, or should we say the “television looker,” uses a special television receiver to receive these transmissions. Pictures of home-movie size are reproduced. These receivers are of two sizes, one having a screen of about 4 inches by 6 inches and the other about 10 inches by 12 inches

It is simple to tune in on television programs, because there is plenty of space in the present wave range, which is about 7 meters. In other words, there are far less stations in this wave range than in the normal broadcast band, and the selectivity of the television receiver does not have to be as great as for plain broadcasting. Also, the “monkey chatter” does not occur, because of the stations being situated so close to one another. There is also no danger of two stations showing their pictures at the same time to the surprised listener. A great number of these new receivers have to be tuned only once. Later on it is brought into operation by turning only the small switch of the power line

For the past 9 months, the Berlin Television Station has been radiating interesting programs, daily, on 7 meters. The picture appears, as stated before, behind the surface of a glass plate. Sometimes it is in black and white, but very often, has a slightly bluish or greenish caste. If the transmitter radiates the picture in the so-called “180 lines manner,” as is done in Berlin, not only heads, but the entire body may be seen. Entire scenes with all movements are easily recognized

The average price range of the receivers is from $250.00 to $500.00 per set. A television receiver contains two complete receivers, one for sound reception, and the other for the reception and reproduction of the image. While the sound receiver is only connected with the loudspeaker, the picture receiver works with a cathode-ray tube which is the heart of the visual system. Another type of picture receiver uses a “mirror-screw” for reproducing the picture.

The roof-mounted 17.5mm movie camera van giving ‘almost’ live television. This was the Intermediate Film television system

Recently, in Germany, there has been developed a television pick-up car. This car carries on its roof a standard motion-picture camera mounted on a cast-iron roof, allowing the camera to be moved in any desired direction. The hollow pillar of the camera support is used to convey the exposed film ribbon to the dark room which is in the interior of the car. By use of special apparatus and extremely fast-working chemicals, the film is developed in 1-1/2 minutes. The still-wet film ribbon is then sent at once through a so-called “Abtastgerat”, which cuts the single-film pictures in 180 lines and transforms each line in a succession of strong and weak electrical impulses. The impulses are radiated from a transmitter into the air and the radio listener, receiving these impulses through the televisor, may see the broadcast scenes

Wilhelm E. Schrage, Radio News, July 1935

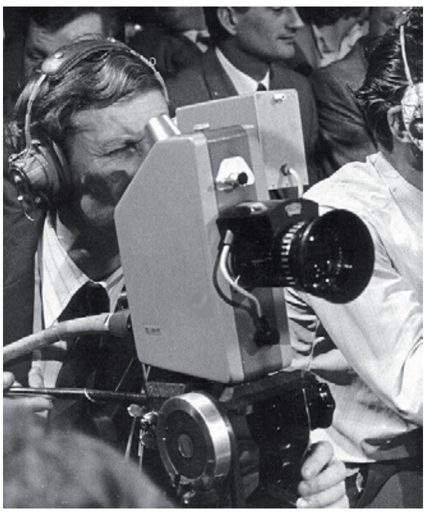
TV CAMERAS COME AND GO.

Dicky Howett recalls the Philips LDK13

This portable colour camera is hardly remembered, due mainly to the shortness of it’s production run and general use in tv. In the UK, the BBC, Thames and LWT had a few each and it’s rumoured that one was used on the famous Queen ‘Bohemian Rhapsody’ promo. The camera itself, which appeared around 1970, featured three newly developed electrostatically focussed 5/8th Plumbicon tubes all housed in an irregularly shaped box. (The three tube ends jutted uncomfortably).The zoom lens was by Schneider and the control CCU electronics were standard to the current Philips LDK3 camera.

The bulk of the LDK 13 camera electronics was in a backpack, strapped to the unfortunate cameraman, with a thick, polypole cable running out the back. However, in practice, the camera was mounted usually on a tripod or dolly. Programmes and sequences shot with this camera included those of ‘Upstairs-Downstairs’, an FA Cup Final (where allegedly, the picture turned purple ocassionally) and a production of ‘Dr Jekyl and Mr Hyde’ at Shepperton Studios, starring Kirk Douglas.

Of this camera, very little remains. Indeed, I seem to own the sum total. My picture shows a Schneider zoom lens, the back pack electronics and the carry webbing unit. No camera body or tubes appear to survive, unless, of course you know better…….



Dicky Howett.

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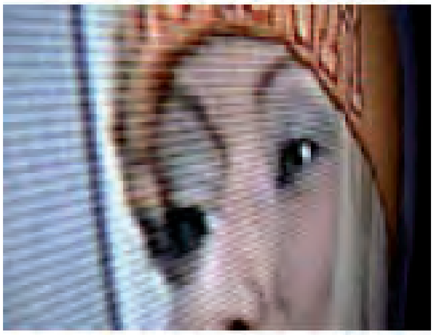
Understanding Analog Video Signals

Abstract: This paper describes the analog video signals used in both broadcast and graphics applications. Topics covered include video signal structure, video formats, standard video voltages, gamma correction, scan rates,and sync signals.



This paper describes the analog video signals used in both broadcast and graphics applications.

There are two forms of video in general use today: broadcast and graphics. While broadcast is based on terrestrial television, the graphics format was developed to meet the needs of workstations and PCs without regard for the formatting and bandwidth limitations needed in TV signal transmission. The broadcast graphics format is specified by government agencies such as the FCC in the US and the ITU in Europe, while the graphics format is specified by industry or company standards. Originally, both formats shared a common baseband signal structure, specified in EIA-RS-170[1], but that changed when color was added to broadcast TV in 1953.

Monochrome TV required a single luminance signal and the required transmission bandwidth was moderate. A simple conversion to color, with the requirement for three video signals — one for each of the additive primaries of red, green, and blue (RGB) — would have tripled the required bandwidth. To circumvent that need, broadcast invented NTSC, PAL, and SECAM — analog encoding methods employed to squeeze color into the original monochrome channel bandwidth. In the process, broadcast invented all of the analog baseband formats used in video today. Graphics didn't require the limited bandwidth, and remains as three separate RGB channels.

The three formats for baseband video signals — native primaries, component, and composite — form a hierarchy that is the basis of all video, whether analog or digital, broadcast or graphic. We'll see how the formats are derived, and what sort of problems there are in handling them, and why. The issue of video quality is also discussed as a function of format.

Broadcast and graphics have other differences that are not immediately obvious. Broadcast video has a property called gamma (g), which graphics lacks. Broadcast uses interlaced scanning while graphics uses progressive scanning. Two types of video displays developed because of these differences; one for TV and another for the PC. We'll look at why they are different and how they can share a display.

Broadcast and Graphics Analog Video Signal Structure

The signal structure of broadcast video is more complex than a graphics video signal because of the analog encoding process used in converting it to the composite signal[2] needed for modulating a TV transmitter. In this process, all the other video formats are created, starting from the native format[3]. The formats are native primaries, component, and composite video. Only broadcast video uses encoding. There are no component or composite video signals in a PC today.

Originally the PC used a TV format in the display. Graphics only has a single RGB format, but it has evolved to include multiple scanning rates for increased resolution. The need for higher resolution was driven by the short viewing distance, typically between one and three screen heights, compared to TV which is typically observed from six or more screen heights away. Based on a minimum resolvable area of one arc-second in the human eye, a graphics display is enhanced greatly by increased resolution, while the TV wasn't until larger displays became available.

NTSC4, PAL5, and SECAM6 are the names of the broadcast video formats developed in the US, Germany, and France to encode color video and sound into a single signal. All reduce the quality of video in two ways: bandwidth reduction, and artifact generation. Bandwidth reduction reduces the resolution7, while artifacts are the crawling, or hanging, dots on an edge. The latter is the most objectionable to viewers, while the former isseldom noticed.

The broadcast video formats have these characteristics in common: l All use amplitude to encode the "Luma" portion of a signal (Y') as the weighted sum of R', G', and B'. l All have a reduced-bandwidth component-video form. l All use subcarrier(s) phase or frequency to encode color or "Chroma". l All include sound subcarrier(s). l All

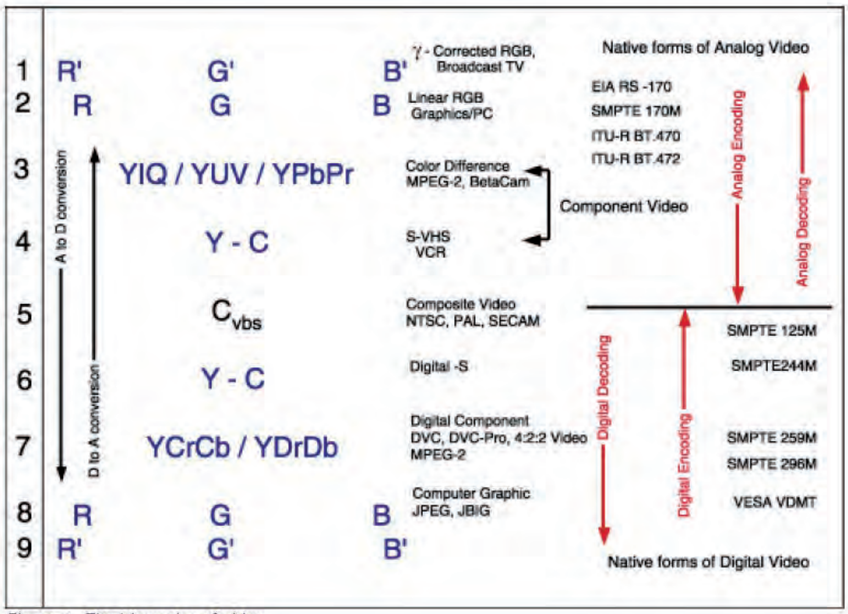


Figure 1. The hierarchy of video.

result in a single wire form called composite video, suitable for terrestrial RF transmission.

Video formats can be viewed as a hierarchy8 (Figure 1):

Native Primaries

The first line in the hierarchy is R', G', B', where the prime mark (') indicates gamma (g) correction. This is the native form of broadcast video. The second line is linear RGB, the native form of graphics, with no prime mark. This convention is misused in some texts, making it difficult to follow through the literature. Here, we'll use a prime to indicate the g-corrected form, in accordance with the SMPTE and ITU standards in Figure 1.

The bandwidth of the signals RGB and R'G'B' are equal and determined by the video resolution9. This is as good as it gets. Any further signal processing degrades the video quality, which is why graphics stuck with RGB. A viewer may not perceive this degradation if human vision or the display can't resolve it. Broadcast used human perception factors to design the composite signal for TV. HDTV, PAL plus, and MPEG all later rejected composite and native primaries, and decided to use the next form — called component video — to improve video quality.

Component Video

The third and fourth lines are the two forms of component video, color difference (Y'PbPr/Y'UV/Y'IQ) and Luma- Chroma (Y'-C)10. Sometimes, there is confusion about the terms used. Some texts use the terms Luminance and Chrominance, which are from Color Science. Here we'll use Luma and Chroma where the Luma term is written with a prime (Y') to indicate the non-linear video form. The Color Difference form is produced by the linear addition and scaling of R'G'B' to implement the well-know equations;

Y' = (Kr × Er') + (Kg × Eg')+(Kb × Eb')

Pb, U, I = Kcb × (B' - Y')

Pr, V, Q = Kcr × (R' - Y')

The coefficients for Luma (Kr,Kg,Kb), are the same for NTSC, PAL, and SECAM, but the coefficients for the difference terms (Kcr and Kcb) vary according to the process. It is important to remember that the equationsapply to the active video portion of the signal and not the sync. They must be separated prior to this process, and combine them again afterwards. One of the challenges with multiple video signals is that of controlling delay. In order to display an image, the video voltages must be correctly aligned in time. Two types of delay prevent this, flat delay caused by the transmission path length and frequency-dependent delay caused by filters. This applies to R'G'B' and component video. Flat delay is seldom a problem at video frequencies, and any required compensation can be made either by coax cable or delay lines. Frequency-dependent delay is another matter. Because the R', G', and B' signals all have the same bandwidth, flat delay is seldom a problem, but the Chroma portions of the component signals (Pb, Pr & C) are filtered to reduce the occupied bandwidth. To compensate for the delay associated with this filtering, the Luma signal (Y) must be delayed the same amount. The Chroma filtering is considered "visually lossless", based on a model of human vision that says the eye doesn't detect small details in color. The analog videotape format of Beta11 is an example of a scaled colordifference format, and S-VHS12 is an example of the Y-C form. MPEG uses a digitized form of the color-difference signals, designated YCbCr, and shown on the seventh line, where the bandwidth reduction is done by sampling Cb and Cr at half the rate of the Y channel. This is called 4:2:2 sampling, and is based on ITU-R BT.601. The Y-C component form is produced by phase- or frequency-modulating color subcarrier(s) with the colordifference components, and then adding them together depending on which process is used. The Y channel is the same as in YPbPr, but the Chroma signal is an FM or PM subcarrier that is band-pass filtered, further truncating the color bandwidth. This is an important point in the encoding process. It's the last place where Luma and Chroma information are separate. Once Y and C are combined, they will never again be totally separated, and that produces the artifacts that give composite its reputation for compromised quality.

Composite Video

The fifth, and center, line is composite video (Cvbs), formed by adding the Luma and Chroma components together with monaural audio, NTSC, PAL and SECAM are composite video signals. The Cvbs signal is the lowest quality video on the chart and suffers from cross-color artifacts. These are bits and pieces of Chroma and Luma information that remain after we try to separate Cvbs back into R',G', & B' for display. These artifacts became more noticible as broadcast began to use larger, higher-quality displays. Today, Cvbs is more of a legacy format, and will probably disappear as single-wire digital forms of component video take its place. One odd thing about NTSC Cvbs is something called "setup." This is a voltage offset between the "black" and "blanking" levels, and is unique to NTSC. As a result, NTSC is more easily separated from its sync portion, but has a smaller dynamic range when compared with PAL or SECAM. The Video formats are also called color spaces in digital literature, and the encoding/decoding process is called color-space conversion to distinguish it from the analog process. Don't be confused by this — digital video uses the same formats as analog video. The signals produced by the encoding process are shown in Figure 2, along with approximate amplitudes, in percent. Exact amplitudes are given in Table 1 for several of the formats, based on a 1V p-p R'G'B' set of native primaries, across a 75W load. These are the signal values you will see going into or out of video equipment like displays, VCRs, and DVD players.

Linear and Gamma Corrected Video

Originally, video signals were created in cameras using vacuum tube sensors. The output voltage (V) of a tubecamera isn't linear in relation to the incident light (B). It's exponential and the exponent is called gamma (g).This relationship can be mathematically expressed as B = K × Vg. where B is light flux, in lumens per square meter. K is a constant; and V is the voltage generated, in Volts. Since the CRT is also a vacuum tube, with inverse non-linearity (1/g) similar to that of the camera tube, the light output is linear with respect to the light input — that is, the inverse gamma of the picture tube compensates for the gamma function of the camera's pickup tube. However, the voltage is non-linear compared to the luminance level. This poses a challenge when superimposing two images since you cannot do simple linear addition of, say, a title or other graphic. Video mixers deliver odd results with broadcast signals because of their non-linear luminance. Special-effects generators use linear signals when layering, compositing, titling, etc. Graphics video is linear, which makes it easy to mix graphics video signals. The

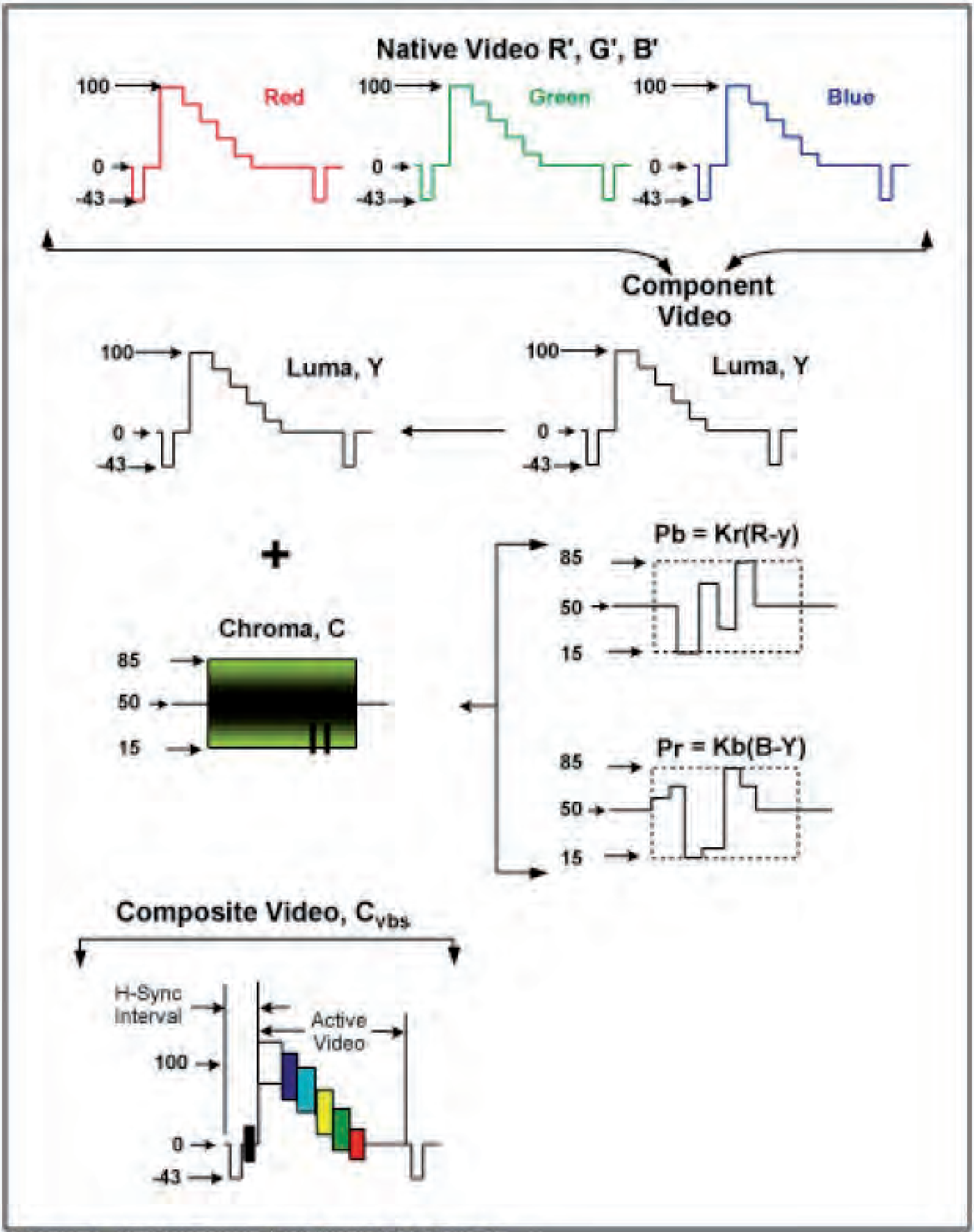


Figure 2. Analog encoding from R'G'B' to C_{vbs}.

linear signal is gamma corrected at the display, so it will appear correctly on the display, to allow for the display's gamma. A beneficial side effect of gamma is that it reduces the effect of additive noise.

Gamma is specified as 2.22 for NTSC and as 2.8 for PAL and SECAM.

Originally, the camera and CRT were thought to be exactly complementary, but they are not. Later it was found that intentionally under-compensating for g in the display improved the contrast ratio. Because of that, Sun and Apple, optimized their displays with values of 1.7 and 1.45, respectively, while others use broadcast values. Today, TV and PC display manufacturers all undercompensate for g to some degree to improve the appearance of the display. One thing is certain. You'll need to be able to add, remove, or change g to fit the video signal. This is called g correction in some texts, which is the addition of g to a linear RGB signal. It's really more in the nature of a gmodification.

Gamma Modification

The addition, removal, or change of g can be done in either the analog or digital domain. In analog, it takes the form of a non-linear amplifier where one of the gain resistors around an op-amp is replaced by a real or a piecewise equivalent to a non-linear impedance. This is non-trivial in terms of design. Analog g correctors are seldom accurate, and they require trimming adjustments. A side effect of g modification is distortion. For these reasons, g correction is best done digitally. Note that this only applies to the active video, not to the sync. The digital process uses substituted values from a look-up table (LUT) stored in software. It's as accurate as the stored value, and trivial in terms of its design. Obviously if the signal is digital, this is the preferred method to use. In either case, we need a formula for the voltage in terms of the light flux (B). Broadcast video has two, one used for standard-definition TV (SDTV), and another for HDTV.

For NTSC/PAL per SMPTE170M and ITU-R BT.709;

E'x = [(1.099 × B (0.45)) - 0.099] for 0.018 > B > 1.0

E'x = [4.5 × B] for 0> B > 0.018

For HDTV per SMPTE240M;

E'x = [(1.1115 × B (0.45)) - 0.1115] for 0.0228 > B > 1.0

E'x = [4.0 × B] for 0 > B > 0.0228

Scanning and Sync

Video signals have two parts: the active video and sync. We have so far only looked at the active video. The proper name for sync is Image Reconstruction Timing, and it's used to reconstitute the image. The sync portion doesn't interfere with the active video because it's below the black level and can't be seen. Any signal below the black level is said to be blanked. The black and blanking level are the same in every format except NTSC composite. Originally, the black, or blanking level was at 0Volts, with active video above and sync below, to simplify separating them based on level and timing.

If you could spread out the active video and sync interval on a flat surface, you would get a raster, which looks like Figure 3. The unused portion, T2(H) to T3(H), originally allowed magnetically-scanned CRTs to "fly back" to their starting point for the next line, and settle during T0(H) to T1(H). The vertical deflection works in a similar manner. The sync interval is "dead time" as far as the active video is concerned. Consequently, there are two resolutions for a video format, the active-video resolution we see, and the total resolution13 of the raster. This is true for both broadcast and graphics. The image quality is a function of the active-video resolution14 and the bandwidth through which the signal is transmitted.

A raster is created by scanning, both horizontally and vertically, starting at the upper left corner of the display. These "scan lines" are synchronized by the horizontal sync pulse, or H-Sync, so that they all start at the same place on the display. The frame, or V-Sync, indicates when the scan is finished and when to start the next. This means the image is sampled at the frame rate, and any motion that's faster than 1/2V-Sync will produce "aliasing" in the reconstructed image. Figure 3. Display raster with horizontal and vertical flyback time.

In RS-170, the frame rate was split into odd and even fields — a process called interlaced scanning — to conserve bandwidth. Visually this has the effect of re-sampling the displayed image faster and avoids flicker without increasing the frame rate — and bandwidth — in broadcast. The addition of a color subcarrier modified this sequence. In NTSC, the phase of the color subcarrier reverses every field, and in PAL, it indexes 90° per field. This gives rise to the 4, and 8 color field sequences for the NTSC and PAL composite signals. Graphics uses progressive scanning, since the increased bandwidth isn't a problem. A side effect of the vertical sampling is that if you AC couple a video signal, you must still have good squarewave response at the field (broadcast), or frame rate (graphics). If you don't, you'll get brightness variations across the raster. This can be seen in a vertically-split black and white screen pattern. Very large capacitors (>330µF) are required to maintain good square-wave response when AC coupling an output because of the 75W

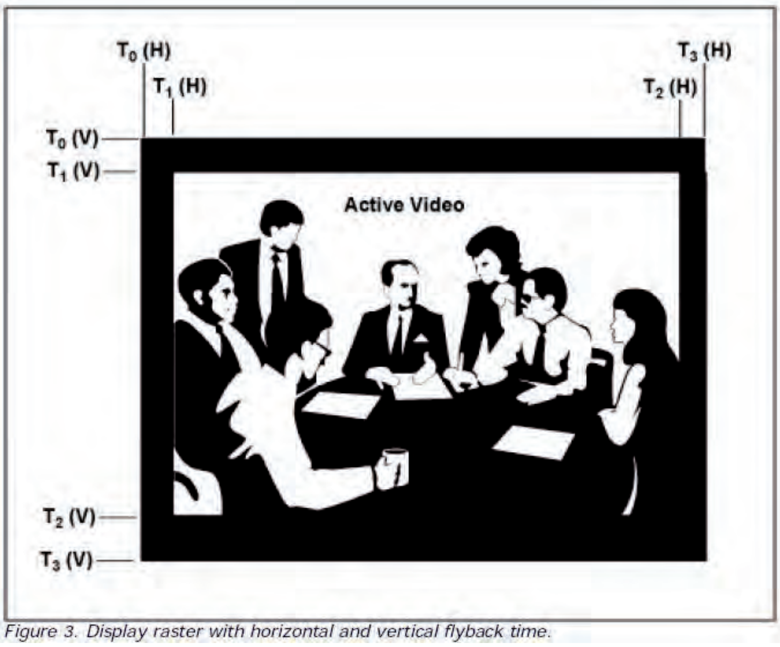


Figure 3. Display raster with horizontal and vertical flyback time.

Table 1. Standard Video Voltages

R'G'B Video			
NTSC		**PAL**	
Setup	53.6 mV	Setup	0 mV
R'G'B'	714 mV (Peak Luma, 100% White)	R'G'B'	700 mV (Peak Luma, 100% White)
Sync	-286 mV	Sync	-300 mV
NTSC Japan		**Graphics Linear RGB**	
Setup	0 mV	Setup	0 mV
R'G'B'	714 mV (Peak Luma, 100% White)	R'G'B'	700 mV (Peak Luma, 100% White)
Sync	-286 mV	Sync	-300 mV
Color Difference Component Video			
NTSC BetaCam		**PAL BetaCam/EBU N10**	
Setup	53.37 mV	Setup	0 mV
Y	714.29 mV (Peak Luma, 100% White)	Y	700.00 mV (Peak Luma, 100% White)
Pb/Pr	700.00 mVp-p (75% Color Bars) 933.34 mVp-p (100% Color Bars)	Pb/Pr	525.00 mVp-p (75% Color Bars) 700.00 mVp-p (100% Color Bars)
Sync	-286 mV	Sync	-300 mV
NTSC BetaCam Japan			
Setup	0 mV		
Y	714.30 mV (Peak Luma, 100% White)		
Pb/Pr	756.80 mVp-p (75% Color Bars) 1009.0 mVp-p (100% Color Bars)		
Sync	-286 mV		
Y-C Component Video			
NTSC S-VHS		**PAL S-VHS**	
Setup	53.57 mV	Setup	0 mV
Y	714.29 mV (Peak Luma, 100% White)	Y	700.00 mV (Peak Luma, 100% White)
V	626.70 mVp-p (75% Color Bars) 835.60 mVp-p (100% Color Bars	C	663.80 mVp-p (75% Color Bars) 885.10 mVp-p (100% Color Bars
Sync	-286.00 mV	Sync	-300.00 mV
Composite Video			
NTSC		**PAL**	
Setup	54 mV	Setup	0 mV
Video	714 mV (Peak Luma, 100% White) 934.15 mV (Peak Luma with 100% Color Bars)	Video	700 mV (Peak Luma, 100% White) 933.85 mV (Peak Luma with 100% Color Bars)
Sync	-286 mV	Sync	-300 mV
Burst	286 mVp-p	Burst	300 mVp-p
NTSC-EIA-J			
Setup	0 mV		
Video	714.0 mV (Peak Luma, 100% White) 908.2 mV (Peak Luma with 100% Color Bars)		
Sync	-286.0 mV		
Burst	286.0 mVp-p		

rcuit. The scanning method and rate varies between the different types of video. In order to share a display, the Multi- Sync™ concept was invented. Originally, these displays had a deflection system that could respond to the different rates by switching component values. As long as the display had sufficient resolution to display the highest scan rates, this worked fine. It displayed each type of video with its native scanning format, but this can be expensive since the display must be sized to the highest resolution and speed. The alternative is to scan the display at a constant rate, and convert the incoming video to the display rate. This is called scan conversion. It allows the display to operate at a single resolution, making the deflection simpler. Scan conversion is best done in the digital domain using dual-ported video RAM.SECAM: Sequential Couleur avec Memoire. The French form of standard definition TV.

Table 2. Graphic Standards and Active Resolutions

GRAPHICS STANDARD	HORIZONTAL RESOLUTION	VERTICAL RESOLUTION	HORIZONTAL FREQUENCY (kHz)	VERTICAL REFRESH RATE (Hz)	PIXEL/ SAMPLE RATE (MHz)
VGA	640	480	31.5	60	25.175
	640	480	37.7	72	31.5
	640	480	37.5	75	31.5
	640	480	43.3	85	36
SVGA	800	600	35.1	56	36
	800	600	37.9	60	40
	800	600	48.1	72	50
	800	600	46.9	75	49.5
	800	600	53.7	85	56.25
XGA	1024	768	48.4	60	65
	1024	768	56.5	70	75
	1024	768	60	75	78.75
	1024	768	64	80	85.5
	1024	768	68.3	85	94.5
SXGA	1280	1024	64	60	108
	1280	1024	80	75	135
	1280	1024	91.1	85	157
UXGA	1600	1200	75	60	162
	1600	1200	81.3	65	175.5
	1600	1200	87.5	70	189
	1600	1200	93.8	75	202.5
	1600	1200	106.3	85	229.5
QXGA	2048	1536		60	260
	2048	1536		75	315

Video Groups and Specifications

NTSC: National Television System Committee. The US form of standard definition TV.

PAL: Phase Alternating Line. The system of standard definition TV implemented in Europe and elsewhere.

SECAM: Sequential Couleur avec Memoire. The French form of standard definition TV.

ATSC: Advanced Television Systems Committee. The US form of high definition TV (HDTV).

VESA: Video Electronics Standards Association. Proposes and publishes video standards for Graphics.

ITU: International Telecommunications Union. Proposes and publishes video standards for Broadcast in the EU.

SMPTE: Society of Motion Picture and TV Engineers. Proposes and publishes video standards for Broadcast in the US.

JPEG: Joint Photographic Experts Group. Proposes and publishes video standards for Still Images.

MPEG: Motion Picture Experts Group. Proposes and publishes video standards for Broadcast.

EIA RS 170 & 170A The original specs for Monochrome and Color TV in the US. Has been replaced by SMPTE 170M.

EIA 770-1: The US spec for Enhanced Component video, similar to ITU-R BT1197/ETSI 300 294 for PAL-Plus.

EIA 770-2: The US specs for Standard Definition TV (SDTV) Baseband Component Video.

EIA 770-3: The US spec for High Definition TV (HDTV) Baseband Video.

ITU-R BT.470: Harmonized spec for SDTV world wide, including NTSC, PAL, and SECAM.

ITU-R BT.601: Universal Sampling spec for SDTV and HDTV Broadcast Video. Similar to SMPTE125M.

ITU-R BT1197/ETSI 300 294: Spec for PAL Plus Enhanced TV in Europe.

SMPTE 125M: Similar to ITU-R BT.601.

SMPTE 170M: Has replaced EIA RS 170A, color spec for NTSC.

SMPTE 253M: RGB Analog Video Interface spec for SDTV Studio applications.

SMPTE 274M: Component spec for 1920x1080 HDTV.

SMPTE 296M: Spec for 1280 x 720 RGB and YPbPr Baseband Video. Similar to PAL Plus.

Choosing A Video IC

Tables 3 and 4 show large-signal bandwidth (2Vp-p), slew rate, differential gain and phase, and supply voltage for Maxim's most popular video drivers, buffers, and receivers with single-ended and differential outputs.

A special subset of the video driver is the video-distribution amplifier (see Table 5). Built to drive multiple loads, they offer higher isolation, selectable outputs, fixed or settable gain and are often used in professional equipment.

Another subset of the video driver is the video mux-amp (see Table 6). Mux-amps combine a video multiplexer and a video line driver for routing video signals.

Analog Video Filters maybe used to eliminate many discrete components and save board space in video reconstruction applications(see Table 7.)

Notes:

1. RS-170 was replaced by SMPTE 170M.

2. Cvbs usually means "composite video, with blanking and sound."

3. The native form is that in which the signal was created. Usually it is R'G'B', the g-corrected primaries.

4. NTSC is the National Television Systems Committee system of analog encoding.

5. PAL is the Phase Alternating Line system of analog encoding.

6. SECAM is the Sequential Couleur avec Memoire system of analog encoding.

7. Bandwidth versus video resolution

8. The exact form and process information for Terrestrial Broadcast can be found in ITU-R BT.470.

9. Bandwidth versus Video Resolution

10. The Y Component is often called "Luminance," and confused with the color science term. We use the term Luma, and designate it with an accent, Y'.

11. Trademark of Sony Corp.

12. Trademark of JVC.

13. Total resolution is also called format resolution.

14. Bandwidth versus Video Resolution

15. This is the Nyquist frequency of the image-sampling process.

Table 3. Single-Ended Video Line Drivers and Buffers

P/N	No. of Amps	Operating Voltage (V)	-3dB LSBW (MHz)	Slew Rate (V/µs)	DP/DG (°/%)	Notes
MAX4090	1	+3,+3.3, +5	55	275	0.8/1.0	SC70, 3V, 150nA Shutdown, Input Clamp
MAX4032	1	+5	55	275	0.6/0.4	SC70, 5V, Sag Corrected Output
MAX4450/1	1 / 2	+5, ±5	175	485	0.08/0.02	SC70/SOT23 Packages
MAX4350/1	1 / 2	±5	175	485	0.08/0.02	SC70/SOT23 Packages
MAX4380-4	1 / 2 / 3 / 4	+5, ±5	175	485	0.08/0.02	SC70/SOT23 Packages, Disable Available
MAX4389-96	1 / 2 / 3 / 4	+5, ±5	127	200	0.015/0.015	SC70/SOT23 Packages, Disable Available
MAX4108 MAX4109 MAX4308 MAX4309	1 1	+5,+/-5	400 225 220 200	1200	0.004/ 0.008	LOW Distortion, Stable Gain,1,2,5,10 MAX4108 0.1db/2V_{p-p} BW is 100MHz.
MAX4012/ 16/ 18/ 20	1 / 2 / 3 / 4	+3.3, +5, ±5	140	600	0.02/0.02	Disable Available
MAX4212/ 13/ 16/ 18/ 20	1 / 2 / 3 / 4	+3.3, +5, ±5	180	600	0.02/0.02	Disable Available
MAX4014/ 15/ 17/ 19/ 22	1 / 2 / 3 / 4	+3.3, +5, ±5	140	600	0.02/0.04	Gain of 2 Buffer, Disable Available
MAX4214/ 15/ 17/ 19/ 22	1 / 2 / 3 / 4	+3.3, +5, ±5	220	600	0.02/0.04	Gain of 2 Buffer, Disable Available
MAX477	1	±5	200	1100	0.01/0.01	130MHz 0.1dB Gain Flatness

Table 4. Differential Video Line Drivers and Receivers

P/N	Driver / Receiver	Operating Voltage (V)	-3dB LSBW (MHz)	Slew Rate (V/ µs)	DP/DG (°/%)	Notes
MAX435	Driver	±5	275	800	Not Specified	300µV Input Offset Voltage
MAX4142	Driver	±5	180	1400	0.01/0.01	Fixed Gain of 2V/ V
MAX4147	Driver	±5	250	2000	0.03/0.008	Fixed Gain of 2V/ V
MAX4447/8/9	Driver	±5	405	6500	0.01/0.02	Single-Ended Input
MAX436	Receiver	±5	275	800	Not Specified	300µV Input Offset Voltage
MAX4144/5/6	Receiver	±5	110	1000	0.03/0.03	Shutdown Mode
MAX4444/5	Receiver	±5	500	5000	0.05/0.07	Shutdown Mode

Table 5. Distribution Amplifiers

P/N	No. of Outputs	Operating Voltage (V)	-3dB LSBW (MHz)	Slew Rate (V/µs)	DP/DG (°/%)	Notes
MAX4135/6	6	±5	185	1000	0.1/0.1	0.1dB Gain Flatness to 40MHz
MAX4137/8	4	±5	185	1000	0.1/0.1	0.1dB Gain Flatness to 40MHz

Table 6. Video Mux-Amps

P/N	Inputs: Outputs	Operating Voltage (V)	-3dB LSBW (MHz)	Slew Rate (V/µs)	DP/DG (°/%)	Notes
MAX4023-6	2:1	+5, ±5	260	300	0.05/0.012	Low Cost, Fixed and Settable Gain
MAX4028/9	2:1	+5	210	300	0.4/0.2	Fixed Gain of 2 with Input Clamps
MAX4310	2:1	+5, ±5	110	460	0.06/0.08	Unity Gain Stable
MAX4311	4:1	+5, ±5	100	430	0.06/0.08	Unity Gain Stable
MAX4312	8:1	+5, ±5	80	345	0.06/0.08	Unity Gain Stable
MAX4313	2:1	+5, ±5	40	540	0.09/0.03	Fixed Gain of 2
MAX4314	4:1	+5, ±5	90	430	0.09/0.03	Fixed Gain of 2
MAX4315	8:1	+5, ±5	70	310	0.09/0.03	Fixed Gain of 2

Table 7. Video Reconstruction Filters

P/N	Channels	Operating Voltage (V)	Gain (dB)	Output Video Buffer	High Frequency Boost	Notes
MAX7450-2	1	±3, ±5	0, 6	Yes	No	Video Conditioner with AGC and Back Porch Clamp
MAX7449	3	5	6	Yes	No	3-Channel RGB Video Filter
MAX7448	4	5	6	Yes	Yes	4-Channel RGB Video Filter with CVBS input
MAX7447	4	5	6	Yes	Yes	4-Channel S-Video, CVBS Video Filter with CVBS input
MAX7446	4	5	6	Yes	Yes	4-Channel RGB and CVBS Video Filter
MAX7445	4	5	6, 9.5, 12	Yes	Yes	4-Channel Video Filter with selectable gain
MAX7443/4	3	5	6, 9.5, 12	Yes	Yes	3-Channel Video Filter with selectable gain
MAX7440-2	6	5	0	No	Yes	6-Channel Video Filters with HF Boost
MAX7438/9	3	±5	6, 9.5	Yes	Yes	3-Channel, Back-Porch Clamp to GND
MAX7428/30/32	1, 2, 3	5	6	Yes	Yes	1-,2-, or 3-Channel Filter, 2:1 input Mux.

Table 8. SCART Audio/Video Switches

P/N	SCART Connectors	Operating Voltage (V)	-3dB LSBW (MHz)	Gain (dB)	DP/DG (°/%)	Notes
MAX4399	3	+5, +12	27	±1, 6	0.36/0.13	SCART Audio/ Video Switch for Digital Set-top Boxes
MAX4397	2	+5, +12	6	±1, 6	0.4/0.2	SCART Audio/ Video Switch for Digital Set-top Boxes

HI DE HI DEF

Dicky Howett and daughter pose in 1989 before a BBC ‘Eureka’ High Definition tv scanner, parked outside the Royal Albert Hall. Such plans and dreams, back in the days when the BBC had its very own mighty ob fleet and could mount eleborate ‘trial’ programmes to test the systems.

Circuit facilitates video fading

JM Terrade, Clermont-Ferrand, France

When you're copying videotapes, it's sometimes desirable to suppress some passages. Using the pause control of the recorder does not yield satisfactory results. Another method produces better results (Figure 1). The video source connects to the video-in plug, and the recorder connects to the video-out plug. Turning potentiometer P_1 adjusts the image brightness from normal video to a black image. With the P_2 potentiometer ganged to P_1, the sound also varies accordingly. The objectives in building this circuit are to use inexpensive, readily available components and to obtain batteryless operation. The video signal follows two paths (Figure 2). In the first path, the signal undergoes amplification by a factor of two and connects to one end of a potentiometer. In the second path, the synchronization pulse, separated from the input signal, connects to the other end of the potentiometer. The wiper of the potentiometer connects to the second video amplifier, which provides the video output.

When you adjust P_1's wiper from one end to the other, the video image disappears and fades to a black screen. Because P_1 and P_2 are ganged, the sound follows the image brightness. The circuit could have used triple integrated video amplifiers, such as an AD813, and a video sync separator, such as an LM1881. However, these ICs are expensive (approximately $25) compared with the six standard transistors shown in Figure 2. R_1 sets the input impedance at 75Ω. Q_1, Q_2, and associated components form a video amplifier with an approximate gain of two. R_2, R_3, and D_1 set the dc voltage, and C_1 blocks any dc voltage from the source. The amplified video signal connects

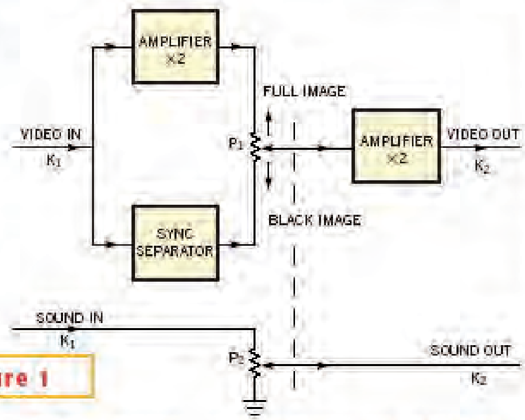
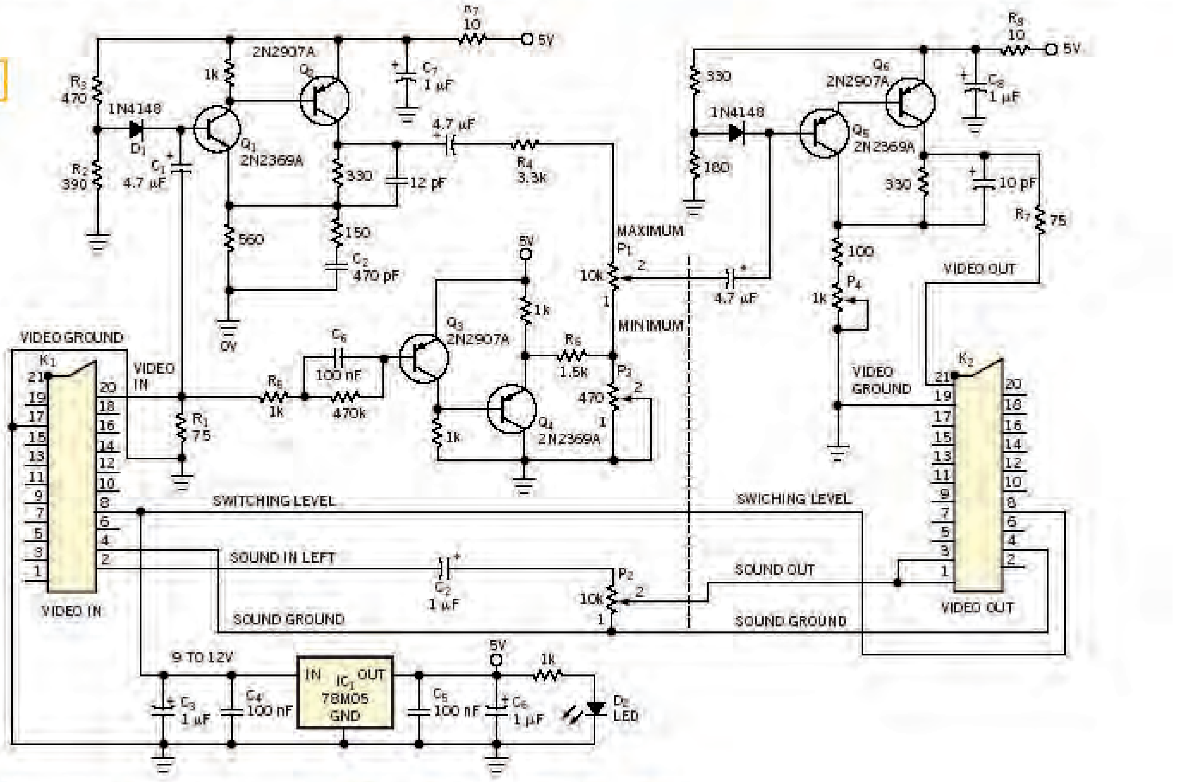


Figure 1

A simple circuit provides for effective video and audio fading when you're recording source material.

Figure 2



A handful of transistors and associated components yields a professional-quality video fader.

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