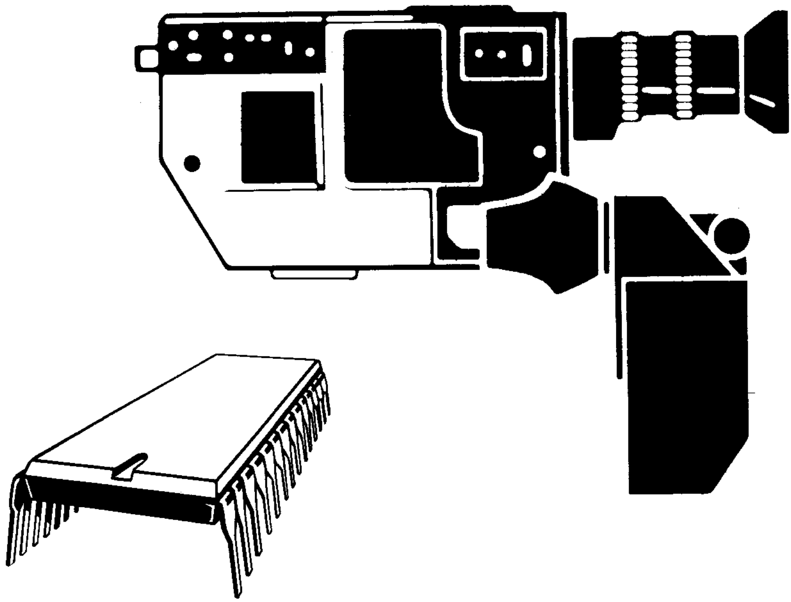
THE REVISED AMATEUR TELEVISION HANDBOOK

Trevor Brown



THE BRITISH AMATEUR TELEVISION CLUB

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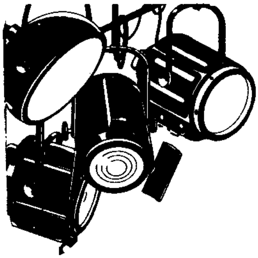

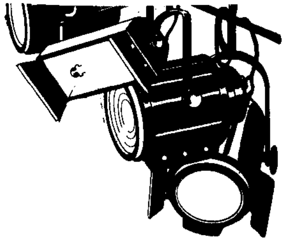

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PREFACE

In 1981 the British Amateur Television Club published "The Amateur Television Handbook". For the first time, a modular approach to building a television station was described, printed circuit boards were made available and a common card frame size was set for all the major video projects.

The popularity of "The Handbook" far exceeded any expectations. The print run was soon exhausted and had to be re-ordered, and the correspondence started to arrive not only from this country, but from around the world. With all this enthusiasm, we produced in 1982 "Amateur Television Handbook Volume 2". This book did not replace the original handbook but supplemented and extended it.

By the summer of 1984 several thousand Handbooks had been sold and the current print run was again exhausted. Electronics is a fast moving art with many chips going out of date, and new ones being introduced. For this reason we decided to revise both books and replace the outdated circuitry with more modern circuits and at the same time incorporate the latest thinking into the existing circuits. Not only the electronics but the way we communicate changes; the increase in 24cms television, the spread of FM television and the introduction of Amateur Television Repeaters are examples.

The standard chosen for printed circuit cards has been continued but, where new cards have been designed, the edge connector has been changed to accommodate the more up to date DIN 41612 connector while still permitting the use of the older and more expensive I.S.E.P. connector. The size of the printed circuit cards remain the same although the components have been kept within a safe area whenever possible in order that the card may be pruned to Euro card should the need arise.

The British Amateur Television Club is pleased to present the revised edition of "Amateur Television Volume 2".

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SLOW SCAN TELEVISION

CHAPTER 1

By Trevor Brown G8CJS.

Slow Scan Television is a form of television originally devised by Copthorne MacDonald as a project at Kentucky University, the aim of which was to see what sort of television pictures could be transmitted through a normal audio communication channel. It has since been adopted by many amateurs on a world wide basis enabling them to see their contacts as well as hear them.

With SSTV the images are transmitted at a slow rate, and essentially a series of still pictures are transmitted so no movement is possible. In the future, with the advent of micro-processors and memory stores, it is quite possible that this difficulty may be partially overcome. At the moment however, it is still pictures and text which form the transmission material. One development that does seem to be taking off is the transmission of colour pictures. Three separate pictures are sent, one Red, one Green and one Blue. These three pictures are stored at the receiving end in large digital memories and then displayed simultaneously to produce a colour picture. At the moment memories are expensive, so not many SSTV stations are equipped for colour. It also takes in excess of seven seconds to send one SSTV picture; multiply this by three for colour and it becomes very time consuming. Future development will only improve things and the next few years will bring many improvements to SSTV.

SSTV originally was devised as an AM system, but it soon became apparent that greater immunity to interference was obtained with an FM system and the parameters of the system now in use are shown in Table 1. It will be noted that the American 60Hz mains gives a longer duration for line and frame and pictures from these areas merely appear somewhat larger on the monitor screen, conversely they will see our pictures smaller than usual. The number of lines per picture was originally set at 120, but there is a growing tendency to use 128 as this division ratio can easily be obtained by binary dividers. Whatever picture is received, the line and frame amplitude controls should be adjusted to give 1:1 aspect ratio.

	50Hz Mains	60Hz Mains
Line Frequency	50÷3 ie 16.666Hz	60÷4 ie 15Hz
Duration of Lines	60ms	66.666ms
No. of lines in picture	128 ± 8	128 ± 8
Duration of picture	7.2 s. to 7.68 s	8 s to 8.533s
Line sync pulse	5 ms	5 ms
Frame sync pulse	30 ms	30 ms
Sync frequency	1200 Hz	1200 Hz
Black frequency	1500 Hz	1500 Hz
White frequency	2300 Hz	2300 Hz

Handbook One described a callsign generator that would work on either SSTV or fast scan television with only a few minor component changes required to change its operating standard.

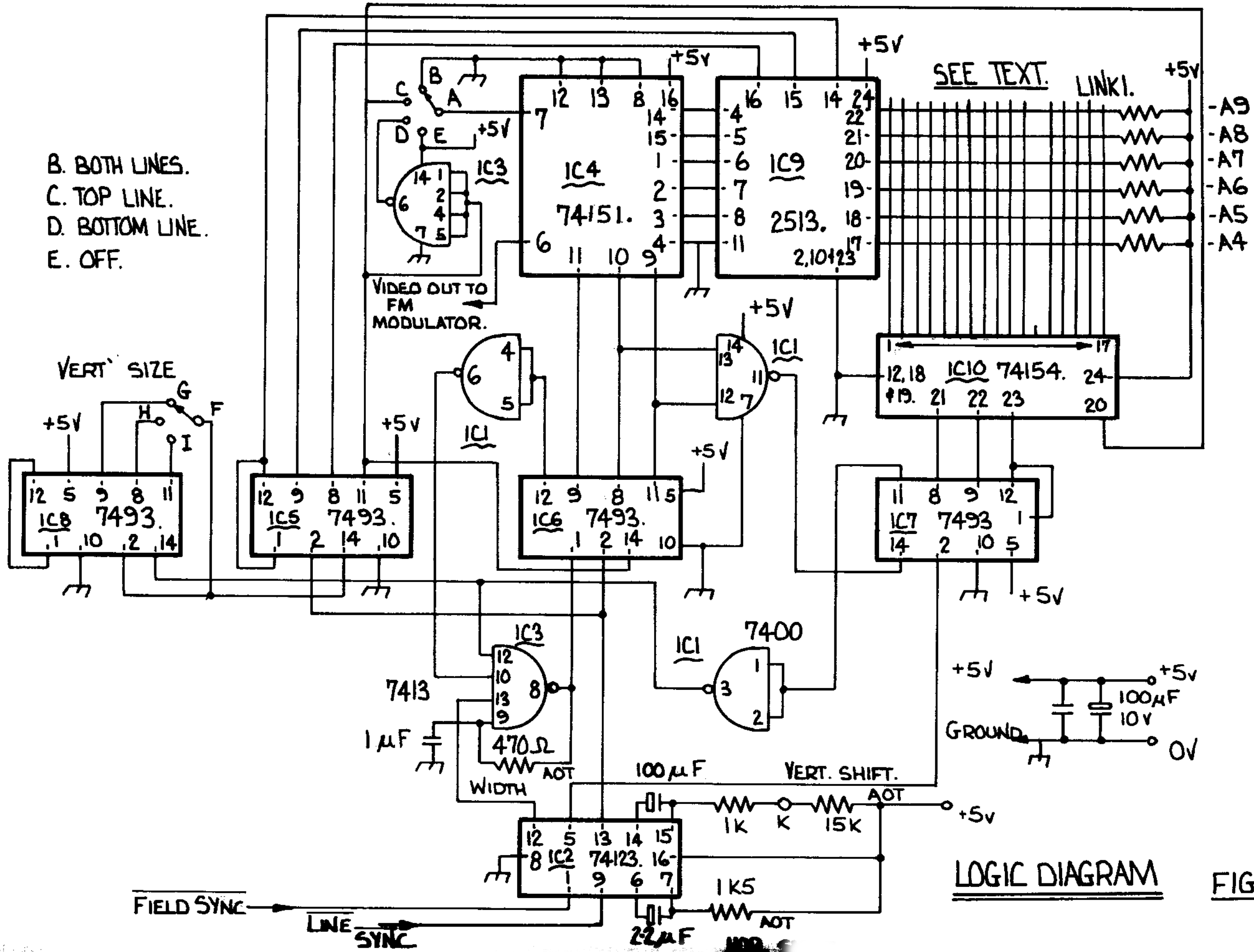
The circuit was drawn with fast scan configuration and no FM modulator was shown for SSTV nor was an SSTV version PCB available. This chapter provides this information.

Fig.1 shows the circuit diagram of the logic required to generate the characters. It is built around a 2513 character generator chip. This chip has been around quite a few years now. In the early stages of its development, it required very complex power rails, but the modern one now requires only +5 volts.

Note that General Instruments have only ever made +5 volt versions.

The 2513 is driven by a master clock and numerous counters that set the size and format of the print. The format chosen is 16 characters, in two rows of eight.

The final data leaves the 2513 as a 5 bit parallel word to a 74151 data selector where it is converted to serial data representing



LOGIC DIAGRAM

FIG. 1.

the characters.

(See Handbook One for a detailed explanation of the Logic).

This digital signal now needs processing into the audio tones that make up an SSTV signal. Fig.2 shows how to do this.

The 741 is configured as an audio oscillator with the 4K7 resistor between Pins 6 and 3 providing the necessary positive feedback to make the stage oscillate. This configuration has very good stability. The oscillators frequency is independant of supply fluctuations.

The frequency is set by the 3K9 resistor, the 68nF capacitor and whichever capacitor is in parallel with the 68nF at the time, depending on which BC109 is switched on.

The logic is arranged so that inverted syncs are fed to the first BC109 so that it conducts during sync only. This causes the oscillator time constants to be 3K9, 68nF and 82nF which should make the oscillator frequency equal to 1200Hz.

The sync signal also disables the video path to stop any characters finding their way into the syncs.

The video logic is such that peak white is a Logic '0' and black a Logic '1'. During active picture the first BC109 switches off. If a Logic '1' is present on the video input, then the second BC109 will switch on making the oscillator time constants 3K9, 68nF and 47nF which should make the oscillator run at 1500Hz.

When characters are present, the video input will be at Logic '0'. This state means neither BC109 will be turned on resulting in a frequency set by 3K9 and 68nF which should be 2300Hz.

The output level is reduced to microphone level by the 47K and 470 ohm resistor while the 0.1 capacitor provides some degree of waveform shaping.

The input to the 2513 has provision for a diode matrix for hard wiring the Character Generator with your callsign etc. If you would like to use this instead of the keyboard add on, then you will need to refer to the programming chart. The symbol X denotes that a diode is required in that position in the matrix.

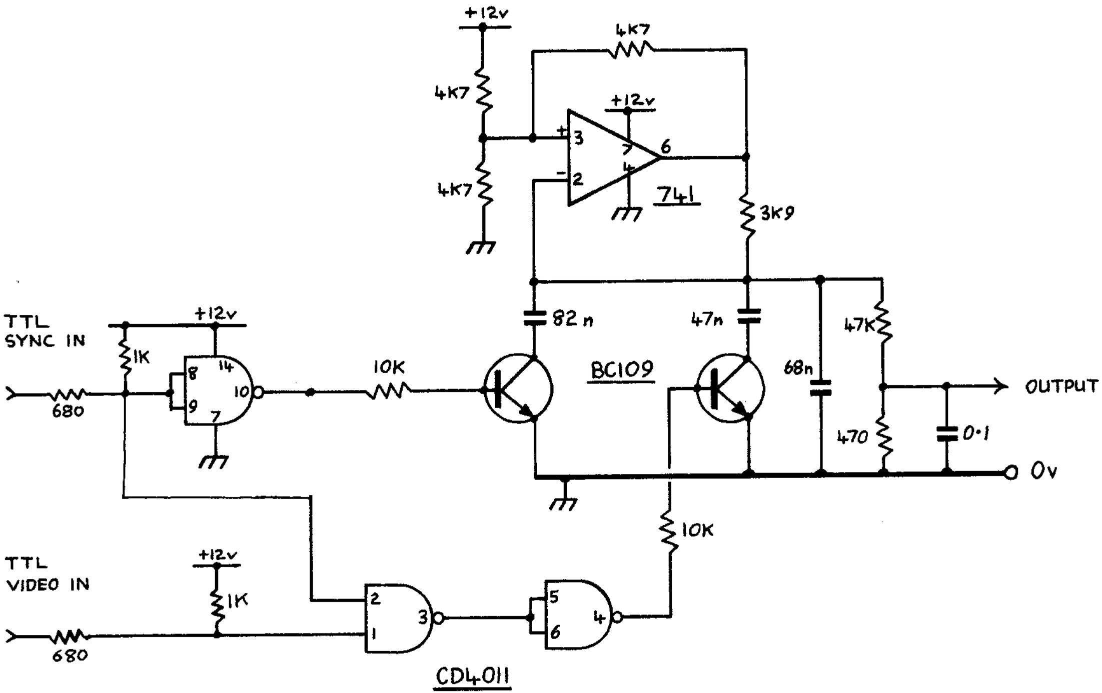

+12v
4K7
4K7
4K7
+12v
3
2
7
4
6
741
3K9
TTL
SYNC IN
680
1K
+12v
8
9
14
10
7
10K
82 n
BC109
47n
68n
47K
470
0·1
OUTPUT
0v
10K
TTL
VIDEO IN
+12v
1K
680
2
1
3
5
6
4
CD4011

FIG. 2

PROGRAMMING

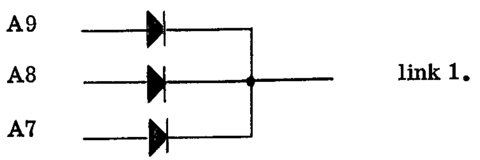
To choose each individual character a simple diode array is required which will connect the A4 to A9 inputs of IC9 to the binary-to-hexadecimal chip IC10. At the input of IC10 is a four bit code which changes every time a different character is output. The output of IC10 has 16 pins each of which goes low in turn as a different character is required.

The inputs of IC9 are pulled high by the 100K pull-up resistors so that the code input to IC9 with no diodes in circuit is 1 1 1 1 1 1 and produces the '?' symbol. A diode between an IC9 input and an IC10 output will cause one of the logic 1 states to be replaced by a logic 0.

If the printed circuit board matrix is being used, the inputs of IC9 are brought out to a six bit address bus which runs along the top of the printed circuit board. The outputs from IC10 are brought out on links, the link at the end of the address bus, i.e. that furthest from IC9, corresponds to the first letter.

The programme chart shows the placing of diodes to create any character in the case of 'G', for example, there is an 'X' in the first three columns, 'X' means that a diode is required so the A9, A8 and A7 inputs require diodes, whilst A6, A5 and A4 are left blank. The bus nearest the top edge of the printed circuit board is A9 and is represented by the first column in the programming chart.

The diodes are wired with the anode to the data bus and the cathode connected to the link corresponding to their position, i.e. if the first letter of the top line is the letter 'G', then diodes connect from A9, A8 and A7 to link 1.



If the character required is a blank space, then five diodes are needed, this is a small problem when working with this kind of code, but it does represent a considerable economy in diodes over the earlier X-Y matrix type of character generators.

One final point on plug-in matrix boards. The ASCII address bus is already brought out to the edge connector because it is required to interconnect to the keyboard module so all that is required to remote the matrix (so that plug-in programme modules are possible) is that the programme links be wired to the edge connector. If you decide to do this, you should use pins 7 through to 11 and 22 through to 32 with the link nearest the edge connector going to pin 7. This will keep all modules compatible with each other and not cause any problems later when adding the keyboard module.

<u>PROGRAMMING CHART</u>

CHARACTER	A9	A8	A7	A6	A5	A4
A	X	X	X	X	X	
B	X	X	X	X		X
C	X	X	X	X		
D	X	X	X		X	X
E	X	X	X		X	
F	X	X	X			X
G	X	X	X			
H	X	X		X	X	X
I	X	X		X	X	
J	X	X		X		X
K	X	X		X		
L	X	X			X	X
M	X	X			X	
N	X	X				X
O	X	X				
P	X		X	X	X	X
Q	X		X	X	X	
R	X		X	X		X
S	X		X	X		
T	X		X		X	X
U	X		X		X	
V	X		X			X
W	X		X			
X	X			X	X	X
Y	X			X	X	
Z	X			X		X
BLANK		X	X	X	X	X
0			X	X	X	X
1			X	X	X	
2			X	X		X
3			X	X		
4			X		X	X
5			X		X	
6			X			X
7			X			
8				X	X	X
9				X	X	

'X' denotes that a diode is required.

Card module

SLOW SCAN SYNC PULSES

By Clifford Brownbridge G6BIN.

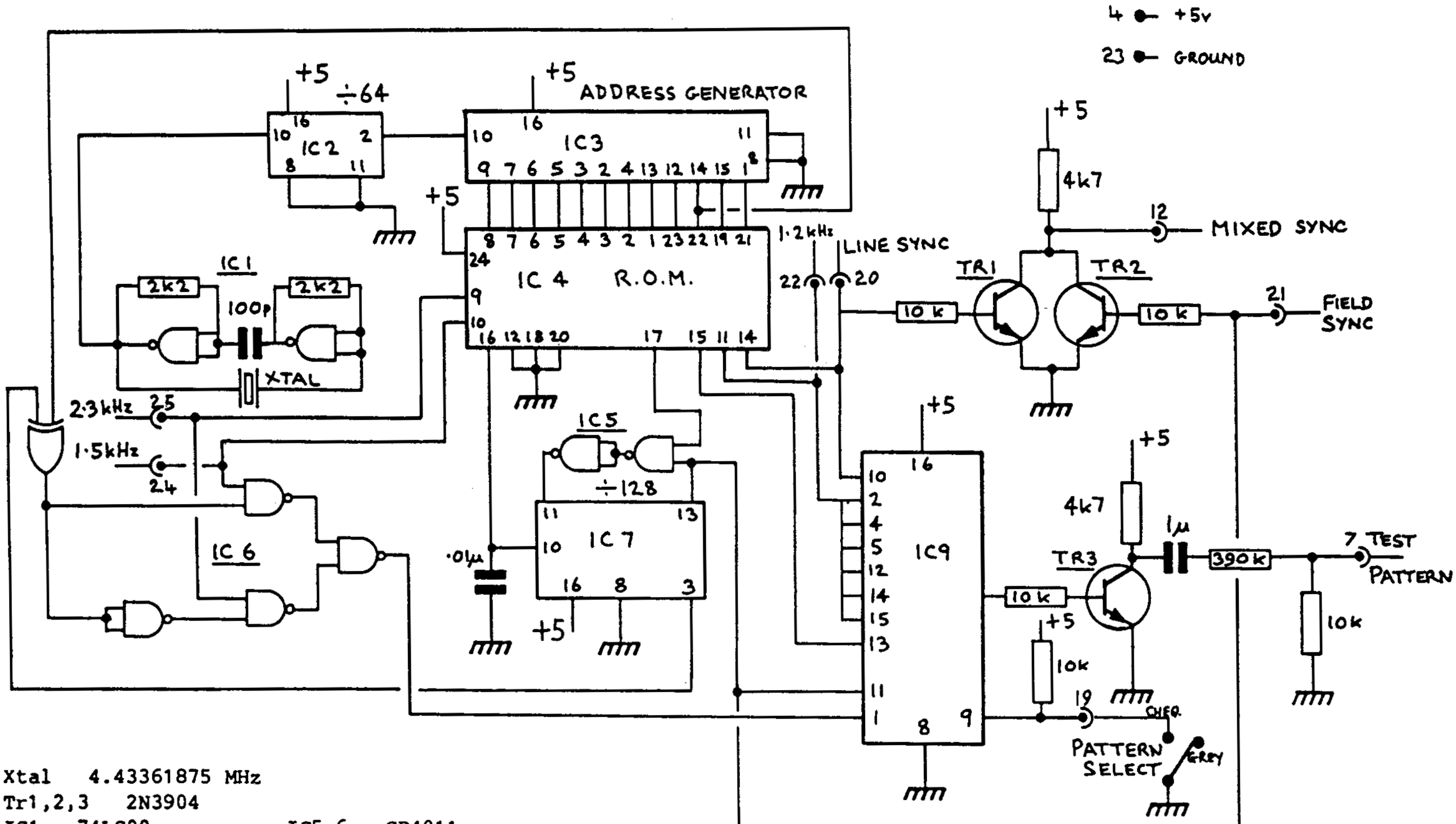
A good stable source of sync pulses is a prime requirement of any TV station whether it operates on slow or fast scan. In the early days the technique employed by slow scan pulse generators was to divide down from a mains locked source. The approach pioneered by G8CGK in which a 276KHz master oscillator was used to provide not only pulses, but 2300Hz, 1500Hz and 1200Hz frequency standards, was a major step in the right direction. This generator takes that technique one step further and increases the frequency of the master oscillator, and xtal locks it. This would normally escalate the number of counters required. Use of the larger Cmos counters can keep the chip count down to a reasonable proportion. The CD4040 12 bit counter being ideal. The use of a programmable read only memory to decode all the necessary counts also leads to reductions in logic while at the same time enabling two test waveforms to be generated. These two waveforms are grey-scale and chequer-board. They are both generated directly as FM signals so as to be independent of the oscillator unit (Fig.2), thus providing very useful signals of guaranteed frequency accuracy.

The choice of master oscillator frequency was such that xtals should easily be available and at a reasonable price, without adding complications to circuit design. The Eprom requires its address counter clocking every 15 micro seconds, if this is multipled by 64, the result is the frequency of PAL Subcarrier i.e. 4.43MHz. As every colour TV set in the UK employs a xtal of this frequency, then they are bound to be cheap and plentiful for many years to come. To people in non PAL countries, sorry, but 3.5795 just does not work out the same.

Dividing by 64 is a very easy exercise for a binary stage counter, i.e. using its QF to reset the counter.

The line period of slow scan (60ms) is split into 4096 time domains, this number being the number of addresses in a 2732 EPROM. This makes each time domain 15 micro seconds approx. A way of generating this repetition rate was sought and proved to be PAL SUB CARRIER divided by 64, approx.

The 8 O/PS from the EPROM are all independently programmed.



Xtal	4.43361875 MHz		
Tr1,2,3	2N3904		
IC1	74LS00	IC5,6	CD4011
IC2,3,7	CD4040	IC8	CD4070
IC4	2732 PROM	IC9	CD4051

SSTV SYNC GENERATOR MODIFIED CIRCUIT

Three of them generate White, Black and sync frequencies directly with slight liberties being taken to syncronize with start of line timing. A fourth output gives a grey scale which is 8 different frequencies in the range 2.3KHz to 1.5KHz for 1/8 of line period each, approx. A fifth output gives a pulse 5 milli seconds in length at the start of line, i.e. line sync. A sixth output gives a short pulse to step on the line counter. A seventh output gives a 30 milli second neg. pulse to reset any other external circuitry (not used). The eighth output is timed to occur ½ way through line so when the line counter reaches 128 it O/PS a frame pulse which is reset ½ line later, i.e. 30 milli seconds.

By picking up two of the counter inputs, a chequer-board signal can be produced using the exclusive OR chip.

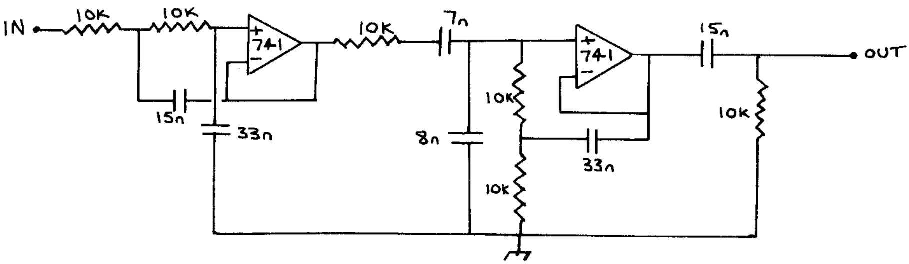
All these signals are then applied to the CD4051 DATA SELECTOR to generate composite grey-scale or chequer-board. This signal can go direct to the microphone input of the transmitter, or cassette recorder.

The line and field sync waveforms are such that they assume logic 1 during sync. They are both inverted and added together in TR1 and TR2 to provide mixed sync which is active low or logic 0 during sync. This signal can then be processed directly by the FM modulator section of the character generator (Fig.2).

It is always good S.S.T.V. practice to pass all signals through a band pass filter prior to transmission, Fig.4 shows such a circuit using operational amplifiers the gain is unity.

Remember, the 2732 is a pre-programmed chip and must be bought with the appropriate programme in it from B.A.T.C. Members Services.

FIG. 4



CHAPTER 2

SOFT OPTION

BY TREVOR BROWN G8CJS

Soft Option is an electronic character generator capable of superimposing 32 characters or graphic blocks on any picture without the need for sync pulses or other external equipment. Characters and graphics are stored in a 2716 EPROM which gives a certain amount of freedom to customise the character and graphics by writing and blowing their own PROM. There is however available a BATC standard EPROM. A printed circuit card is also available for this project which encompasses the circuitry of figs 1, 2, and 3. Fig 4 shows one suggestion for a simple keyboard which could easily be put together on veroboard, or alternatively a standard ASCII keyboard could be used to drive the generator direct. This new design of character generator is loosely based on the very popular handbook 1 circuit, only the diode matrix option has been omitted and the number of characters increased to 32. The superimposition port is of a much higher standard and graphics have been added.

Fig 1 shows the input output port where syncs are stripped from the video and fed to the character generator for use as a locking reference. IC1, a CD4066, is used to switch between video characters and a preset level of brightness set by RV1. This keys the characters into the picture rather than sitting them upon the picture as in previous designs. The port will work well with colour pictures but the two 47pf capacitors require reducing in value or removing as they form part of a rather steep video filter which restricts video bandwidth.

Fig 2 shows the character generator circuitry IC3 is used to separate field pulses from line pulses by detecting their longer duration. The latter part of IC3 (dual monostable) sets the frame position of the characters ie the 47K and 0.1 UF may require their values adjusting if the characters do not occupy the frame position required. IC4 is a dual 4 bit counter wired as a single 8 bit counter to function as the row address generator. The row count controls the address lines of the 2716 character PROM, thus ensuring that the correct character row is presented to the video port at the correct time. IC9 is the line start delay, and positions the characters in the middle of a line scan. Again to alter the position of the characters adjust the 1K5, 10nF time constants. IC8 is the line locked clock which increments IC10 to provide column addresses. There is a time problem in changing the PROM address lines because of the number of columns, ie 8 times 16 times TV line (in this case). The traditional way around this problem has been adopted in that all the columns for a single character are presented at once by the PROM, IC6, a data selector is used to scan the columns in time with the TV raster. When the first 8 columns have been scanned and the characters displayed then IC10's most significant bits are used to address the next location in RAM memory and bring on line the next character to be displayed.

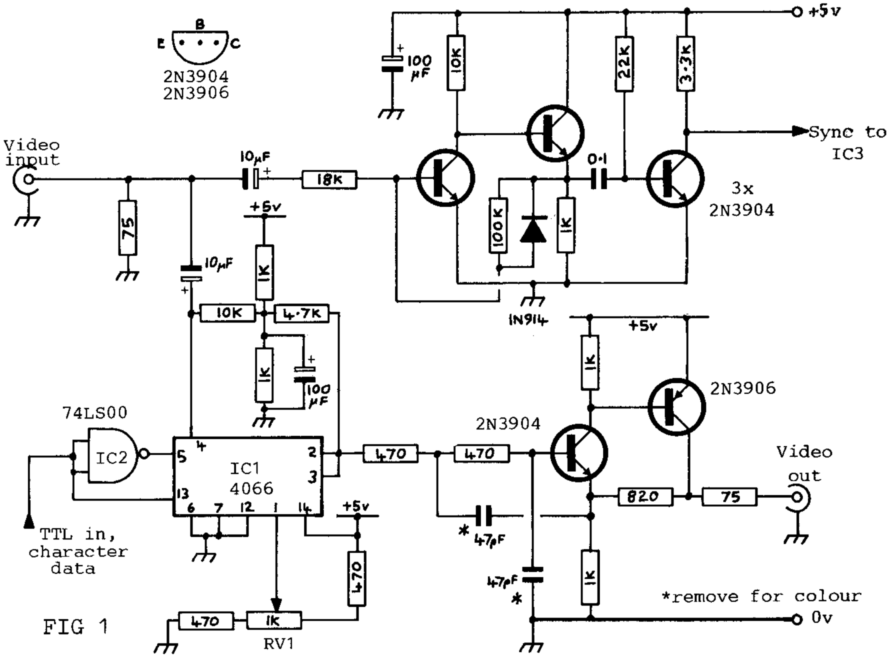


FIG 1

VIDEO INPUT AND SYNC SEPARATOR

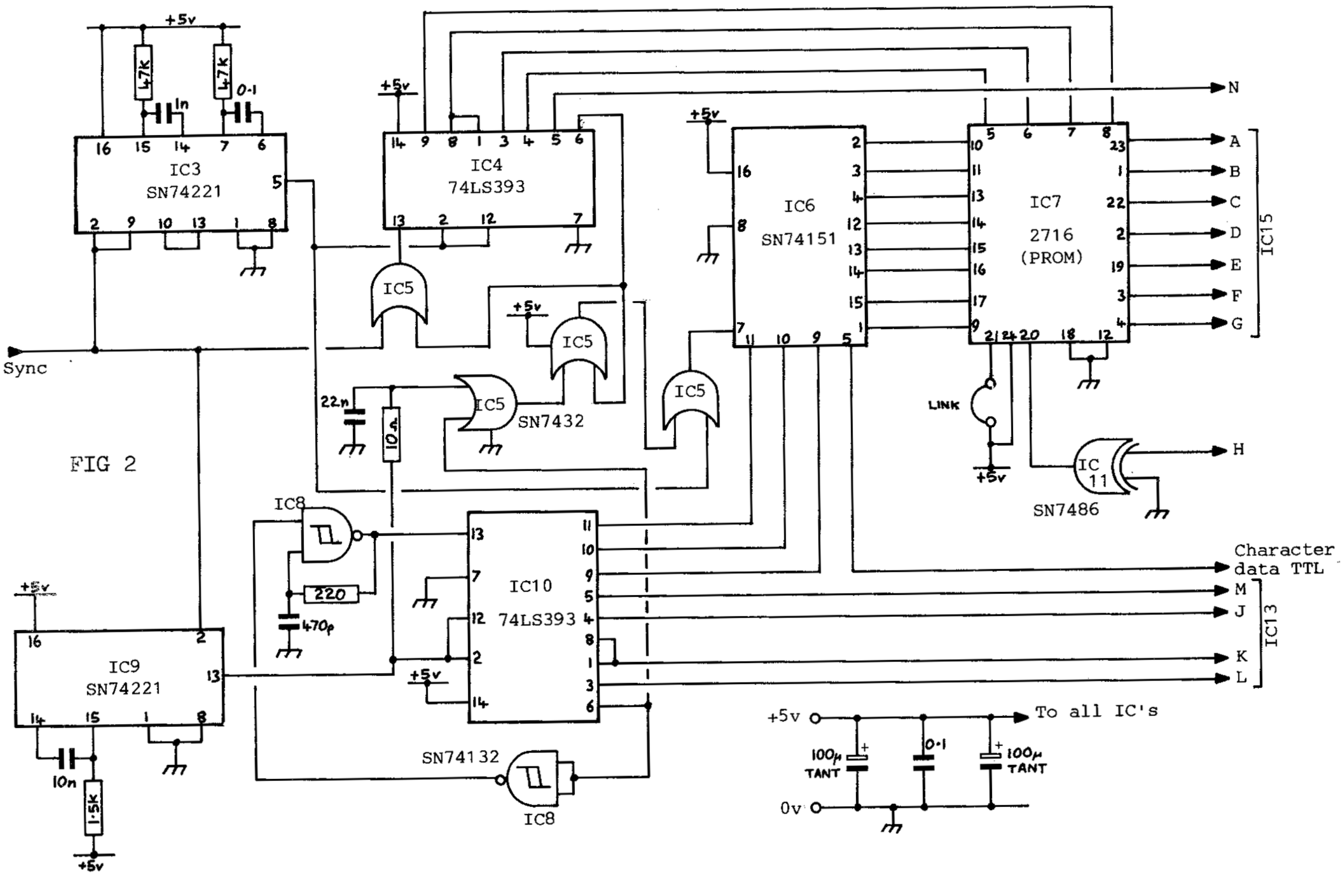


FIG 2

COUNTERS AND CHARACTER GENERATOR

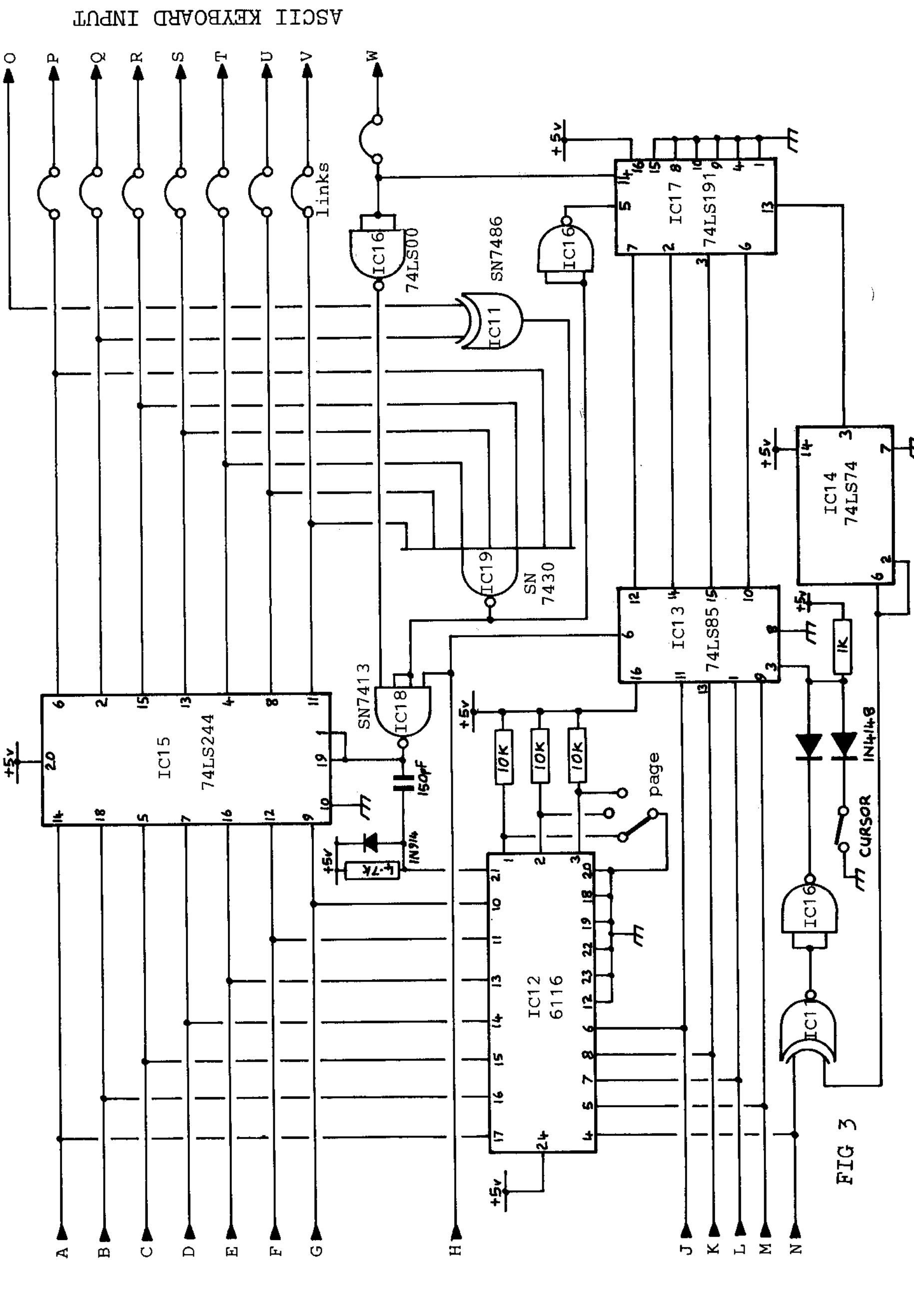
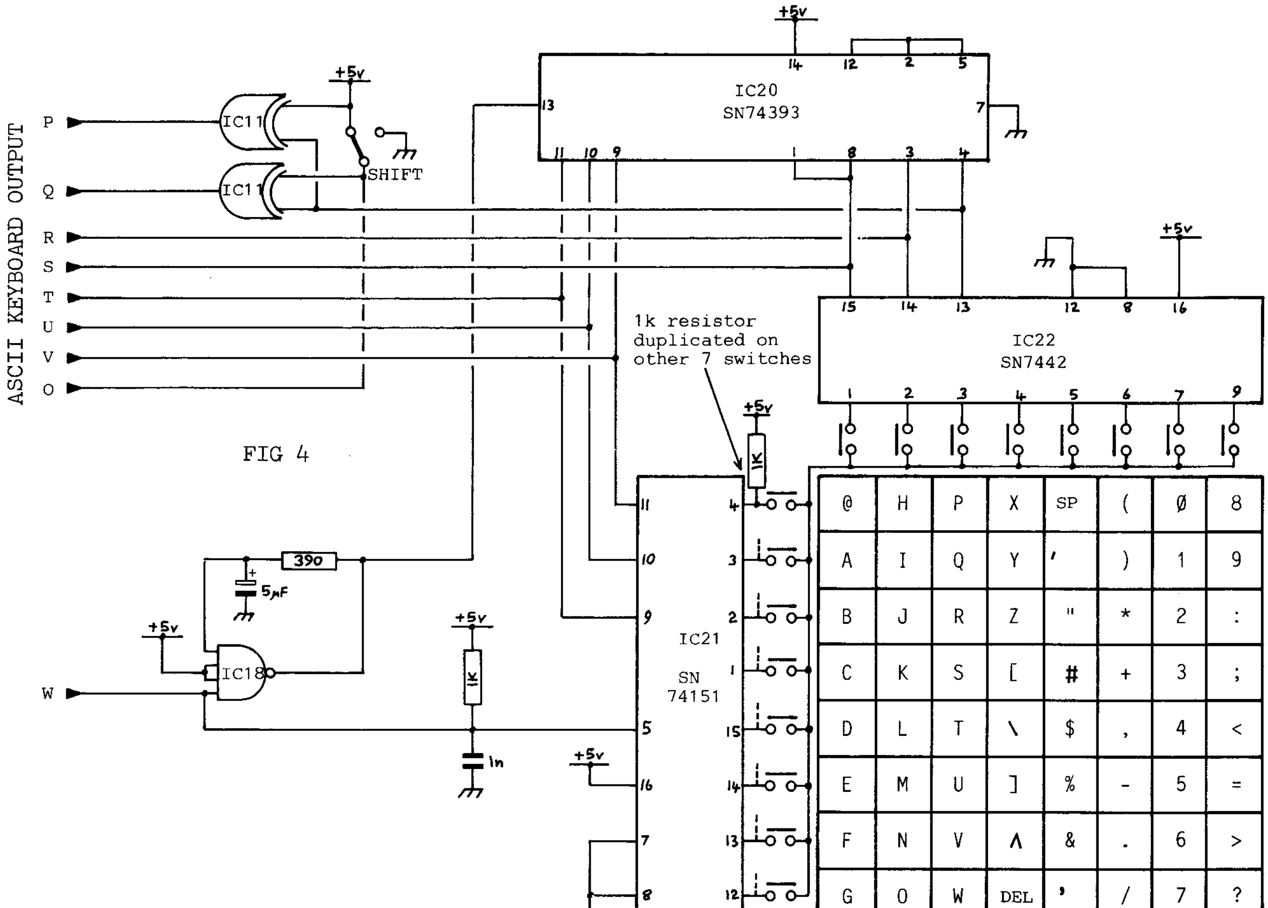


FIG 3

MEMORY AND CURSOR GENERATION



ASCII KEYBOARD CIRCUIT

IC5 controls the resets of the counters and blanking of the characters while various counters are reset, all the blanking between the characters is within the PROM thus it can be dispensed with in the graphic mode in order to join bits together to create large graphics.

Fig 3 shows the memory and cursor circuitry. The 5 most significant address lines of IC10 bring different locations in IC12 onto the data bus (A to G). In each of these locations is stored the PROM address for the character required.

To load each location the memory address into which it is required to write must be selected. Put the PROM data for this selected character onto the data bus and generate a write command. This is done in the following manner. Connections P to W carry keyboard data, W being the stobe pulse. The strobe pulse is used to advance IC17, a four bit counter (cursor position). When the counter overflows, IC4 is toggled to indicate a change of text line. When the code generated by IC 17 and IC 4 (5 bit) is the same as the 32 location address supplied by the character generator, then IC13 (magnitude comparator) goes high at Pin 6. This disables the PROM and causes a white square (cursor display) at the write location. The 'and' gate IC18 is also enabled by the strobe so should this occur a write pulse will be generated. The output of IC18 also takes IC15 out of tristate and puts the keyboard on the data bus, thus the memory stores the keyboard data. The cursor switch inhibits the comparator at IC13 thus removing the cursor display and write inhibiting the memory.

If the keyboard is outputting the code 7F at the moment the strobe is generated then IC19 will inhibit the write pulse and reverse the direction IC 17 counts ie it will be down instead of up. This is the backspace function. The 6116 is an 8 bit memory which is CMOS and has a very low power consumption. Pins 1, 2, and 3 are spare address lines suitable for a page switch a three position rotary switch is shown, alternatively a decade switch could be used giving 8 memory pages. The CMOS RAM could be easily backed up on Pin 24 by a small series diode and a rechargeable battery for retention of data.

Keyboards have always presented the constructor with problems. Fig 4 shows a simple keyboard for use with this generator. Provision is not made for it on the PCB so vero construction is recommended. The vero board should be mounted in a box and the 16 push buttons mounted on the lid in an L shape as per the circuit diagram. The "lookup table" should be inscribed inside the L also as fig 4. To operate, locate the character on the logo trace its X and Y co-ordinates to two pushbuttons and press both together.

To enter the graphics mode simply operate the switch S1. If the standard PROM is fitted, then try the following:-

! " £ $ % & '	should be a car (mobile !!)
) (* -	BATC LOGO
0 1 2 3 4 5 6 7 8 9 : ;	Union Jack

There are a lot more, which the operator can explore.

If this card is to be used to drive the colourizer module found elsewhere in this book, then the video input requires a feed of mixed sync from SG, 17 and connection ** should be wired to CZ 9.

Another solution to the keyboard problem is to use a home computer to control the character generator by doubling as a keyboard. Fig 5 shows the circuit of a suitable interface that could be used to connect the rear socket of a sinclair Spectrum to the charactor generator. The following basic programe should then be loaded into the computer and RUN in the normal way.

```
10 PAUSE 0
20 LET a$=INKEY$
30 LET b=CODE a$
40 IF  b=0 THEN GOTO 10
60 IF  b=12 THEN OUT 127,127:GOTO 10
80 OUT 127,b
90 PAUSE 10
100 GOTO 10
```

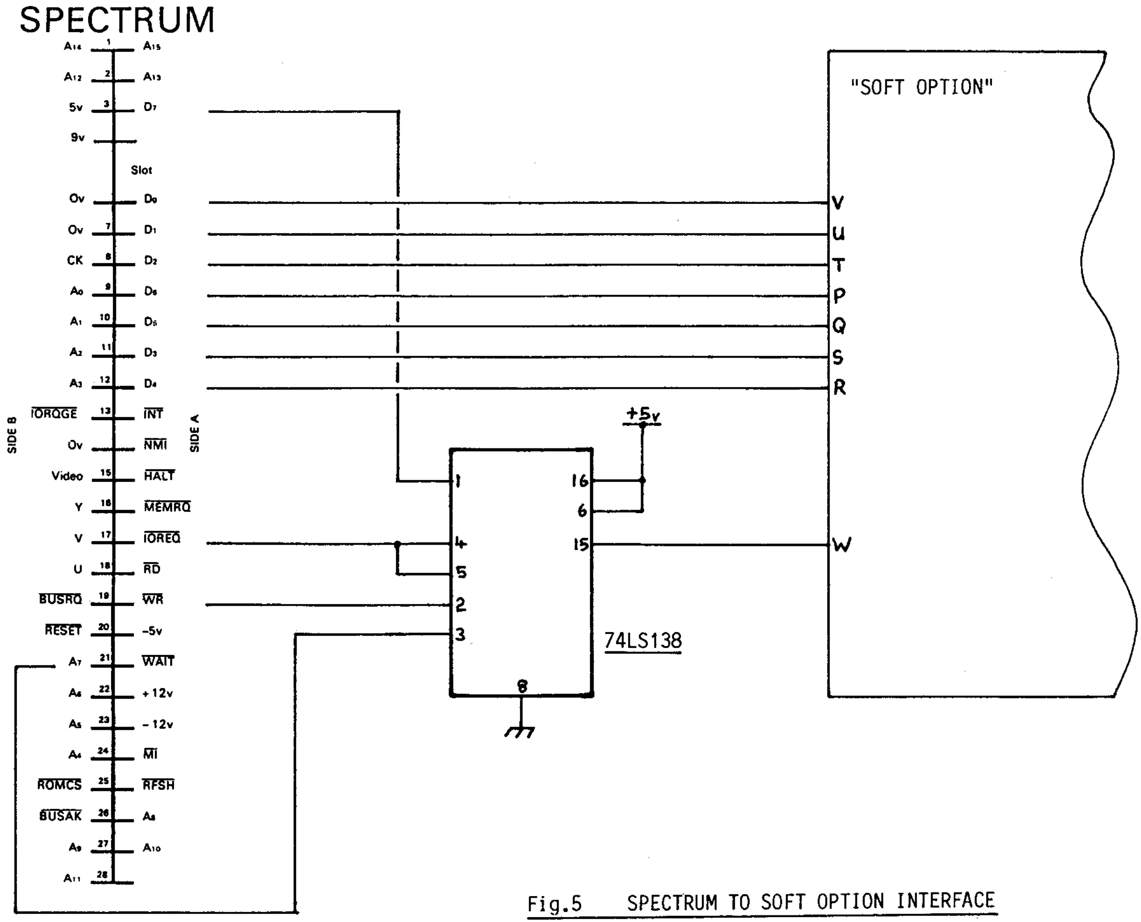


Fig.5 SPECTRUM TO SOFT OPTION INTERFACE

DESIGNING A SOFT OPTION PROM

BY TREVOR BROWN G8CJS

There are 128 characters stored in the 2716 EPROM, each character occupies 16 Bytes of memory, so writing a EPROM is no small task. The first stop is to design the character/graphics on graph paper working on an 8 by 16 matrix for each character. Remember to include blanking around the character unless you want it joining the adjacent character or the character above or below. The effect of omitting blanking in order to join characters together is useful for large graphics. When you have designed a character on graph paper is is necessary to reduce the design to 16 small sums in order to fit them into the 16 bytes of eprom that each character occupies. We do this by putting the numbers 8,4,2,1,8,4,2,1 under the 8 columns of the newly designed character.

```
        . . . . . . . .      00
        . . . . . . . .      00
        . . . . . . . .      00
        . . . . . . . .      00
        . * * * * * . .      C7
        . * . . . . . .      04
        . * * * * . . .      B7
        . . . . . * . .      40
        . . . . . * . .      40
        . * . . . * . .      44
        . . * * * . . .      B3
        . . . . . . . .      00
        . . . . . . . .      00
        . . . . . . . .      00
        . . . . . . . .      00
        . . . . . . . .      00

FIG 1   8 4 2 1 8 4 2 1
```

The 16 sums are made up of one row at a time by adding together the numbers at the bottom of the 4 right hand columns, but only where there is a * .By repeating the process for the 4 left hand columns you will end up with two numbers. Repeat the process for all 16 character rows and you will end up with 16 pairs of digits. Just one problem - the answer to the sum should be in hex, this does not effect numbers 1 to 9 but 10 should be written as A, 11 as B, 12 as C, 13 as D, 14 as E, and 15 as F. The sum in hex after each row is indicated in the example above. Try decoding the numbers

00,00,00,00,C1,02,04,B7,44,44,B3,00,00,00,00,00

just for practice.

Having mastered writing the EPROM data it must be decided how to locate it, ie at which address the data should be stored. This depends on which keyboard key you wish to use or retrieve the character.

First list of 128 numbers shown in FIG 2 in a single column and in numerical order in the following manner.

00
01
02
03
04
05
06
07
08

FIG 2

7C
7D
7E
7F

When you have 128 locations you can fill in the EPROM data, let us locate the example at 35, it will appear then:-

34
35 00 00 00 00 C7 04 87 40 40 44 83 00 00 00 00
36

FIG 3 shows the layout of EPROM addresses generated by the simple keyboard. If you use 'SOFT OPTION' with a commercial keyboard then make sure it is A S C I I. FIG 4 will show you which keys correspond to which EPROM addresses so that you can arrange that the correct key summonds up the correct character.

"SOFT OPTION" will not obey the ASCII COMMANDS, ie. SOH, ETX etc with the exception of DEL so here (along with lower case letters which you probably will not need) is an excellent place to put your custom graphics. By now the BATC custom EPROM will be looking good value.

FIG 3

40	48	50	58	20	28	30	38
41	49	51	59	21	29	31	39
42	4A	52	5A	22	2A	32	3A
43	4B	53	5B	23	2B	33	3B
44	4C	54	5C	24	2C	34	3C
45	4D	55	5D	25	2D	35	3D
46	4E	56	5E	26	2E	36	3E
47	4F	57	5F	27	2F	37	3F

KEYBOARD CHARACTER MODE

60	68	70	78	00	08	10	18
61	69	71	79	01	09	11	19
62	6A	72	7A	02	0A	12	1A
63	6B	73	7B	03	0B	13	1B
64	6C	74	7C	04	0C	14	1C
65	6D	75	7D	05	0D	14	1D
66	6E	76	7E	06	0E	16	1E
67	6F	77	7F	07	0F	17	1F

KEYBOARD GRAPHICS MODE

Character / ASCII Code Table: ASCII (Without Parity)

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CH	SO	SI
1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
2	SP	'	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	∧	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	¦	}	~	DEL

CHARACTER/ASCII CODE TABLE FIG 4

EXAMPLES A is 41 carriage return is OD

-Computer Aided PROM Design;

It is possible to use a home computer as a design aid when writing a PROM blow chart. The following 2 programmes are written to run on a SPECTRUM, and BBC/ELECTRON respectively. The result being a 8 by 16 matrix displayed on the screen which can be inked in by guiding the cursor around the matrix with the cursor keys in the case of the SPECTRUM, and Z,X,/,:, for the BBC.ENTER and ZERO to ink in and delete on the SPECTRUM and RETURN and DELETE on the BBC. To restart the SPECTRUM use SYMBOL SHIFT and A, and to restart the BBC press ESCAPE. Both programmes also display the HEX sum appropriate to the character displayed in the matrix which should be copied down onto the programme chart in the position appropriate to the keyboard key.

SPECTRUM

```
 10 REM By R. Stephens G8XEU
 20 CLS : PRINT AT 0,5;"CHARACTER DESIGNER"
 30 FOR F=3 TO 18
 40 PRINT AT F,5;"++++++++";AT F,20;"00"
 50 NEXT F: LET X=5: LET Y=3
100 PRINT PAPER 9; INK 8;AT Y,X;"#"
110 PAUSE 0: LET A$=INKEY$
120 PRINT PAPER 9; INK 8;AT Y,X;"+"
130 IF A$="5" THEN LET X=X-(X>5)
140 IF A$="6" THEN LET Y=Y+(Y<18)
150 IF A$="7" THEN LET Y=Y-(Y>3)
160 IF A$="8" THEN LET X=X+(X<12)
170 IF A$=CHR$ 48 THEN PRINT AT Y,X;"#": GO TO 310
180 IF A$=CHR$ 226 THEN RUN
190 IF A$<>CHR$ 13 THEN GO TO 100
300 PRINT PAPER 0; INK 6;AT Y,X;" "
310 LET C=0: LET D=1
320 FOR F=12 TO 5 STEP -1
330 IF ATTR (Y,F)<>56 THEN LET C=C+D
340 LET D=D*2: NEXT F
350 LET E=INT (C/16): LET G=C-(E*16)
360 PRINT AT Y,20;CHR$ (G+48+7*(G>9));CHR$ (E+48+7*(E>9))
370 GO TO 110
```

BBC/ELECTRON

```
 10 MODE 6
 20 PRINT TAB(9,1);"CHARACTER DESIGNER"
 30 FOR F=3 TO 18
 40 PRINT TAB(9,F);"++++++++";TAB(24,F);"00"
 50 NEXT:ON ERROR RUN
 60 X=9:Y=3:DIM A(8,16)
 70 IF A(X-8,Y-2)=0 THEN PRINT TAB(X,Y);"#" ELSE PRINT TAB(X,Y);CHR$(111)
 80 A$=INKEY$(1):IF A$="" THEN 80
 90 IF A(X-8,Y-2)=0 THEN PRINT TAB(X,Y);"+" ELSE PRINT TAB(X,Y);"O"
100 IF A$="Z" AND X>9 THEN X=X-1
110 IF A$="X" AND X<16 THEN X=X+1
120 IF A$="/" AND Y<18 THEN Y=Y+1
130 IF A$=":" AND Y>3 THEN Y=Y-1
140 IF A$=CHR$(127) THEN A(X-8,Y-2)=0 :GOTO 170
150 IF A$<>CHR$(13) THEN 70
160 A(X-8,Y-2)=1
170 PRINT TAB(24,Y);
180 FOR G=0 TO 4 STEP 4
190 C=0:D=1
200 FOR F=8-G TO 5-G STEP -1
210 IF A(F,Y-2)=1 THEN C=C+D
220 D=D*2:NEXT: PRINT ;÷C;
230 NEXT:GOTO 70
```

DRAGON

```
 10 CLEAR 1000:DIM RC,(15,7):CLS:PRINT@6,"CHARACTER DESIGNER"
 20 PRINT@129,"ARROW KEYS CONTROL CURSOR":PRINT@289,"D DELETES CHARACTER"
 30 PRINT@193,"ENTER KEY ENTERS CHARACTER INTO MATRIX"
 40 PRINT@357,"HIT ENTER TO CONTINUE"
 50 G$=INKEY$:IF G$<>CHR$(13) THEN 50 ELSE CLS3
 60 FOR V=0 TO 480 STEP 32:PRINT@V,"++++++++";:PRINT TAB (12)"00";:NEXT
 70 PRINT@480,"#";:R=15:C=0:N=(R*32)+C
 75 FOR I=0TO9:POKE&H150+I,&HFF:NEXT:REM KEYBOARD REPEAT
 80 A$=INKEY$:IF A$="" THEN GOTO 75
 90 Y=R:X=C:L=N
100 IF A$=CHR$(94) AND R>0 THEN R=R-1
110 IF A$=CHR$(10) AND R<15 THEN R=R+1
120 IF A$=CHR$(8) AND C>0 THEN C=C-1
130 IF A$=CHR$(9) AND C>7 THEN C=C+1
140 N=(R*32)+C:IF N=L THEN GOTO 150 ELSE IF RC(R,C)=1 THEN PRINT@N,"O";ELSE
    PRINT@N,"#";
150 IF RC(Y,X)=1 THEN PRINT@L,"O";ELSE PRINT@L,"+";
160 IF A$=CHR$(13) THEN RC(R,C)=1:PRINT@N"O";
170 IF A$="D" THEN RC(R,C)=0:PRINT@N,"#";
180 FOR G=0 TO 4 STEP 4:B=0:D=1
190 FOR S=G+3 TO G STEP -1
200 IF RC(R,S)=1 THEN B=B+D
210 D=D*2:NEXT:PRINT@(R*32)+(13-(G/4)),HEX$(B);:NEXT:GOTO 75
```

The chart that has now been prepared is the EPROM programme chart and with the aid of an EPROM blower the desired informationa can be programmed into a 2716 EPROM. The BATC does not have the facilities to blow individual EPROMS at this stage but we would still like to hear of attempts to create new designs and perhaps revise the clubs' standard EPROM or provide alternative options based on your contributions.

Card module

CHARACTER COLOURIZER

OR COLOUR BAR GENERATOR

By Trevor Brown G8CJS.

The LM1889 TV Video Modulator has been around a while and it does have the ability to make coded P.A.L. or NTSC from colour difference signals. The LM1889 will also work with 4.4336MHz or 3.5795MHz subcarrier making it an ideal chip for providing a colour option for the Character Generator, or other digital vision sources.

The only problem left is to select how much R.G. or B is wanted on the screen at any one point. This is done by joining the three bits of each word input together, restricting us to 100% chroma. If a decade switch is used to drive the LM1886, it will give the following colours, dependent upon switch position.

0 - White
1 - Cyan
2 - Magenta
3 - Blue
4 - Yellow
5 - Green
6 - Red
7 - Black

A 74157 data selector switches between two such decade switches. This data selector is operated by character data so as to bring one decade switch on line during the characters and the other decade during background, thus giving separate control over the colour of the characters and background.

A further addition is to use the MSB of the background switch to switch another 74157 and bring on line a colour bar generator as a background. This corresponds to positions 8 and 9. The colour bar generator is made by using ½ of a 7413 as a clock oscillator which is made line synchronous by stopping it oscillating during mixed blanking. This clock is used to advance a 74193 4 bit counter. The other half of the 7413 is used to detect when the counter is full and stop the clock. Line sync is used to reset the counter and start the cycle all over again. If the three most significant bits of this counter are used as green, red and blue, then 100% colour bars result. These colour bars will be inverted i.e. the blue bar is on the left.

INPUT: - ground to use colourizer as a colour bar generator
or connect to pin 5 ic 6 on soft option
or connect to pin 5 ic 4 H/book 1 character gen
to colour characters and background

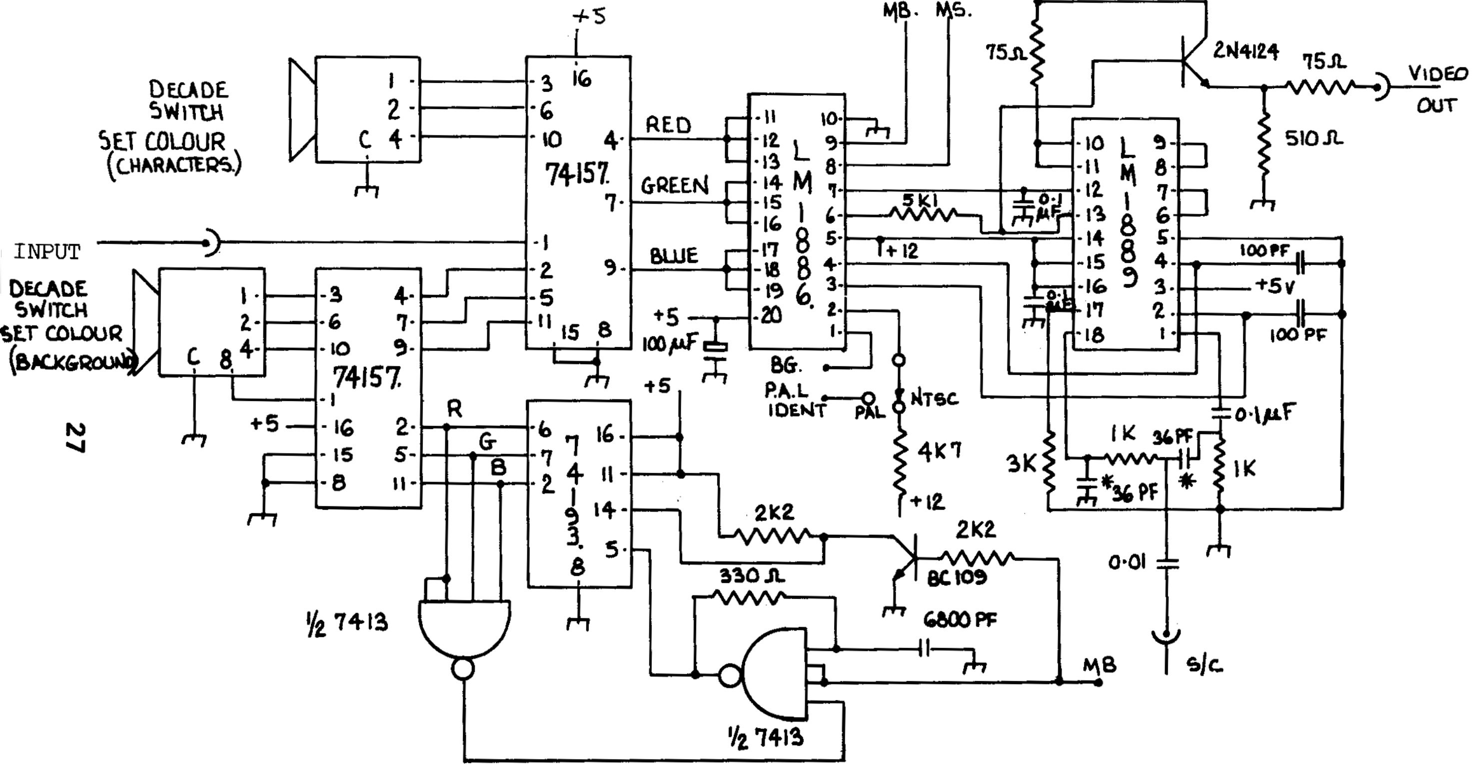


FIG. I

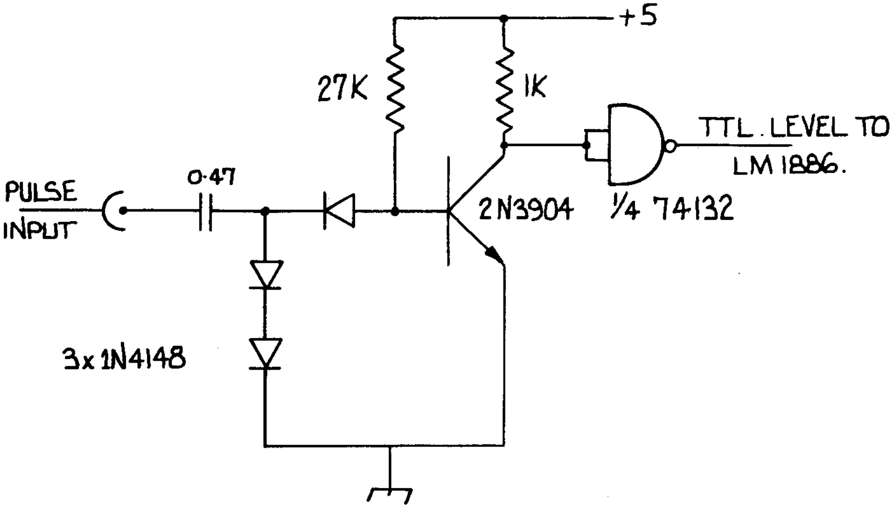

+5
27K
1K
TTL. LEVEL TO
LM 1886.
PULSE
INPUT
0·47
2N3904
1/4 74132
3x 1N4148

FIG. 2

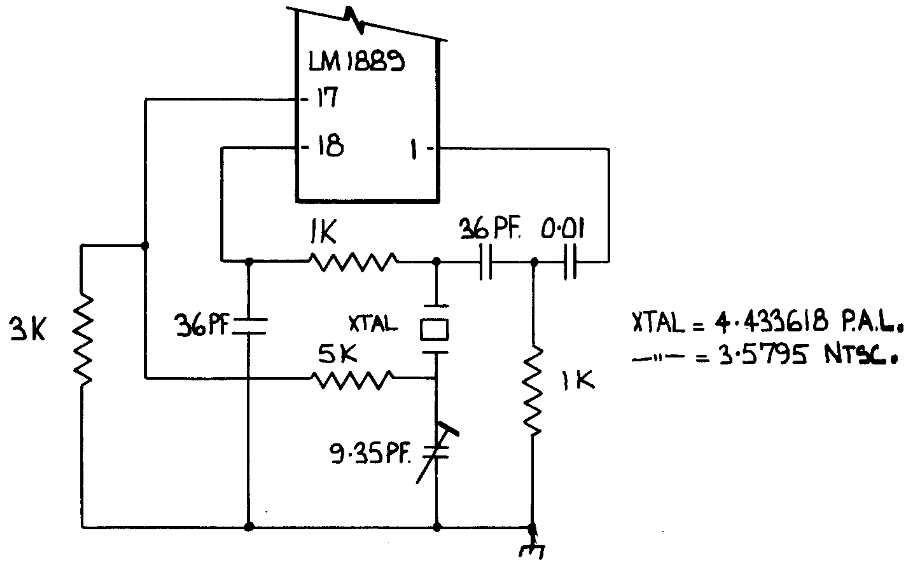

LM 1889
17
18
1
1K
36 PF.
0·01
3K
36 PF
XTAL
5K
1K
9·35 PF.
XTAL = 4·433618 P.A.L.
—"— = 3·5795 NTSC.

FIG. 3

This distinguishes them from the test bars available by making the test card in Handbook One. If they are to be the same as the test card colour bars, then replace the background 74157 with a 74158 they are pin compatible. If sockets are used when building the PCB, then the task of deciding which way round the colour bars are to be can be left until the end. If the colour bars finish before the end of line scan, then it is necessary to slow down the line locked oscillator. This is done by putting a small value capacitor in parallel with the 6800pF time constant on the input of the 7413 gate.

When the LM1889 is used with 3.5795MHz subcarrier, the two phase shift capacitors marked * require increasing in value to 43pF.

The mixed blanking, mixed sync, burst gate and P.A.L. switch inputs are all TTL level inputs and can be driven direct from the ZN134J and associated colour logic in Fig.4.

If a 2v pulse distribution system is preferred, then it will be necessary to add the pulse drive stages in Fig.2 to each pulse input.

The subcarrier input is designed to accept a level of one volt. In the absence of a subcarrier generator then it is possible to make the LM1889 generate its own subcarrier. Fig.3 shows how to do this.

A printed circuit board is available for this project. It is a card of ISEP rack standard as per the original character generator.

The printed circuit board is laid out along with the pulse drivers in Fig.2 so as to accept a 2v pulse distribution system and a feed of external subcarrier.

THE BRITISH AMATEUR TELEVISION CLUB

Card module

COLOUR SYNC PULSE GENERATOR

BY TREVOR BROWN G8CJS

This sync generator has been specially designed so as to provide all the pulses required for the video card projects in Handbooks 1 and 2. The pulses are engineered to a very high standard, while at the same time the component count has been kept low in order to accommodate all the circuitry on one single printed circuit card. This has meant using large scale intergration components such as the ZNA134J and VX03 oscillator, which was chosen for its high degree of stability. The generator is not "genlockable" in its present form, but it is hoped to add this feature later by addition of a piggy-back module.

This design features its own very high standard "on board" colour subcarrier oscillator. The syncs are locked to this subcarrier with the correct offsets in order to reduce subcarrier patterning on the picture. The colour burst is also blanked correctly in the vertical interval, not usually necessary given the high standard of decoder usually found in most modern tv receivers but problems can still be encountered when some equipment is genlocked to an incorrectly blanked source. The pulse levels at the printed circuit edge connector are of the 2 volt level, as used by all the other modules in BATC projects.

The heart of the circuit is the Ferranti ZNA 134J sync pulse generator chip, which uses a 2.5625 MHz oscillator to produce all the necessary pulses, excepting BURST GATE, and PAL IDENT. These two waveforms have to be derived by external circuitry. The chip is steered into subcarrier lock by generating an error signal and using it to control the frequency of the oscillator by means of varicap diodes. This error signal is generated by looking at the incoming subcarrier, ie 4.43361875 MHz and gating out one cycle every 25 Hz. This is done by IC1 which is fed with an even field pulse from the S P G chip. The resultant waveform is subcarrier with holes which change it's frequency to 4.43359375 MHz.

This modified subcarrier is divided by 5 in IC3 and then by 227 in IC4 so that the resultant frequency should be equal to 3.80625 KHz (H* divided by 4.) This waveform is then compared in IC5 with H* divided by 4 from the SPG chip (IC6 is wired as a divide by 4). The error signal from IC5 is applied to the varicap diodes which in turn controls the S P G oscillator and steps the generator into subcarrier lock.

The resulting subcarrier visible in any picture source locked to these pulses is visually cancelled by virtue of the phase change on alternate lines of picture and an upward crawl of subcarrier caused by the 25Hz offset ie the holes we generated using IC1. Both these timings were deemed to be advantageous by Dr. Bruch and were engineered into the PAL system. To judge for yourself, compare pictures generated by this sytem with pictures from a home Micro. As to date none of them have all the timings to produce true P A L.

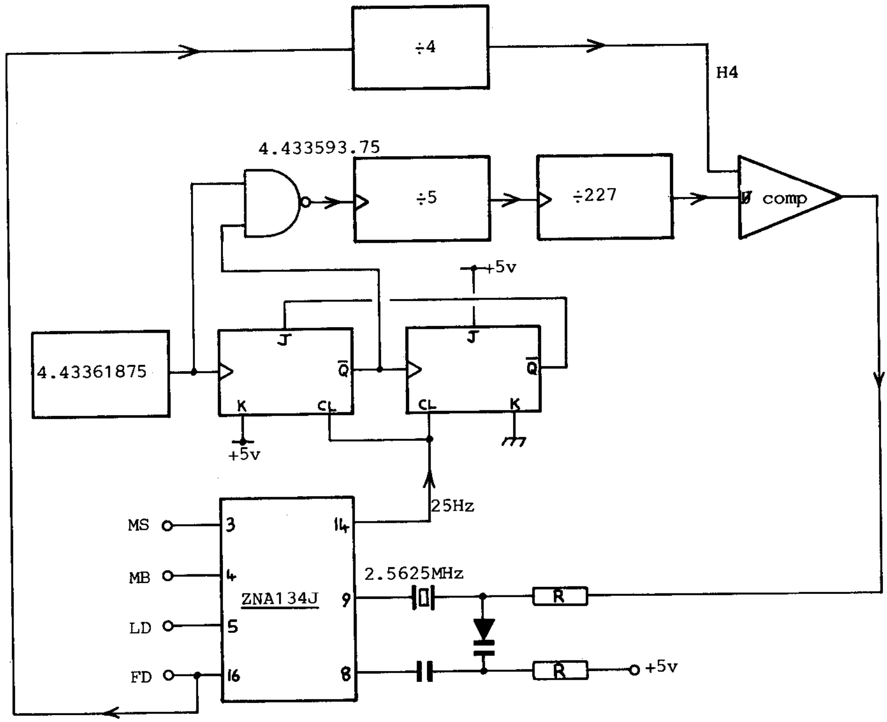


Fig.1. BLOCK DIAGRAM OF COLOUR LOCK SYSTEM

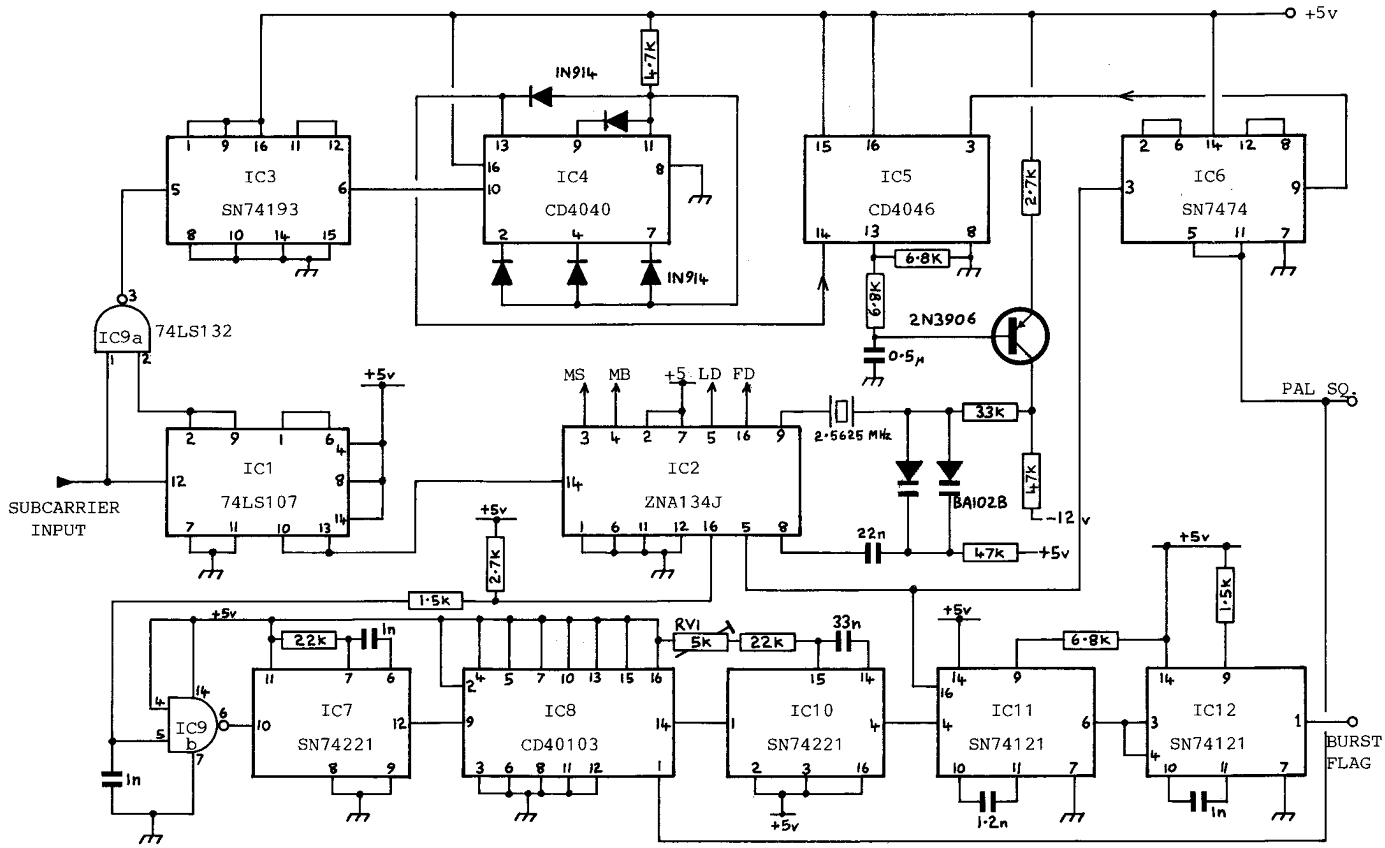
The ZNA134J is unfortunately only a monochrome SPG and as such does not generate PAL IDENT or BURST GATE. PAL IDENT, or PAL SQUAREWAVE as its sometimes called, is simply line drive divided by two. This is already available from IC6 and needs only buffering and bringing to the edge connector.

BURST GATE, or BURST FLAG as its sometimes called, is a little more complex. This defines the position of the colour burst. In its simplest form this waveform can be derived from a simple monostable delay fed from line drive to set the burst position, and then a further monostable to set the duration of the colour burst. These are both still present in the form of IC 11 IC 12. The complications come in the vertical interval, where the colour burst is blanked out. If field blanking is used then, because of the swinging burst, we can leave the last line on one phase of burst pass through the vertical interval, where no bursts are present, and commence the next field on a different phase of burst. This effect was thought to be bad practice by Dr. Bruch when he set about designing our PAL system. To overcome the effect, he put together a complex field blanking waveform, with a four field repetition rate, to remove the undesirable bursts that occur either side of some vertical intervals.

These bursts are removed by a 9H* duration monostable IC 10. The delay runs every 310 lines and is generated by IC 7 (divide by 2) and IC B (divide by 155). Providing everything starts off at the correct point then the burst should be blanked during the vertical interval in the way Dr. Bruch intended and achieve a very high standard of pulses.

TTL level sync pulses from ZNA134J and associated logic are each buffered by the circuit in FIG 3 in order to give the 2 volt level required into a 75ohm termination.

* H is equivalent to one TV line.



RV1 — set duration of vertical colour burst blanking

Fig.2 COLOUR SYNC PULSE GENERATOR WITH 25Hz OFFSET AND SUBCARRIER LOCKING

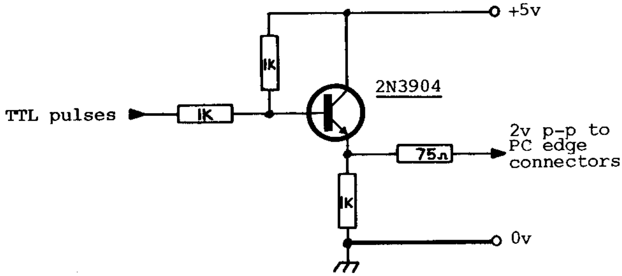


Fig.3 OUTPUT BUFFER - 1 FOR EACH PULSE OUTPUT

VXO 3 IS AN IQD DEVICE

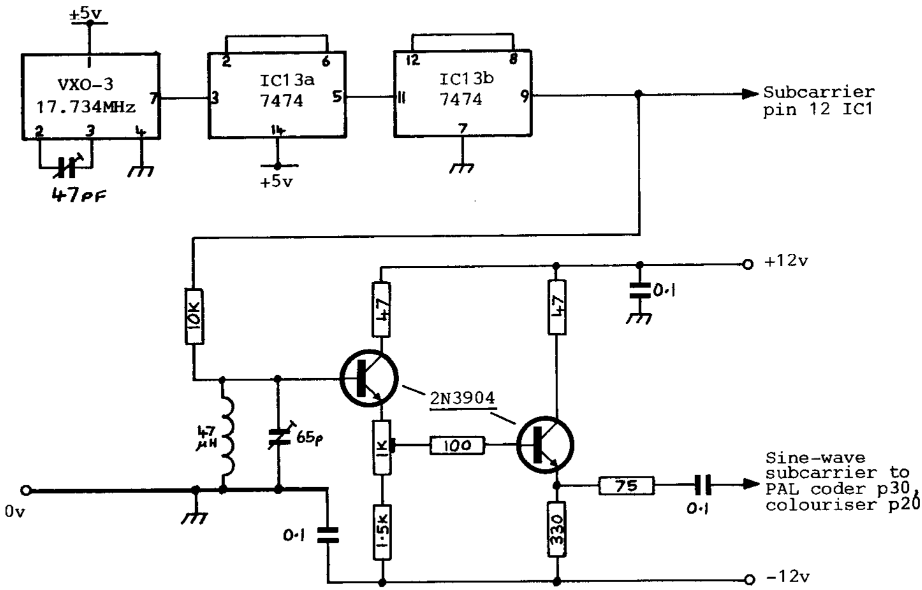


Fig.4 COLOUR SUBCARRIER OSCILLATOR (PAL)

Card module

VISION SWITCHER

CHAPTER 3

By David Stone G8FNR.

The signal handling of the previous vision switcher design was acceptable for monochrome applications, but, if used for colour, the chroma signal from sources that were not selected, could sometimes be seen on the output. The answer to this problem is to use a slightly more complex crosspoint to switch the video. Fig.3 shows the one used on this improved switcher, it uses three transistors and a few additional resistors.

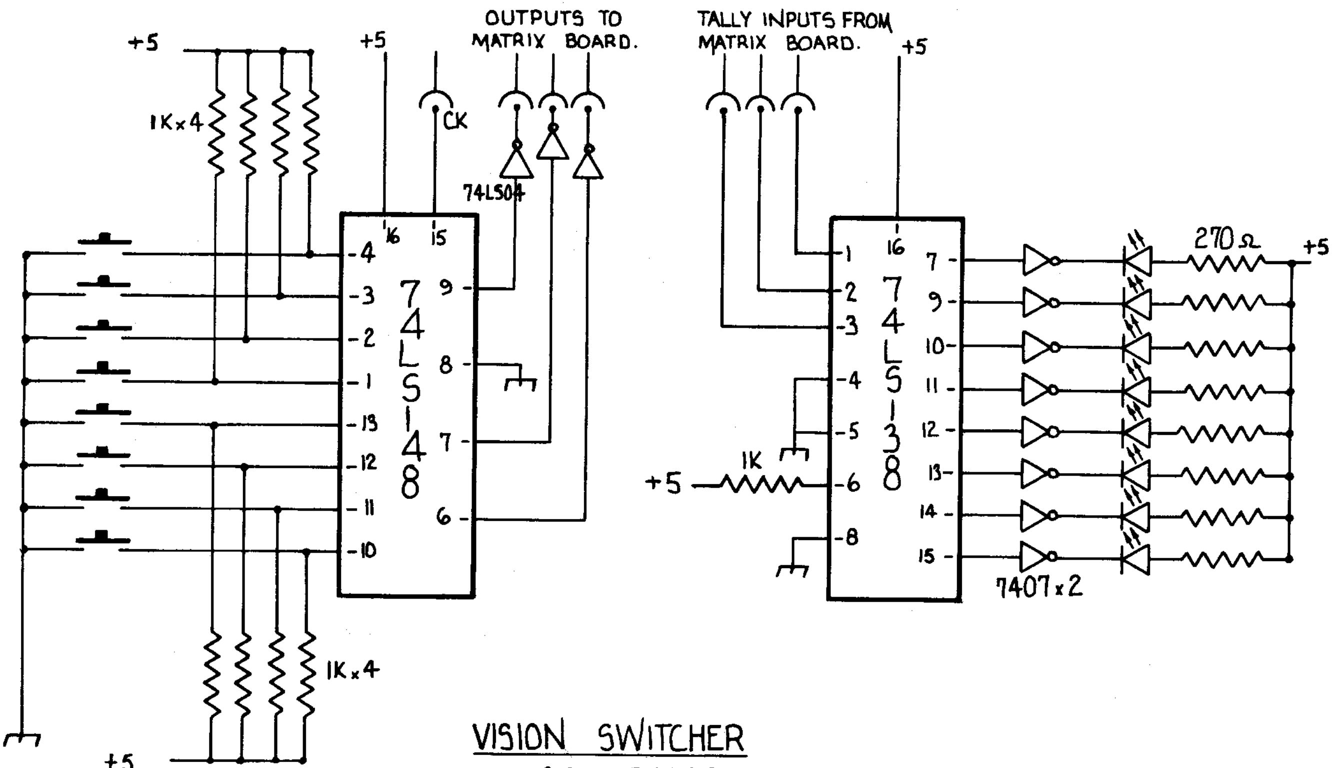
The new switcher also has eight inputs and the logic has been upgraded, in that vertical interval switching is used on all the banks and a tally system has been incorporated.

The new switcher occupies three printed circuit boards.

The first is the logic and tally board which accepts the commands from the pushbuttons and codes them, in order to keep printed circuit interconnects down, and to process the command signals into a form more readily acceptable by the vertical interval logic, and pushbutton memory circuits. The push buttons used are of the momentary contact non-latching kind. The logic board also has the necessary logic to decode and display tally information. This information is also passed between the boards in a coded form.

Arranging the coding of the commands and the decoding of tally information on one printed circuit board makes it possible to be housed, along with the push-buttons and tally LEDs, to form a remote control. This means that only coded information is passed to and from the remote panel.

The tally lights also provide verification that the commands have arrived at the matrix board and been accepted. Should the commands not be accepted by the matrix board for any reason, say the loss of field drive, then the tally LEDs would not change when selection of a new video source was attempted, showing instantly that a problem has arisen.



VISION SWITCHER
LOGIC BOARD.

The matrix board takes in the coded commands from the logic board and stores them in the 74LS75 latch - this enables non-locking pushbuttons to be used. The information is allowed to pass from this latch to the next 74LS75, so as to only allow picture changes to occur during vertical interval. This technique minimises any subsequent picture disturbance. It is at this point that tally information is derived and fed back to the displays on the logic board.

The coded commands now pass to the 74LS138 where they are decoded back into eight separate commands once again and used to switch the appropriate video crosspoints.

Fig.3 shows one such crosspoint. This is repeated eight times in each of the blocks in Fig.2.

The logic command out of the 74LS138 is a low for the selected source, which is subsequently inverted by the 74LS05. This chip has open collectors so it will allow the base of TR2 on the vision switch to rise to the voltage set by the 10K and 1K8 potential divider in its base (approximately 1.8 volts). This transistor is now switched on and starts to pass current.

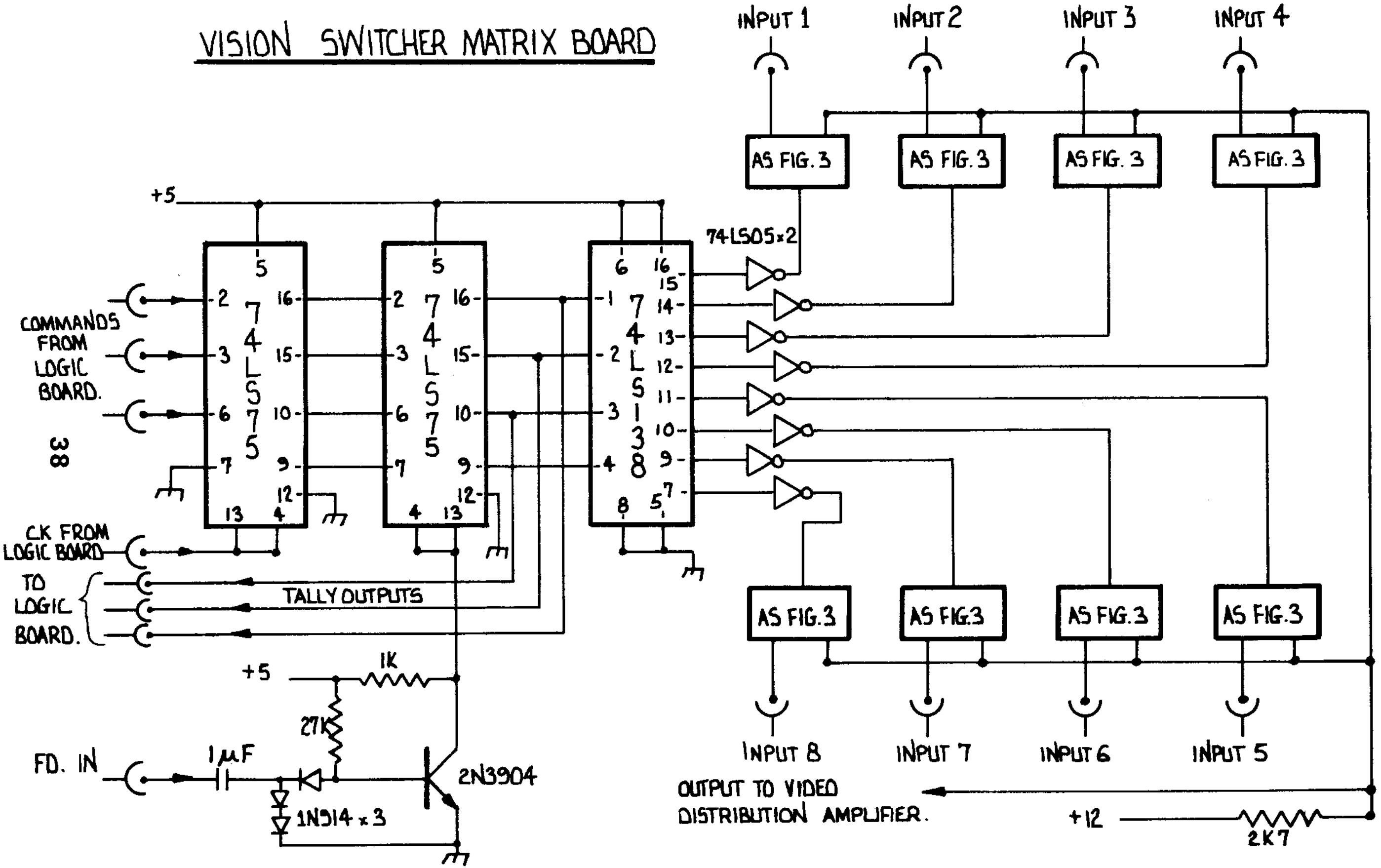
The effect of this is to also turn on TR1 by pulling down its emitter below the base potential as set by the two 22K ohm resistors in its base circuit, and to turn on TR3 by pulling down its base voltage. This completes a signal path through TR1 and TR2, both transistors being operated as emitter followers.

All the TR3 transistors in all the video switches share a common load resistor (2K7) but only one TR3 is conducting at any one time, so the selected video appears across this load resistor.

The selected signal is passed to the video distribution amplifier board. The signal is first processed by a differential amplifier, where gain and signal inversion take place. The other half of the differential amplifier is fed with in-phase video to form a negative feedback - the amount of feedback is adjustable, giving a gain control. Its response is also adjustable, which gives variable equalisation - useful when trying to compensate for cable runs.

The signal is inverted back in the next stage and fed to a complimentary symmetry emitter follower stage. This balanced emitter follower provides very good signal handling, especially for colour applications and provides a very low output impedance, so a 75 ohm build up resistor is provided to restore the signal impedance. This very low impedance also enables the signal to be split into four

VISION SWITCHER MATRIX BOARD



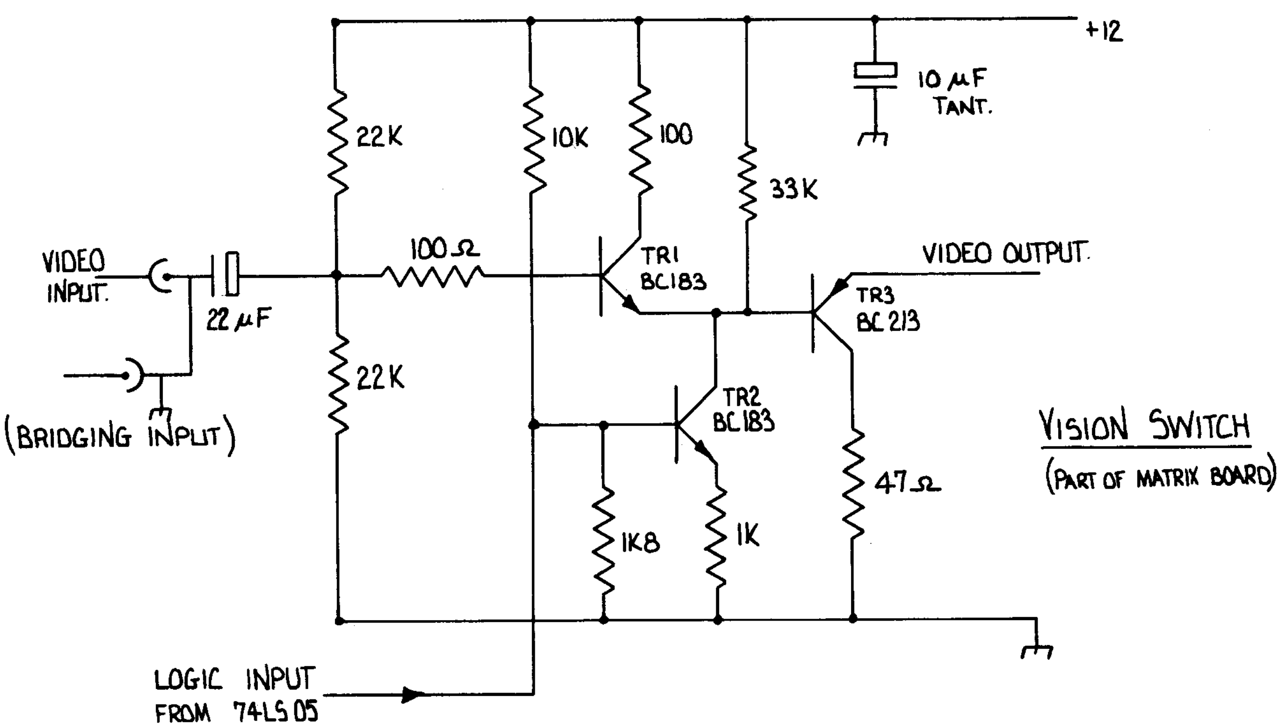

+12
10 μF
TANT.
22K
10K
100
33K
100 Ω
VIDEO INPUT.
22 μF
TR1
BC183
VIDEO OUTPUT.
TR3
BC 213
22K
TR2
BC183
(BRIDGING INPUT)
VISION SWITCH
(PART OF MATRIX BOARD)
47 Ω
1K8
1K
LOGIC INPUT
FROM 74LS05

FIG. 3.

VIDEO DISTRIBUTION AMPLIFIER

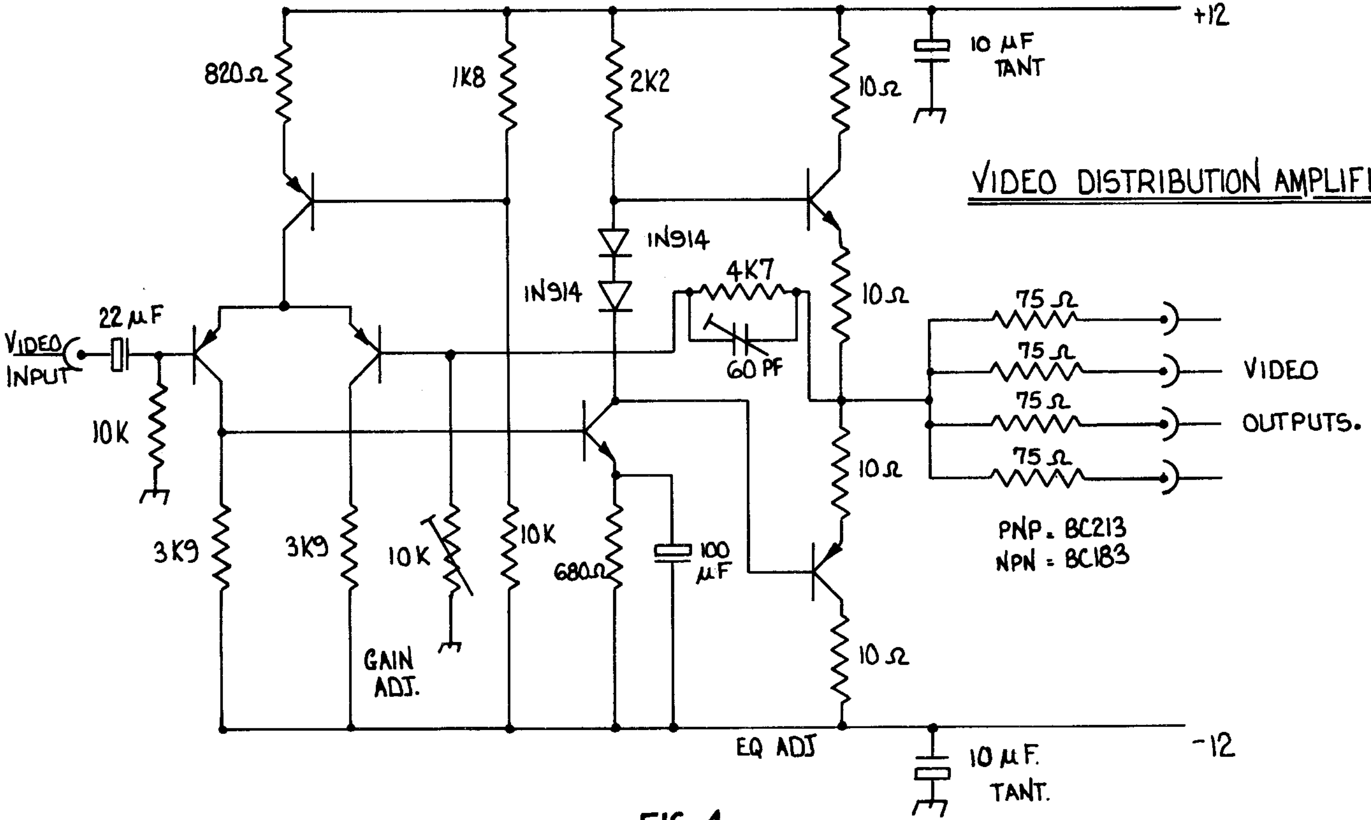


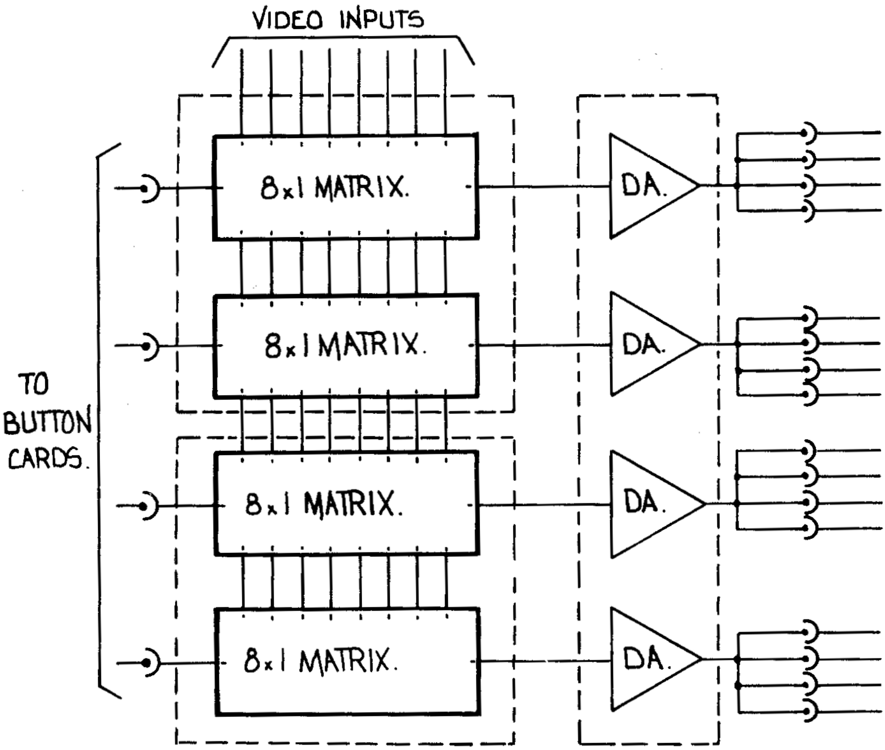
FIG 4.

separate outputs, very useful for feeding additional monitors, VTR's etc.

The video distribution amplifier can be used as a stand alone distribution amplifier as well as following the vision matrix board.

The distribution amplifier does have the added complication of requiring a -12 volt rail. This could be considered a disadvantage, but it is a common practice to use split power requirements when designing professional video circuits, as it makes for ease of DC coupling between stages, which gives superior L.F. performance.

The vision switcher PCB's are laid out as follows:-
The card frame matrix board has 8 cross points and 1 distribution amplifier. The control panel logic board has 16 logic and tally systems. i.e. you need 1 logic board and 2 matrix PCB's for an A-B switcher.



Card module

MIX EFFECTS AMPLIFIER

By David Stone G8FNR.
and Chris Short G8GLQ

The next step after vision switching is vision mixing. Being able to switch electronically between cameras and other video sources is very useful, but it is even better to be able to cross-fade or wipe between sources, or even inlay captions across camera pictures.

If you have built up the previous three printed circuit boards (vision switcher), then you will be able to switch any of your video sources into either of the two inputs of the mix effects amplifier. This module gives the added facility of cross-fades between sources, and later, with the addition of a special effects module, that connects to the external key input, wipes of all shapes and directions with hard or soft edges will be possible.

This circuit contains two voltage controlled faders connected in parallel to the video signals and antiphase to the control signal. Thus a single control input can select either video input, perform a fade between two signals, or later with the addition of the wipe pattern generator perform wipes, keys, and inlay captions etc. The performance of the circuit is excellent, keys between identical input signals are invisible and attenuation of the 'off' signal is more than 40dB at subcarrier, invisible on a picture monitor.

Both the video inputs and the key input have feedback clamps to hold the blanking level very accurately, and are worth the extra components required. The voltage controlled attenuators use MC1495 ICs, a wideband analogue multiplier, which although fairly expensive makes construction and alignment easy for the home constructor.

CIRCUIT DESCRIPTION

Each video input is buffered by an emitter follower TR1 etc. The voltage at the emitter is sampled by the gated op-amp IC1. This type of op-amp allows one to set the operating current by means of a current injected into pin 5. If no current is injected the output is high impedance, and when a current is injected the chip behaves like a

VISION MIXER

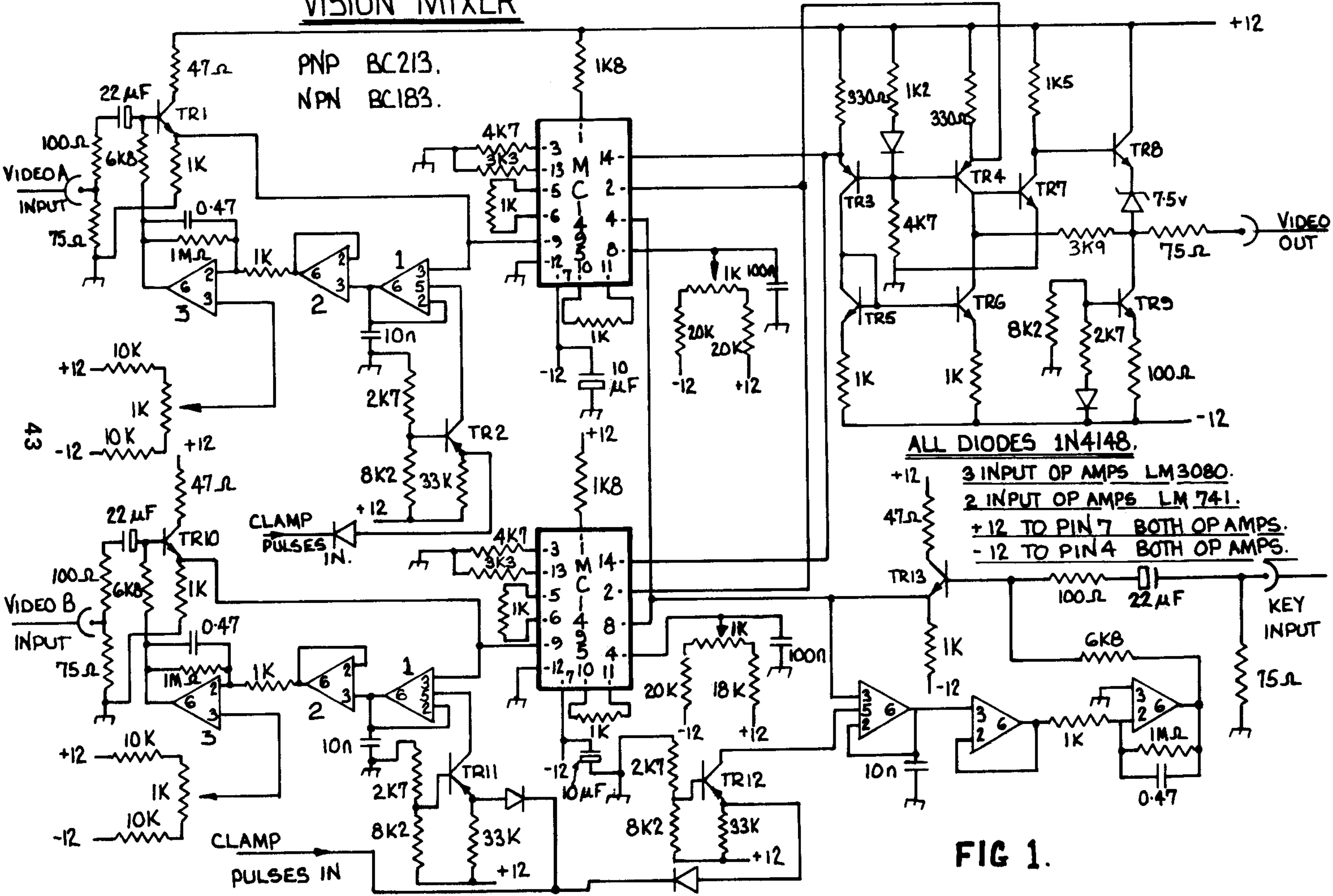


FIG 1.

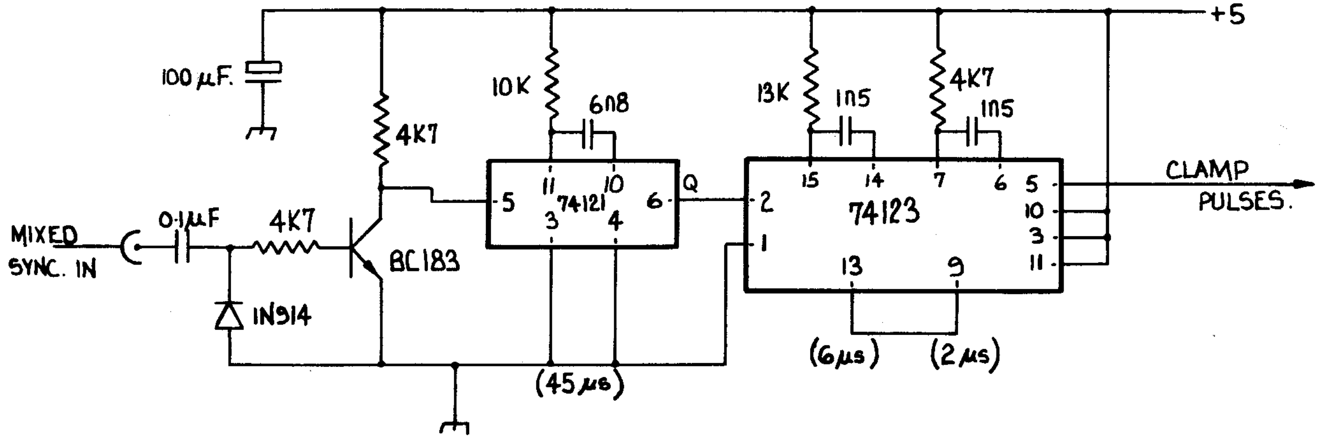
normal op-amp. A pulse current is switched into pin 5 by TR2 when the emitter of TR2 is allowed to rise to its normal potential during the clamp pulse high time. When the emitter is held low by the TTL IC feeding the clamp pulses to the circuit, TR2 base-emitter junction is reverse biased and no current passes to the gated op-amp. This forms an effective sample and hold circuit sampling the input black level during the clamp pulse and holding this voltage during the rest of the line. The stored voltage on the 10nF capacitor is buffered by voltage follower IC2 and compared by IC3 with a reference voltage. Any difference between the two voltages is amplified and passed to the base of TR1 to correct the error. Thus the voltage at pin 9 of IC4 will be maintained at the reference level during blanking.

The MC1495's give a differential current output, which is fed into the output amplifier TR3-9. When equal currents are fed into the two current source emitters, the output should be OV. The circuit can thus be checked before the 1495s are fitted to ease fault finding. Current in TR3 passes through current mirror TR5-6, so that the current in TR6 is equal to that in TR4. Thus there is no current imbalance in TR4 and TR6 and thus no current flows in the 2K feedback resistor and the output is at OV. If a differential current is added to the current sources, it will be seen that twice the applied current is unbalanced at the collector junction of TR4 and TR6. This 'error' current is amplified by TR7 and TR8 moving the output from OV. This results in a current in the 2K resistor to exactly balance the 'error' current in TR4-6. Thus the collector of TR4 and TR6 work as a current summing point just like the input to a normal op-amp circuit, but with Video bandwidth. Thus the gain of the circuit is controlled only by the 2K resistor provided that the open loop gain is high, which it is. The gain is set to 2 Volts per MA of error current. TR9 acts as a current source of about 30 mA to provide a low output impedance in the negative direction in place of the low value of emitter resistor otherwise required.

The operation of the multiplier is best understood from the data sheet, but the following should suffice. The gain of the multiplier is controlled by the voltage applied between pins 4 and 8 and constants set by resistors. The gain is zero when the voltage is zero and maximum when the voltage is 0.7 volts. The gain is a direct proportion of the maximum for all voltages between 0 and 0.7.

Thus	V = 0.175	Gain = 1/4
	V = 0.35	Gain = 1/2
	V = 0.525	Gain = 3/4
	V = 0.7	Gain = 1

CLAMP PULSE GENERATOR FOR MIX EFFECTS AMP.



In practice a small error or offset may be present so that zero gain may not exactly correspond with zero volts. This may be adjusted out by means of the pot, provided on pin 8 or 4 of the IC. The second 1495 must be off when the other is on and therefore the control voltage is inverted by changing over pins 4 and 8 and offsetting pin 4 to 0.7 volts. Thus when the control voltage is 0.7 volts one IC has 0.7 volts applied and the other 0.0 volts between their control pins.

It is worth noting that negative control voltages will give inverted video outputs and this can be very confusing during alignment. A slight adjustment of gain of one channel may be needed during alignment and this may be done by changing the 1K resistor between pins 5 and 6 by a few percent or it could be replaced by 910 ohms in series with a 200 ohm preset, although this was not required on the prototype.

The mix effects amplifier is controlled via the input called external key. To perform a mix you will require to build the A.B. cross fader in Fig.3. No provision is made for this unit on the mix effects printed circuit board as it is part of a special effects unit yet to come, that will do much more than a mere mix, i.e. wipes of all shapes and directions with soft and hard edges.

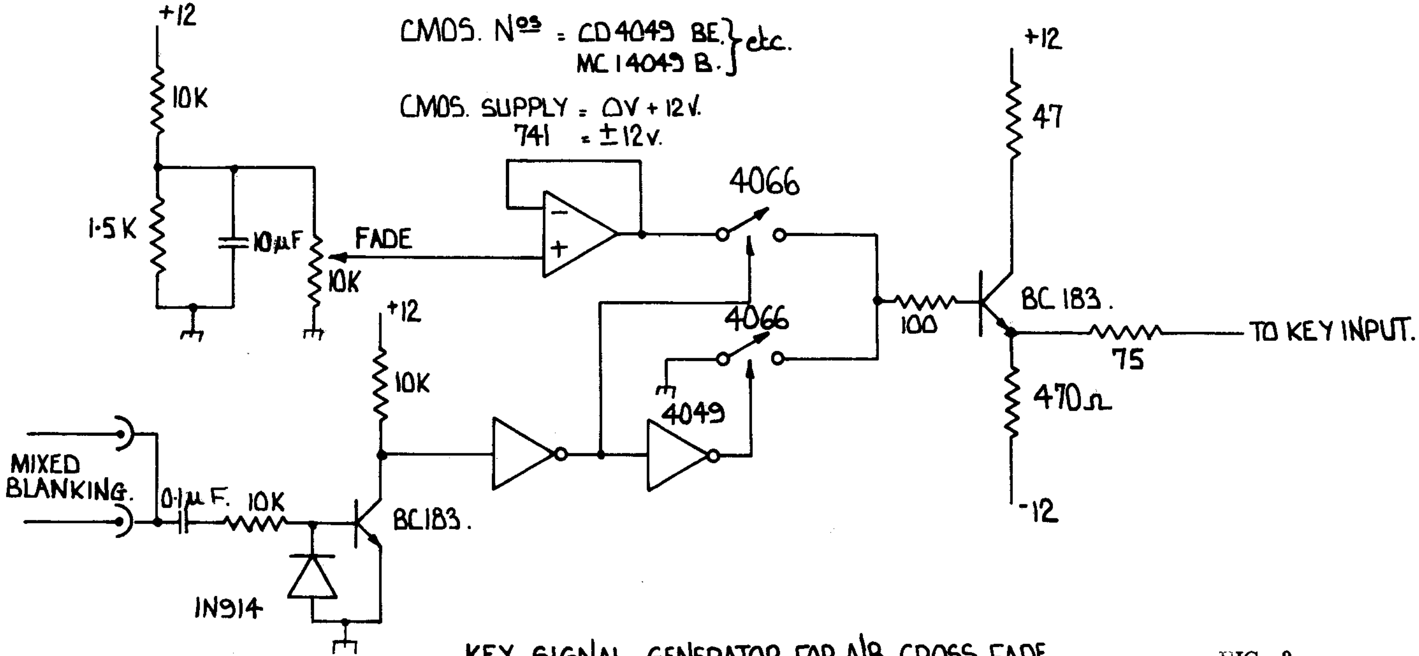
Another use for the external key input is to drive it direct with the video output of the character generator and additional video processing unit (Handbook 1 page 33). By selecting different video signals at the A. and B. inputs, the effect will be a video source with holes cut in it by the characters through which the other video source is visible.

When building the mix effects amplifier, it is essential to use sockets for mounting the MC1495 IC's as it is necessary to be able to remove them easily when setting up the amplifier.

The A.B. cross fader in Fig.3 generates an output which is a variable DC with sync pulses, i.e. as the fader is operated, the generator's output will vary between peak white and black.

To set up the presets on the mix effects amplifier, apply a video signal to both inputs. Fade up the A input and remove the MC1495 in the B channel. Adjust the DC level control (connected to Pin 3 of the op-amp) so that the video at the output sockets has its black level at zero volts when viewed on an oscilloscope.

Now perform a cross fade and the signal will disappear, increase the gain on your oscilloscope and adjust the other pot(pin 8



KEY SIGNAL GENERATOR FOR A/B CROSS FADE

FIG. 3

of the MC1495) to cancel out any video present at the output.

Fade up the A channel and repeat the DC adjustment, fade down and repeat the other pot adjustment to remove any video signal.

Now replace the MC1495 in the B channel and remove the one in the A channel. Repeat the above adjustments for the B channel setting the DC pot for a black level corresponding to zero volts as viewed on an oscilloscope.

Perform a cross fade, make sure the signal disappears, and remove any residual video with the pot connected to pin 4 of the MC1495.

Reinstall the MC1495 into the A channel and check the DC adjustments by cross fading between channels, slight adjustment may be necessary along with the signal pots.

Try a cross fade between colour bars and black and adjust the signal pots with the black source faded up.

PCB's

Printed circuit boards are available for many of the projects contained in this handbook. Full details may be obtained from the Members Services dep't order form with each copy of CQ-TV magazine.

Boards are also available for the original (blue) handbook, details of which may again be taken from Members Services order form.

'MEMBERS SERVICES' ITEMS ARE ONLY AVAILABLE TO CLUB MEMBERS.

MIXER - WIPE GENERATOR

By D.R.Stone G8FNR

This article describes the next section of the building block vision mixer design - the wipe generator. However, as this is an ideal area for experiment (often with interesting results) the circuits are presented as a starting point rather than a finished experiment.

The basis of mixer wipes are two waveform generators, one at line rate, and one at field rate, added together and this added signal compared with a d.c. voltage from the wipe arm position control. (Fig.1).

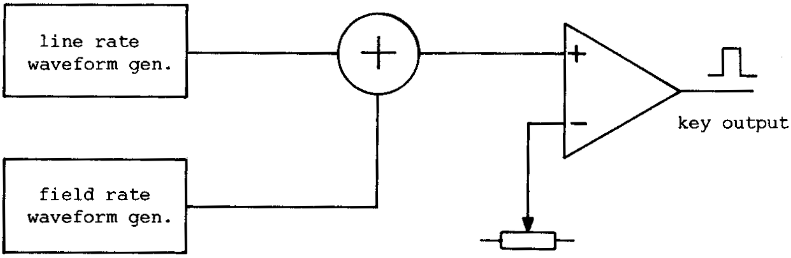


Fig.1

How this works may be seen from Fig.2. Assume that a picture has only 4 lines for simplicity. Waveforms A and B are generated each with one sawtooth per line or field. These are added together and produce a waveform like that in Fig.3. (Assume a picture with only 4 lines).

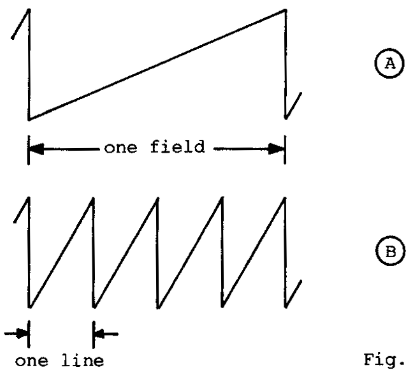


Fig.2

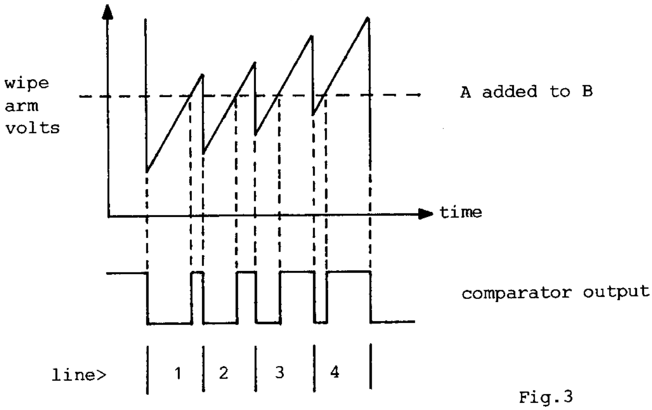
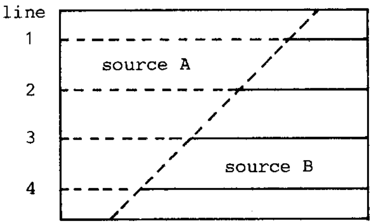


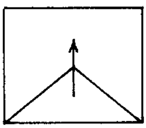
Fig.3

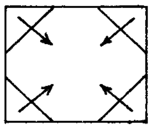
The voltage comparator will compare this with the wipe arm voltage, say the dotted line and produce the output waveform shown. If this is used as a key to the mix/effects amplifier the following result will be obtained :-

As the wipe arm position and therefor the voltage is changed the ratio of A to B changes and a diagonal wipe will result.

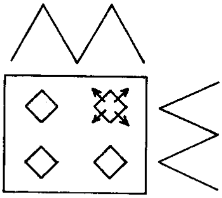


If this principle is extended it can be seen that a triangle field waveform will produce a wipe; and a triangle at line rate also will produce a diamond wipe.

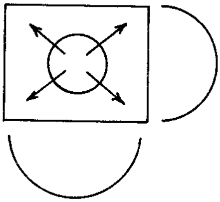




Making the waveforms multiples of line and field frequency, multiple wipes are produced :-



If the sawtooth waveforms are integrated a parabolic waveform is generated which will produce circles :-



Which of course also works at multiple frequencies.

Comparing the line and field rate waveforms separately and gating the outputs together gives square wipes :-

The direction of the wipes may be reversed by inverting the input waveforms, or inverting the key output.

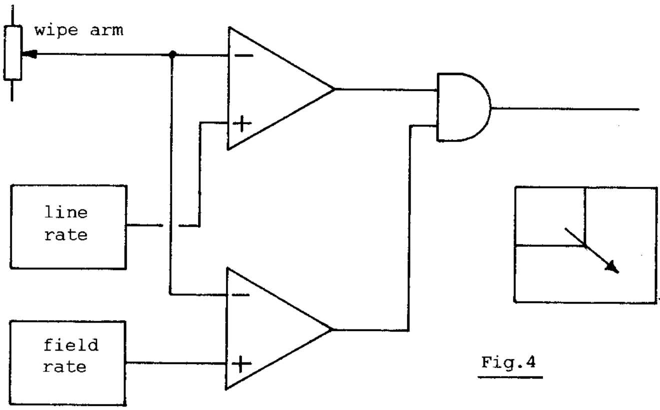
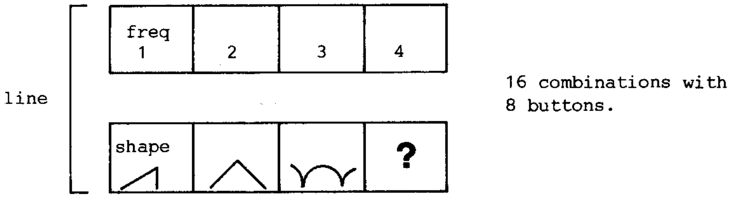


Fig.4

AN AMATEUR WIPE GENERATOR.

Professional vision mixers often have a large number of switches each producing a particular wipe shape. For our purposes, two selectors, one for a line rate waveform and one for a field rate waveform are probably best, and these may be further split to a frequency selector and a waveform selector.



Overall this makes 255 wipes available with 16 buttons, a good bargain !

CIRCUITS.

The 8038 waveform generator is a convenient way of producing the triangular and sawtooth waveforms. It requires a single capacitor and two resistors to set the frequency, one resistor controlling the risetime, and the other the fall time.

$$t = 5/3\ CR$$

Where t is the rise or fall time and C and R are the timing components.

The waveforms must be fixed to line and field timings and so the 8038 outputs are phase locked to a multiple of line or field frequency as shown in Fig.5. The 8038 square wave output is compared in a 4046 phase comparator with a line timing signal. By altering the taps on the 74161 divider the ratio of the 8038 frequency to line frequency may be set to 1, 2, 4 or 8 times line frequency.

The error signal from the 4046 is filtered by a 741 integrator and used to apply frequency correction to the 8038 at the control input pin 8. An H POSITION control is provided to centre the wipes on the screen. A parabola waveform is made by an integrator (748)
for circle wipes. The gain of this integrator will require adjustment as the frequency range is changed, change the 6.8k resistors to suit.

The field rate circuit is similar to Fig.5. but does not include the divider. Mixed syncs at "A" are integrated and a field reset pulse extracted. It is delayed as necessary by the V POSITION control and used to phase lock the 8038 as in the line rate circuit. Again an integrator is provided for circles, but as the frequency is lower a 741 may be used.

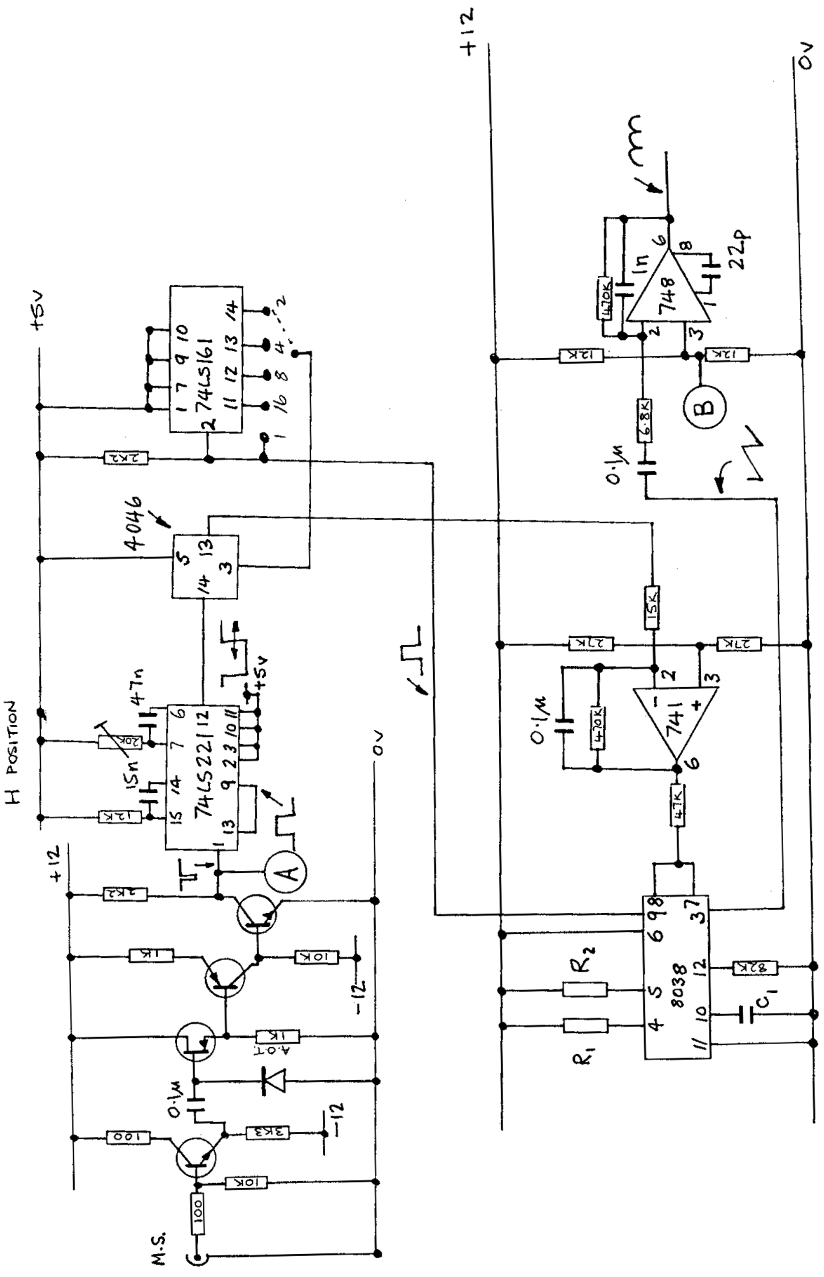

+12
0V
+5V
74LS161
4046
74LS221
H POSITION
748
741
8038
A
B
M.S.
R1
R2
C1
-12

Fig.5

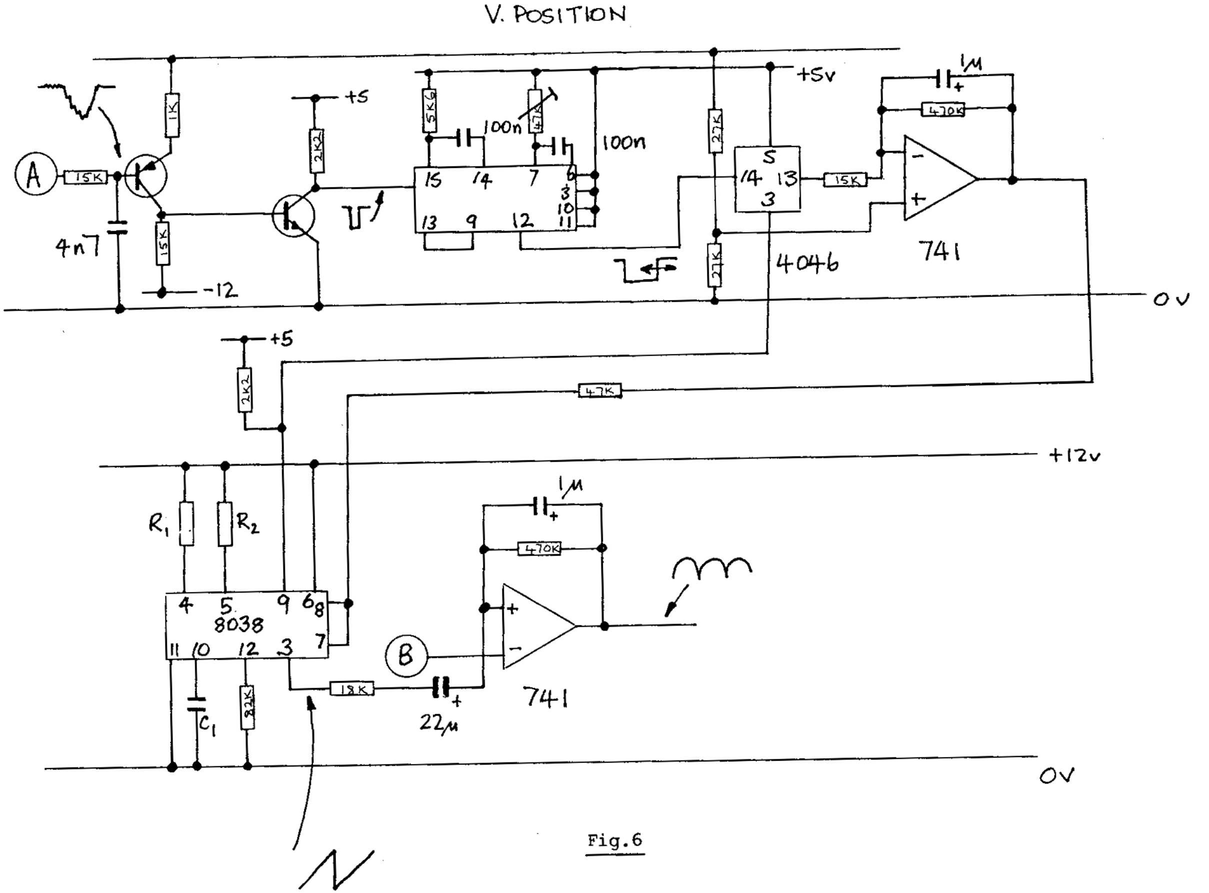

V. POSITION
A
15K
1K
4n7
15K
-12
+5
2K2
15
14
7
6
3
10
11
13
9
12
5K6
100n
47K
100n
27K
27K
+5v
S
14
13
3
4046
15K
470K
1M
741
0V
+5
2K2
47K
+12v
R1
R2
4
5
8038
9
6
8
7
11
10
12
3
C1
82K
18K
22μ
B
1M
470K
741
0V
Fig.6

Fig.7 shows the prototype comparator circuit. The wipe arm voltage is shifted to 6 +or- 2.5v. by a 741, whose bandwidth is reduced by the o.1u feedback capacitor to reduce any noise from the wipe arm pot, which should be wirewound to last a reasonable time. If only a sectipn of the pot track is used the gain may be increased to give the full control voltage range. A 710 voltage comparator is used for high speed operation and its output is blanked by a 7400 gate for correct operation of the ME board clamps. A further 7400 gate gives a 1v. interface to the ME amplifier. Soft edge wipes may be made by adding an integrator between this output and the ME amplifier, even a 0.1u capacitor from the output to 0 v. gives a reasonable effect !

For those who don't wish to experiment with the circuit, a PCB based on these circuit ideas will be developed with circuit information and notes,these will be made available in due course. Details of price and availability will be published in CQTV.

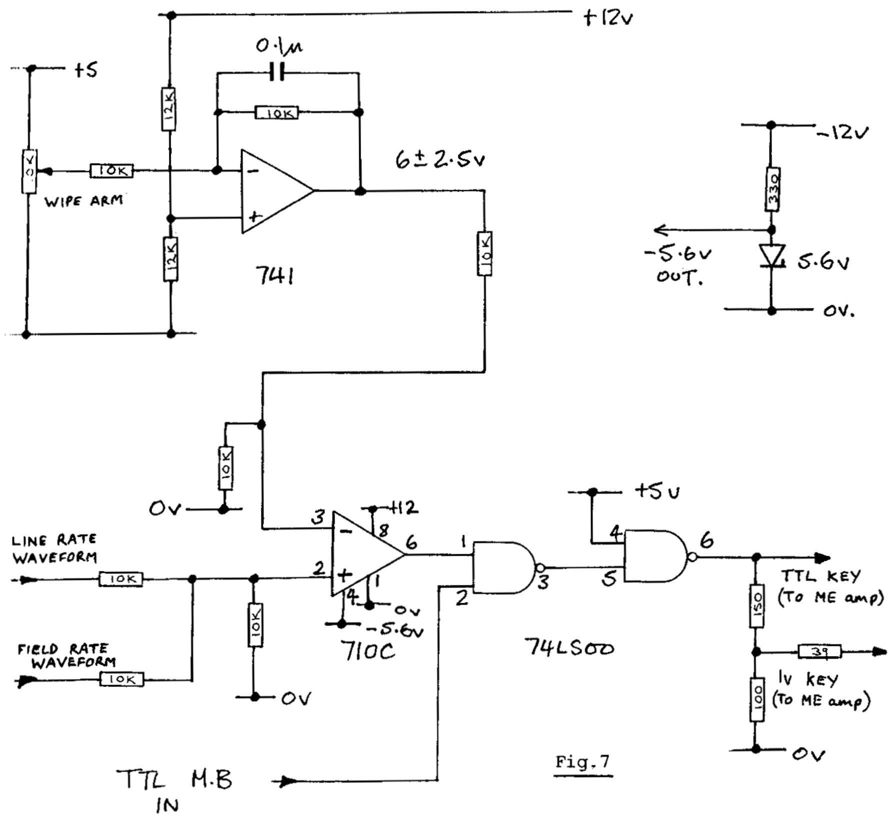


Fig.7

INTERCONNECTION OF CARD FRAME MODULES

This short chapter details the inter connections between some of the standard printed circuit cards which are available for circuit designs in Handbook 1 and 2. The result will be an eight input vision mixer of the A/B bank design ie two of the inputs will be fed with the electronic test card and a colour background generator (colourizer) the latter is capable of being further updated with electronic characters. Eight printed circuit cards of the rack mounting style are used along with one non rack mounting card which holds the push buttons and associated logic which controls the system. One piece of construction work which is not covered by a printed circuit board is the circuit on page 43 of this book. This may be constructed on veroboard and mounted alongside the push buttons under the vision mixer control panel.

Handbook 1 modules used are:-

Electronic test card	(3 printed circuit cards)
P.A.L. Coder	(1 printed circuit card)

Handbook 2 modules used are:-

Colour sync pulse generator	(1 printed circuit card)
Vision switcher	(2 identical printed circuit cards required)
Mix effects amplifier	(1 printed circuit card)
Push buttons	(1 printed circuit card, not rack mounting)
A/B crossfade	(page 43 of this book)

The rack cards should be fitted with the appropriate I.S.E.P. edge connector and mounted into a suitable rack frame. If I.S.E.P. connectors are not available then it is possible to use DIN 41612 although the boards were not designed for this standard and would require drilling.

Figs 1 and 2 show the connections required between the modules with the A/B crossfade being used to drive Pin 32 of mix effects amplifier.

Three decade switches are used, one to drive the electronic test card and the other two for the colour background generator. Only the colour background switch will be operational, by grounding the colourizer input connector (which is where the system is further expanded by feeding in an electronic character generator). It is recommended that all three decade switches be mounted adjacent to the control panel.

The coax delay in fig 1 is to match chroma phase between coders otherwise loss of colour on a mix will result. The length can be determined experimentally.

-MODULES INTERCONNECT-

```
TC1,1----TC2,1----TC3,1----PC,1----SG,29------CZ,26-------GROUND
         TC2,4----TC3,4    PC,3----VS2,21-----VS1,21
         TC2,5----TC3,5    PC,7----SG,5-------CZ,32
TC1,5-------------TC3,12                      CZ,1----VS2,22
TC1,7----TC2,6                                CZ,9---GROUND
                                              THIS IS THE INPUT
                                              FOR C/GEN

         TC2,8----TC3,8
         TC2,9----TC3,9
         TC2,10---TC3,10
TC1,8-------------TC3,6
TC1,10---TC2,11
TC1,11---------------------PC,15---SG,17------CZ,33
TC1,12---TC2,12            PC,17--------------CZ,24------------+12
TC1,13---TC2,13
TC1,14---TC2,14---TC3,14   PC,27---SG,9-------CZ,31
TC1,15---TC2,15---TC3,15
TC1,16---TC2,16---TC3,16   PC30---------------CZ,20
         TC2,17---TC3,17       THIS PATH IS A COAX DELAY
         TC2,18---TC3,18
                  TC3,19---PC,21
                  TC3,20---PC,23
                  TC3,21---PC,25

                  TC3,23----SW COM
                  TC3,25----SW C
                  TC3,26----SW A         DECADE SWITCH
                  TC3,27----SW D
                  TC3,28----SW B

TC1,17----------------------------SG,13------CZ,22----------+5
TC1,19---TC2,19
TC1,22---TC2,22
         TC2,30---TC3,30
TC1,30------------TC3,29
TC1,31------------TC3,31
TC1,33---TC2,33---TC3,33----------SG,31-----CZ,22-----------+5

                                             CZ,16---A
                            GROUND           CZ,5----B
                            COMMON           CZ,7----C DECADE
                            ON                         SWITCHES
                            BOTH             CZ,11---A
                            DECADE           CZ,13---B
                            SWITCHES         CZ,15---C
                                             CZ,17---D
```

TC1 = ELECTRONIC TEST CARD BOARD ONE
TC2 = ELECTRONIC TEST CARD BOARD TWO
TC2 = ELECTRONIC TEST CARD BOARD THREE
PC = PAL OR SECAM CODER
SC = SYNC PULSE GENERATOR HANDBOOK 2
CZ = COLOURIZER HANDBOOK 2

-MODULES INTERCONNECT-

```
VS1,1-------VS2,1-------ME,1--------------------------------+12
VS1,2-------VS2,2---------------------------------------IN 2
                        ME,3--------------------------VIDEO/OUT
VS1,3-------VS2,3---------------------------------------IN 3
VS1,4-------VS2,4---------------------------------------IN 4
VS1,5-------VS2,5---------------------------------------IN 5
VS1,6-------VS2,6---------------------------------------IN 6
VS1,7-------VS2,7---------------------------------------IN 7
VS1,8-------VS2,8---------------------------------------GROUND
VS1,9-------------------------------PB,9
                        ME,10--------SG,17
VS1,10------------------------------PB,8
VS1,11------------------------------PB,7
            VS2,9-------------------PB,19
            VS2.10------------------PB,18
            VS2,11------------------PB,17
            VS2,12------------------PB,16
VS1,12------------------------------PB,6
VS1,13------VS2,13------------------PB,5 and 15 --------GROUND
VS1,14------VS2,14-----ME,14----------------------------GROUND
VS1,15------VS2,15------------------SG,15
VS1,16------VS2,16------------------PB,4 and 14 ------------+5
VS1,17------VS2,17------------------------------------------+5
VS1,18------------------------------PB,1
VS1,19------------------------------PB,2
VS1,20------------------------------PB,3
            VS2,18------------------PB,11
            VS2,19------------------PB,12
            VS2,20------------------PB,13
VS1,21------VS2,21----------------------------PC,3
VS1,22------VS2,22----------------------------CZ,1
VS1,23-----------------ME,12
VS1,24------VS2,24--------------------------------------GROUND
VS1,25*
VS1,26------VS2,26--------------------------------------GROUND
VS1,27*
VS1,28------VS2,28--------------------------------------GROUND
VS1,29*
VS1,30------VS2,30--------------------------------------GROUND
VS1,31------VS2,31------ME,4---------------------------- -12
VS1,32------VS2,32------ME,5---------------------------- -12
            VS2,23------ME,30
            VS2,25*
            VS2,27*
            VS2,29*
                        ME,32------EMITTER OF BC183 PAGE 45 HANDBOOK 2
                                   OR THE OUTPUT OF THE WIPE GENERATOR
*DENOTES SPARE VIDEO OUTPUTS
 VS1 = VISION SWITCHER
 VS2 = VISION SWITCHER HANDBOOK 2
 ME  = MIX EFFECTS AMP HANDBOOK 2
 PB  = PUSH BUTTONS    HANDBOOK 2
```

70 cms V.S.B. TRANSMITTER

CHAPTER 4

By Paul Marshall G8MJW.

INTRODUCTION.

This transmitter design offers 1W peak sync. output on the 70cm band. It is I.F. modulated and filtered giving true V.S.B. (Vestigal Sideband) output. At 1 Watt output the transmitter is suitable for short range contacts, or it can be coupled to a LINEAR amplifier to give more output (see later).

Why V.S.B. and I.F. modulation/filtering? The 70cm amateur band offers 8MHz to the T.V. amateur. A standard V.S.B. System 1 (British 625 line) broadcast signal occupies 8MHz and takes the form shown in Fig.1.

The purpose of empolying V.S.B. is to reduce the bandwidth required compared to the equivalent A.M. which would need 12MHz.

The receive characteristic has a -6dB slope through zero in order to achieve an appoximately flat frequency response when the signal is demodulated.

Achieving a true V.S.B. transmission is a difficult proposition for the amateur due to the filtering required and the high degree of linearity need in any subsequent mixing and/or amplification.

Traditionally, amateurs have either limited their transmitted video bandwidth (say to 3MHz) and used A.M. (a bandwidth of 6MHz), or filtered at U.H.F. using inter-digital or cavity based U.H.F. filters. The former precludes the transmission of colour and the latter is difficult or impossible for the average amateur with limited test equipment and resources.

This design uses the modern broadcast transmitter approach of modulation and filtering at an I.F.. This has been tried before but has fallen into disuse due to the difficulty of alignment, particularly of

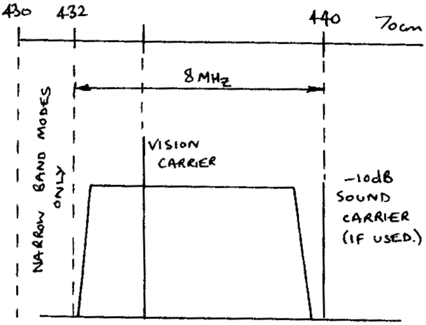
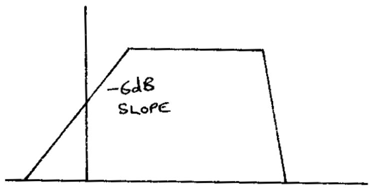


FIG. 1. BROADCAST V.S.B. + 70CM BAND



RX. V.S.B. FILTER CHARACTERISTIC.

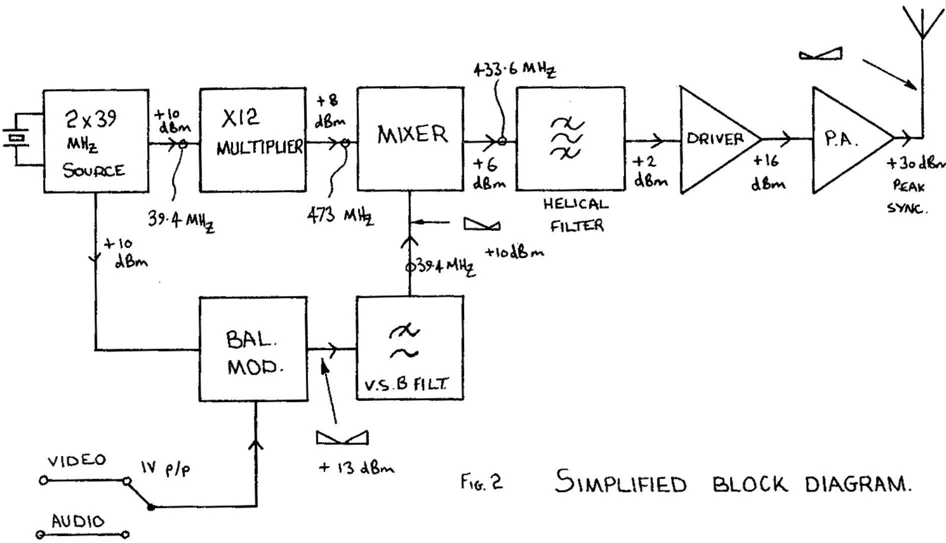


FIG. 2 SIMPLIFIED BLOCK DIAGRAM.

(0 dBm ≡ 1mW INTO 50Ω, 10 dBm ≡ 10 mW, 20 dBm = 100mW ETC. LEVELS SHOWN ARE TYPICAL.)

the V.S.B. filter. The reader may now be asking why not use an S.A.W. filter as used in modern T.V.s? This would be very desirable, but it has the receive V.S.B. characteristic, and due to the time delay (5uS) through the device, parallel or series path compensation using additional inductors and capacitors, cannot be used. (Transmit V.S.B. filters are available but, at £300 each, they are beyond the amateur's pocket). The V.S.B. filter employed is a very simple unit and is easy to align using pre-wound inductors.

Referring to Fig.2, it can be seen that the design is quite simple in essence, employing as few stages as possible. The channel filter seen after the mixer is a helical pre-aligned type.

The transmitter is modular to further facilitate alignment - it was considered that screening of individual stages would be more easily accomplished using small "modules" and that a small module is less "daunting" to align. Modular construction also means that anyone wishing to build a T.V. transmitter to a different scheme may wish to use part or parts of this one.

BRIEF SPECIFICATION.

OUTPUT:	1W P.S.
O/P SIDEBAND S/C REJECTION:	25dB (Typical Broadcast Tx. Specification)
DIFFERENTIAL GAIN:	5%
DIFFERENTIAL PHASE:	6 deg.
INPUT:	1V peak-to-peak 75 ohms
VISION CARRIER:	433.6MHz
STANDARD:	System I
SUPPLY:	+11 to +14V d.c.

N.B. Differential phase and gain can be optimised given the right test equipment - a typical figure is hard to define - PAL colour is very tolerant of such defects anyway.

R.F. CONSTRUCTION.

Designing an R.F. project for the amateur constructor poses many problems in the actual construction and availability of parts. The intending constructor must use good quality trimmers, resistors, fixed capacitors, etc. Problems of low Q in stages can sometimes be attributed to poor trimmers and/or chokes.

It is very important to use only branded 2N3866's from well-known manufacturers - many so-called 2N3866's available are not first grade. They may be O.K. at V.H.F., but of no use at U.H.F. The higher

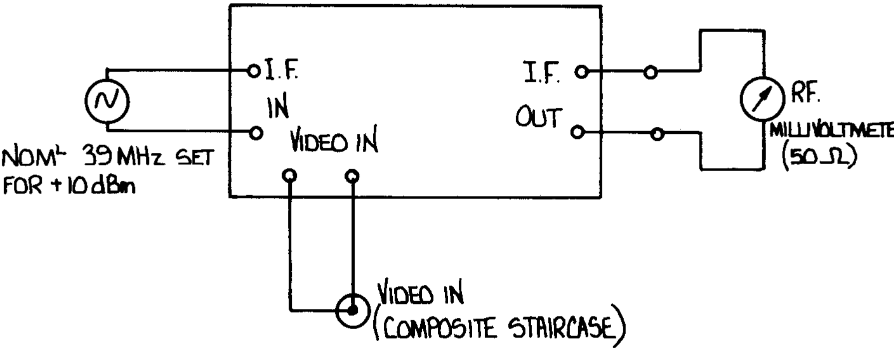


FIG.3 MODULATOR BOARD

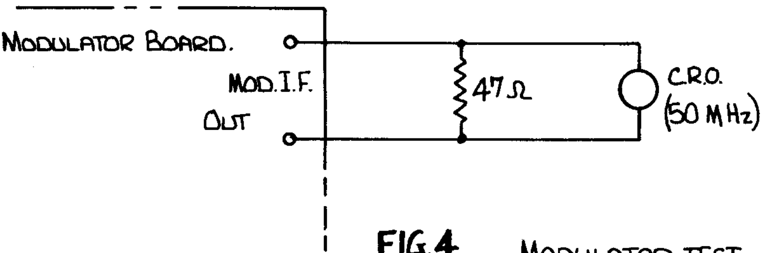
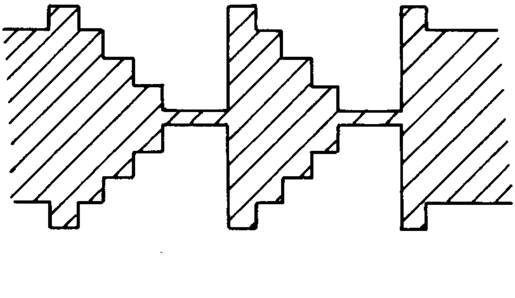


FIG.4 MODULATOR TEST



gain 2N3866A can be used to some benefit.

Boards 5, 6 and 7 require "edging" with tinned copper foil as plated through hole boards are not cheaply available. Edging involves making tinned copper foil strips about ¼" wide and wrapping them round the board edges to complete the earth plane between top and bottom of the board. Careful soldering all along the edges on both sides is required.

Please note that <u>all</u> components are mounted on the top side of boards 5, 6 and 7 (no holes are requied except for the BFR90 and BLX67 transistors to sit in).

Make sure each board functions on its own before trying to couple up the whole transmitter. Steady, patient construction is the key.

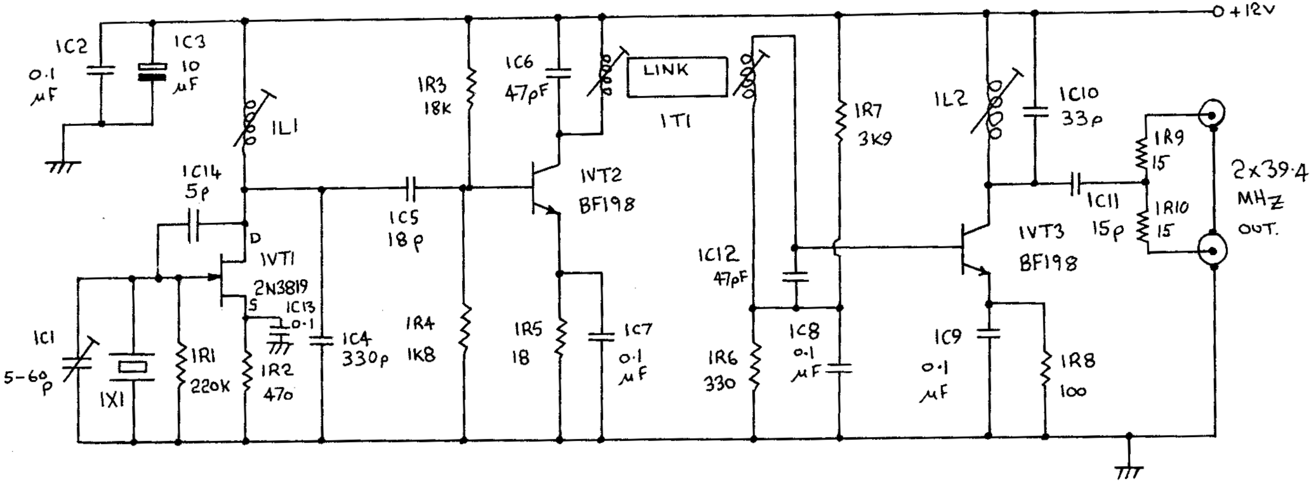
Each module should be screened from its neighbour, die cast boxes are ideal, if a little expensive. Tin plate boxes or a segmented chassis serves just as well. All U.H.F. inter-board or aerial connections should be made with good quality coax. (Not video grade, even though the runs may be short.) Feedthrough capacitors of 1 nF should be used in the +ve power feeds to the units.

1. <u>I.F. GENERATOR.</u>

The I.F. Generator provides two 39.4MHz outputs at approximately +10dBm each. A 13.4860MHz Pierce Crystal Oscillator is the base, followed by an X3 Multiplier, coupled via a double tuned circuit (giving low harmonic content) to a single tuned output circuit. Pre-wound coils are used for simplicity.

Alignment requires a wavemeter and an R.F. millivoltmeter and/or a 50MHz or better oscilloscope. Using either the wavemeter (set to 13MHz) or the oscilloscope adjust 1L1 and 1C1 for maximum 13.14860MHz. (If a frequency counter is available, the capacitor across the crystal may be adjusted until 13.14860MHz precisely is achieved.)

Terminate both outputs with 47ohm resistors. Transfer the wavemeter or oscilloscope to 1T1 and tune the cores for maximum 39MHz. Move on to 1L2 and adjust it for maximum 39.4MHz. Using an R.F. millivoltmeter (50ohms), check that each output is at least +10dBm. (0.707V R.M.S.). (Ensure that the other output is terminated.) Second and third harmonics should be typically better than 40dBm down.



(1X1 SHOULD BE FOR
30pF PARALLEL LOADING)

FIG. 5. 1. 2 X 39 MHZ. SOURCE.

2. VIDEO MODULATOR

The modulator uses a conventional double balanced diode bridge technique, fed by a D.C. coupled video amplifier/inverter. The input and output are buffered by simple amplifiers. No clamping or D.C. restoration of the video input is performed as it was considered that, in a typical station, the video fed to the transmitter would be clamped anyway - if not, there are plenty of standard circuits available.

Construction is quite straightforward, providing care is taken with the transformers. Other cores such as toroids could be used, providing the ferrite is of a grade high enough to cope with the frequency (39MHz).

Alignment is as follows:-

Set oscillator to 39.4MHz and check for a nominal +10dBm output. Replace the R.F. millivoltmeter by the circuit shown in Fig.4.

Adjust 2RV1 for waveform shown.

If a 50MHz Oscilloscope is not available, a diode probe can be used with a 5MHz Oscilloscope, and the resulting video waveform adjusted for best "shape" (i.e. minimum crushing). The 47ohm termination must be used.

For best performance, adjust the values of 1C6 and 1C12 for maximim modulated R.F. out. (If other cores are used, this will certainly have to be done.)

3. MULTIPLIER

The Multiplier is a conventional design using an x2,x2,x3 configuration. The first stage is lightly biased to improve sensitivity, the following stages operate in Class C.

Alignment requires the use of a wavemeter and preferably an R.F. millivoltmeter. Due to the low input frequency (39MHz), the technique of tuning for maximum collector current on each stage cannot be recommended. (It may be used as a "fine tune" once a rough alignment using a wavemeter has been accomplished.)

Either inject a 39MHz +10dBm signal from a Signal Generator into the input, or use an output from a completed 2 x 39MHz board. (Terminate the unused output in 50ohms or connect to the modulator board.) Using a wavemeter in close proximity to 3L2 and 3L3, tune for maximum 80MHz. Transfer to 3L6 and 3L7 and turn 3C9 and 3C10 for

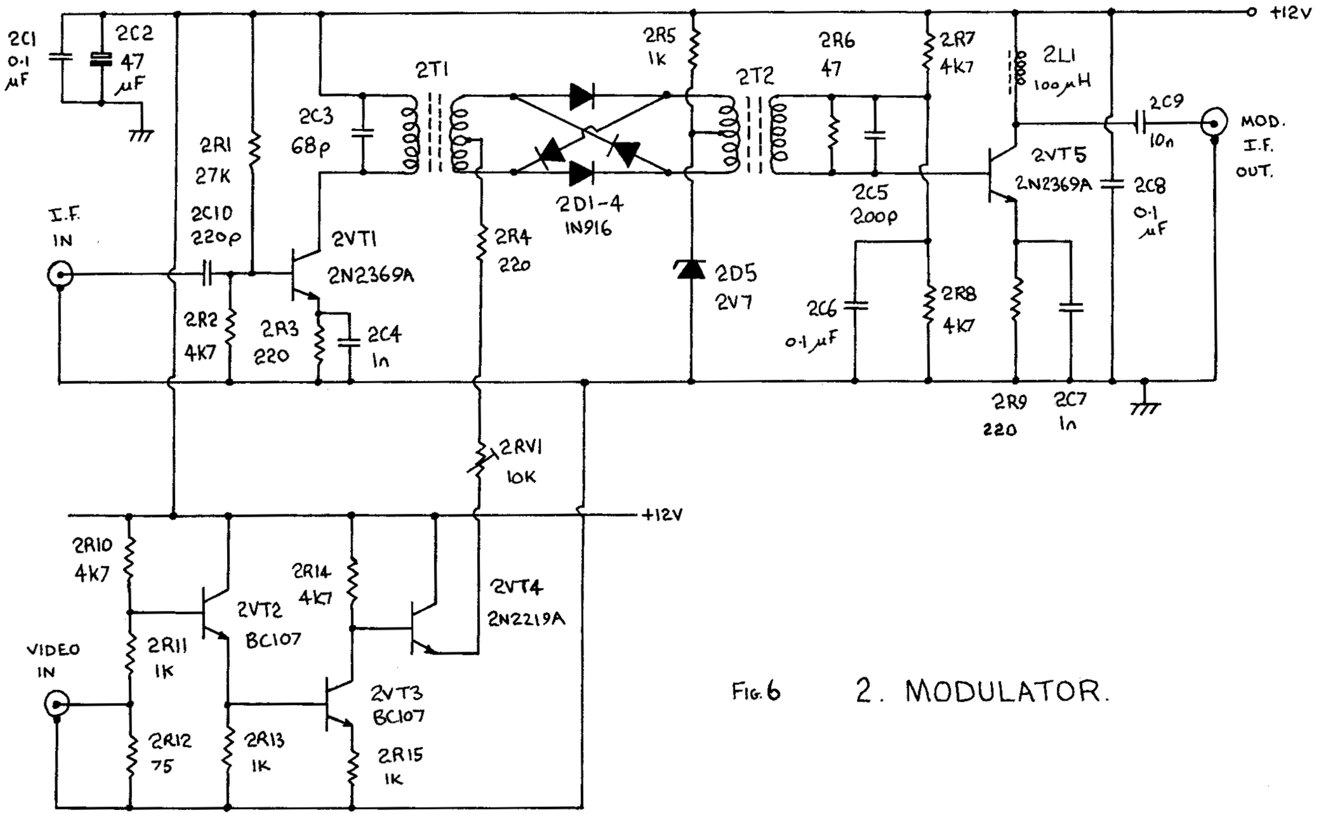


Fig. 6 2. MODULATOR.

maximum 160MHz. Finally, connect a 50ohm R.F. millvoltmeter to the output and tune 3C16 for maximum output. Check with a wavemeter that the output is on the 473MHz required. If a Spectrum Analyser is available, alignment is, of course, somewhat quicker and easier. Spurious outputs should be at least 25dB down. The output level should be at least +5dBm.

4. V.S.B. FILTER

The complexity of the V.S.B. Filter has been kept to a minimum in order to facilitate alignment for those with limited test equipment. The group delay performance of the filter is certainly none too good, but this does not affect the picture quality seen on the screen.

It consists of three M derived pi sections with reject frequencies of 41.5MHz, 43.7MHz and 45.4MHz. Note that it is low pass and therefore removes the UPPER sideband. Since the heterodyne frequency is higher than the output frequency, (473MHz, 433.6MHz respectively) inversion takes place and it is the LOWER sideband that is truncated.

Fairly close tolerance capacitors (5%) should be used, plate ceramic being suitable.

Alignment requires a signal generator capable of covering 40-50MHz, with a source impedance of 50ohms, and an R.F. millvoltmeter with 50ohms termination. Set the signal generator to 41.5MHz and inject, say 0dBm, into the filter. Connect the R.F. millvoltmeter to the output and tune 4L1 for minimum output. Repeat at 43.7MHz and 45.4MHz, adjusting 4L2 and 4L3 for minimum respectively.

As a check, tune the generator to 39.4MHz and measure the loss which should be no more than 1-2dB.

If a Network Analyser or Polyskop etc. is available, more precise settings can of course be made. (The settings are a little interactive.)

5. U.H.F. MIXER

This unit is of the double balanced active type - this yields less loss than the diode type, and offers better linearity. Furthermore, it's cheaper!

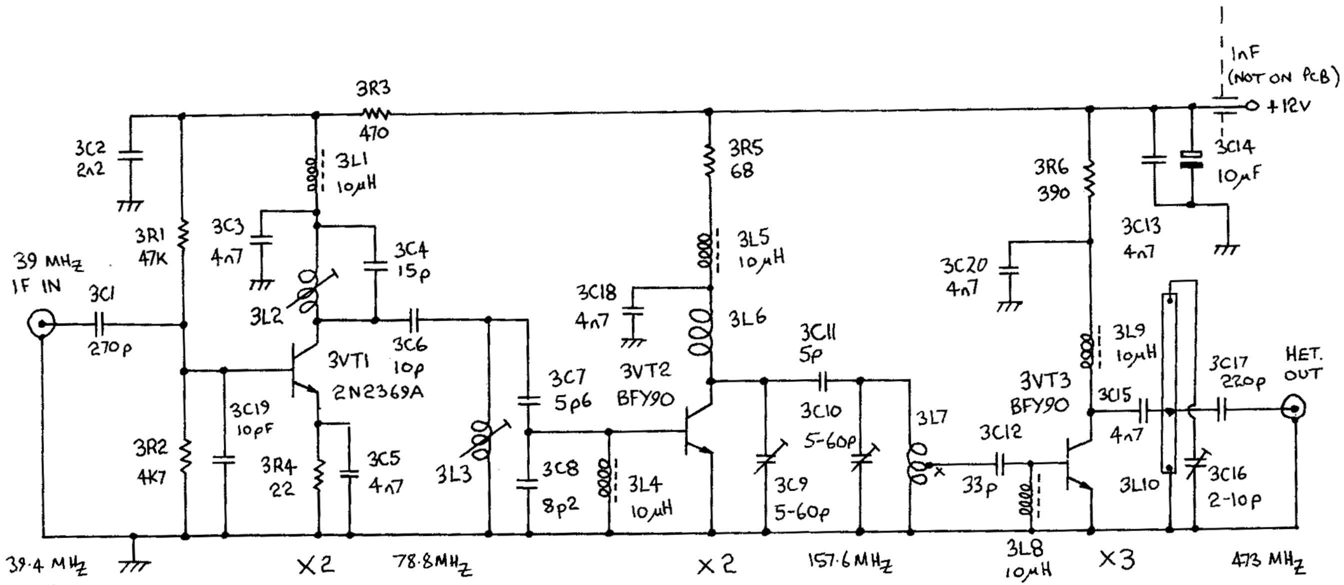


FIG. 7. 3. 12X MULTIPLIER.

The input transformer 5T1 is of the same design as that used in the video modulator. The heterodyne signal of 473MHz is fed equally to the F.E.T. sources, the resulting out-of-phase heterodyne component outputs cancel in 5T2 primary - leaving (theoretically) the two in-phase sidebands. Preliminary lower sideband filtering is performed by 5L2, the output is then amplified by 5VT3 by around 12dB. Finally, the signal arrives at 5F1, the double helical filter which provides the main upper sideband rejection.

Alignment requires the use of a U.H.F. signal generator and a V.H.F. one. Alternatively, completed and working transmitter boards 1 and 3 may be used, or a combination. An R.F. millvoltmeter is needed and a sensitive wavemeter would be useful. The ideal is, of course, a Spectrum Analyser!

The first task is to adjust 5VT3 bias - to do this, turn 5RV2 to MINIMUM resistance. Apply +12V. With a voltmeter connected to 5VT3 collector and ground, adjust 5RV2 for 6V. This can be optimised for best video (differential phase and gain, etc.) when the whole transmitter is finished.

Inject around +10dBm of I.F. into the I.F. input, and around +5dBm into the heterodyne input. (More may be required initially until a rough alignment has been achieved.) Set 5RV1 to mid-travel. With the wavemeter or R.F. millivoltmeter connected to the output, tune 5C6, 5C7 and 5C17 for maximum 433.6MHz out. Slight adjustment of 5C1 and 5C2 values may improve output and the video bandwidth. 5C6 and 5C7 settings should be roughly symmetrical.

Remove the I.F. input, adjust 5RV1 for minimum 473MHz output (Carrier balance). The output should be +2dBm approximately.

6. U.H.F. PRE-AMPLIFIER.

This is a straightforward amplifier requiring only a signal generator or part completed transmitter, and and R.F. millivoltmeter or sensitive power meter for alignment. The gain of this unit when aligned is typically +15dB and will probably need backing off a little in a completed transmitter system. An output of 50-100mW with good linearity is achievable. Inject a U.H.F. signal of +5dBm of 436MHz into the input. (433.6MHz may be used, but this will give inferior results as it is not band centre.) Adjust 6C1, 6C2 and 6C4 for maximum output. Some movement of 6L6 and 6L7 may also help. Again, it must be stressed that only good 2N3866's are suitable - surplus ones invariably only operate satisfactorily at V.H.F. A current of around 40-60mA quiescent should be drawn.

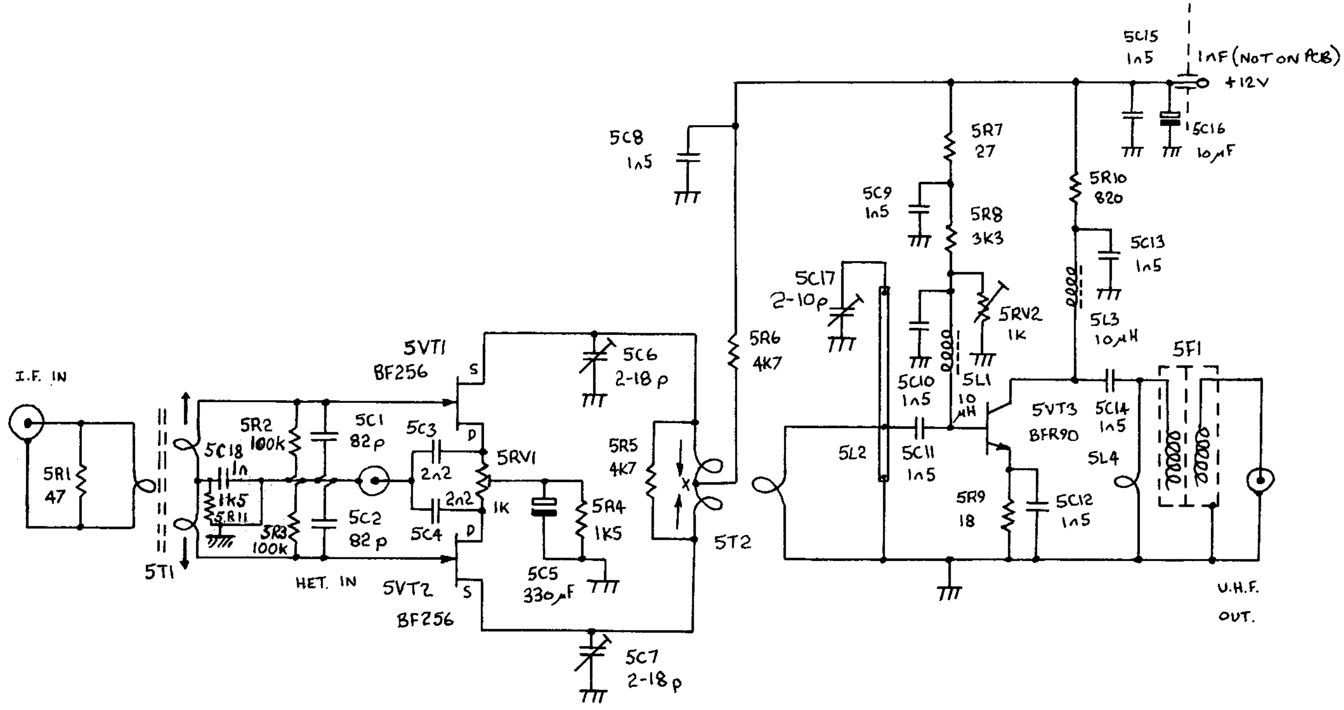


Fig. 9 5. U.H.F. MIXER.

7. POWER AMPLIFIER

This is the most expensive unit, requiring a Mullard BLX67 R.F. Power Transistor. This device is actually capable of 3½W C.W., but in order to achieve good IMD performance (linearity) the output is restricted to 1W peak sync. Both drive (BFW16) and output run in Class A. 7VT1, the BFW16, can be replaced by a 2N3866 without too much sacrifice of linearity. (If this is done the bias will probably need adjustment to give a collector current of around 30mA.) Some sacrifice in potential gain has been made in order to reduce the number of variables - thus easing alignment.

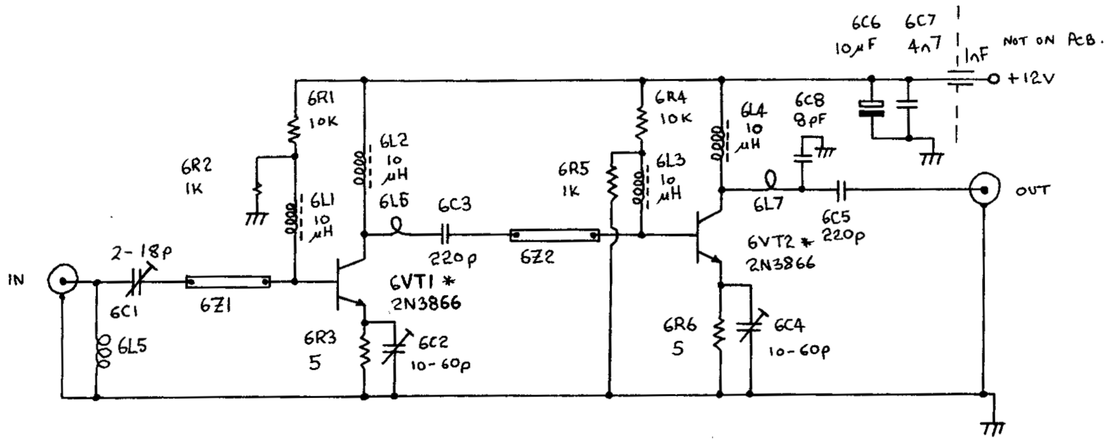
An R.F. power meter and U.H.F. signal generator (or part completed transmitter) are required for alignment. The first task is to adjust 7RV1 until a collector current of 200mA is reached. Proceed as per the instruction for setting up 5VT3. For peace of mind a ½A fuse should be included in the Supply Line. (Especially if powering from a car battery.)

Inject a 436MHz signal at the input of about +15dBm. Connect the power meter to the output. Adjust 7C2, 7C3, 7C5, 7C6 and 7C7 for maximum power out. Some size adjustment of 7L5 may be necessary. 7C2 tuning is quite sharp. If equipment is available, 7C2, 7C3 should be adjusted for best input return loss and not gain - this helps ensure stability of the amplifier chain. An SWR meter could be used to do this.

SYSTEM TESTS.

Once all the modules have been tested and aligned, the whole transmitter can be connected up. (As directed earlier.) Providing care has been taken with screening, decoupling and module alignment, the transmitter should function with no more adjustment, except perhaps backing off the linear amplifier chain gain (stagger tune). With no input, the transmitter will give about 1W C.W. when the gain is right. Upon applying a standard level black and sync. signal to the input, the power should fall to about ½W.

The video performance can be observed on an oscilloscope by using a diode probe circuit such as has appeared in CQTV many times and in the Radio Amateur's Handbook. For this the V.S.B. filter should be linked out to give A.M. (The simple detectors only give true demodulation for A.M. - V.S.B. requires a V.S.B. receive filter characteristic.) If test patterns such as staircase and burst are available, modulation depth, R.F. amplifier biasing/tuning etc. can be optimised. Time and patience can be a replacement for thousands of pounds worth of equipment.



* 2N5109 OR BFW16A ETC.
MAY BE USED WITH
SMALL ADJUSTMENTS.

FIG. 10 6. U.H.F. DRIVER.

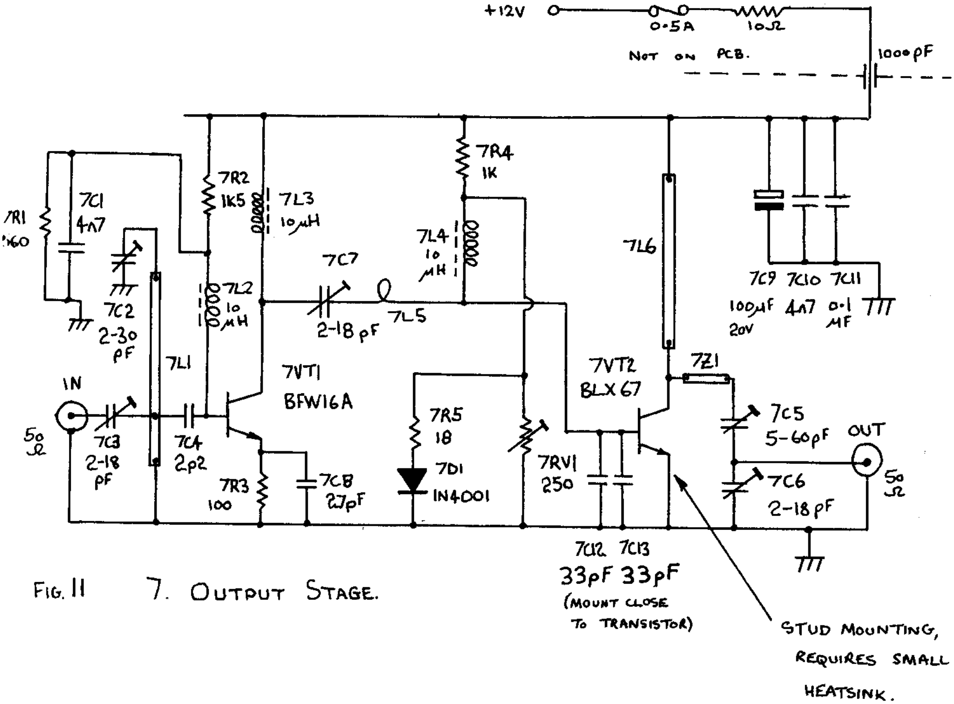


FIG. 11 7. OUTPUT STAGE.

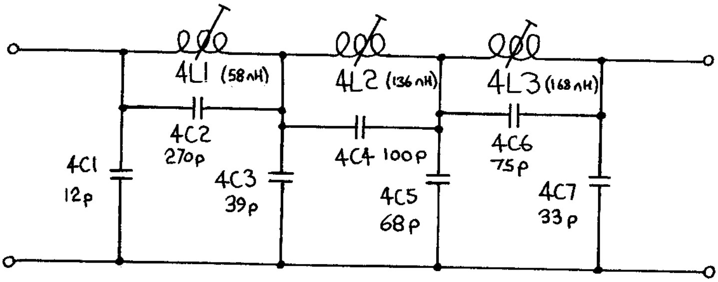


FIG. 8 4. V.S.B. FILTER.

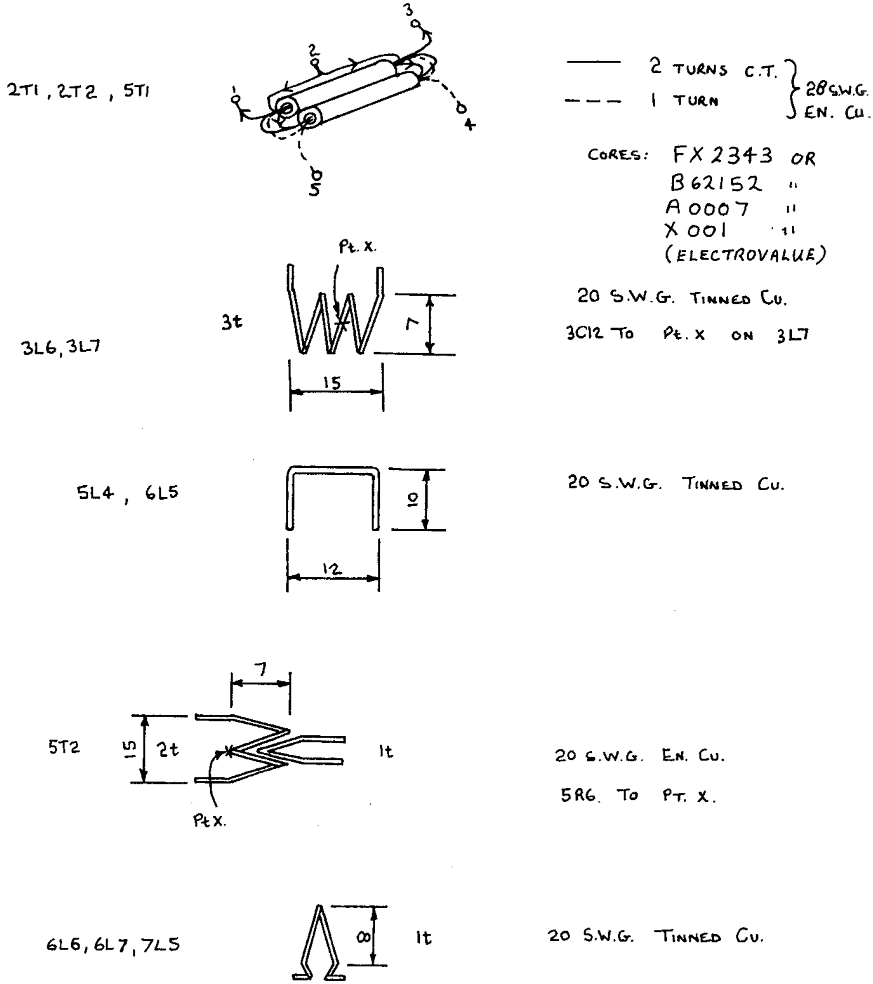
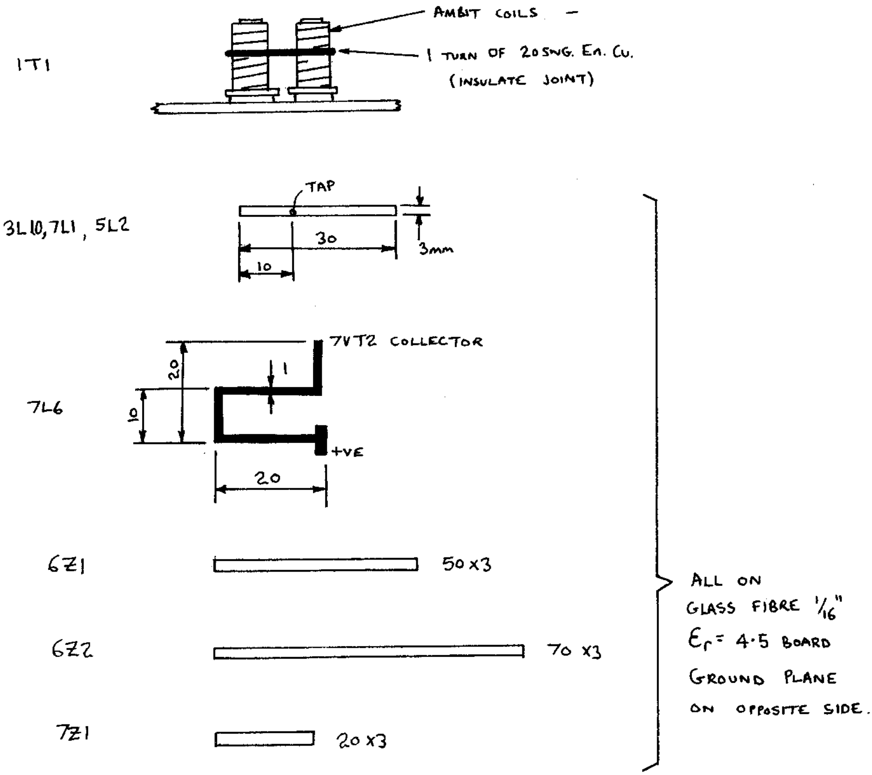


FIG. 12.

NB 3 ELECTROVALUE CORES ARE REQUIRED END TO END, PER TRANSFORMER



AMBIT COILS
1T1
1 TURN OF 20 SWG. EN. CU.
(INSULATE JOINT)
TAP
3L10, 7L1, 5L2
30
10
3mm
7VT2 COLLECTOR
7L6
20
1
10
+VE
20
6Z1
50 x 3
6Z2
70 x 3
7Z1
20 x 3
ALL ON
GLASS FIBRE 1/16"
ε_r = 4·5 BOARD
GROUND PLANE
ON OPPOSITE SIDE.

FIG. 13.

CONCLUSION.

Nothing in this transmitter is particularly expensive, the crystal is probably the most expensive bit, and the R.F. power transistor a closer second at around £5. The project is intended for someone with a reasonable background in R.F. construction - it cannot be described as a simple project.

Careful, methodical construction is the key coupled with no-skimping on components!

The author would recommend a valve P.A. to follow the transmitter to give more output - the linear transistors for 70-80W R.F. output are not cheap - about £70, and probably impossible for the Amateur to obtain anyway. Some commercial valve S.S.B. linears may well be suitable, if they have the bandwidth.

INDUCTOR LIST

1L1	AMBIT S18 6.5 turns
1L2	" " " "
3L2	" " " "
3L3	" " " "
3L6	
3L7	See Drawings
3L9	
4L1	AMBIT S18 1.5 turns
4L2	" " 3.5 turns
4L3	" " 3.5 turns
5L4	See Drawings
5F1	AMBIT 252MT 1001A
6L5	
6L6	
6L7	
6Z1	
6Z2	See Drawings
7L1	
7L5	
7L6	
7Z1	

TRANSFORMER LIST

1T1	(AMBIT S18 6.5 turns - 2 off)
2T1	
2T2	See Drawings
5T1	
5T2	

NOTES:

1. All drawing dimensions in mm in Fig.10 +Fig.11

2. All Ambit S18 Coils have ferrite screws

CAPACITORS: All small valued fixed capacitors should be ceramic plate.
All trimmers are film dielectric types, although Johannsen types could be of advantage on boards 5, 6 and 7.

Printed circuit boards are available for this project

FM TV TRANSMITTER

CHAPTER 5

By Trevor Brown G8CJS.

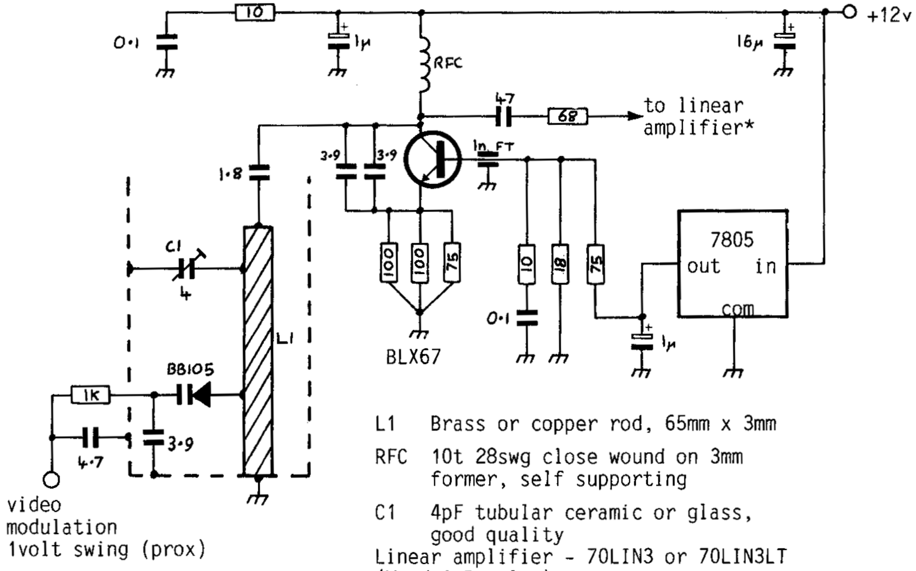
Fig.1 shows the heart of an FM television transmitter, employing a very stable free running oscillator designed to operate in the frequency range of 420 to 440MHz. The oscillator's stability comes from the design parameters and construction techniques. Using a 3 watt power transistor and considerably under-running it avoids any temperature drift. The construction is made as rigid as possible, in this way avoiding frequency changes caused by mechanical changes. A typical figure for drift is about 100KHz over several hours use.

The frequency of the oscillator is set by L1 C1 and the variable capacity diode. The modulation of the oscillator is carried out by driving this varicap diode with a video signal. The video signal is processed by the circuit shown in Fig.3. The incoming video undergoes pre-emphasis, which increases the H.F. component by 6dB's at 5MHz. This is not to C.C.I.R. standards, but is quite reasonable for amateur applications in the absence of any standards. TR1 is a dc restorer, which removes any dc level changes that often accompany video signals. TR2 and TR3 are a unity gain amplifier which present a low impedance video to the varicap diode.

The construction diagram in Fig.2 must be followed very closely. FM television has not been aimed at 70cms due to the lack of frequency space, and the fact that linearity is not a problem. By running the oscillator on 430MHz, setting up and amplification can take place using already proven experience. By moving the frequency down to 420MHz, the drive source can be used in conjunction with a tripling amplifier or varactor tripler to the 23cms band.

The standing current of the BLX67 must be kept below about 8mA in order to keep the device cool. To this end the emitter resistor is made up of a collection of resistors which may require some adjustment.

The output of the oscillator is about 50 to 80 mW and should first be followed by a linear amplifier such as the Wood & Douglas 70 LIN 3 this ensures oscillator stability. After a single stage of linear amplification, it is permissible to use non-linear amplifiers.

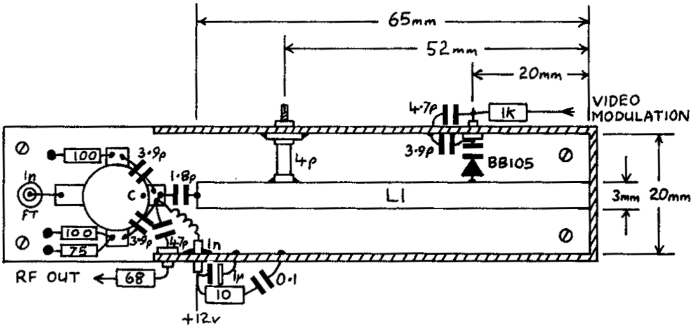


L1 Brass or copper rod, 65mm x 3mm

RFC 10t 28swg close wound on 3mm former, self supporting

C1 4pF tubular ceramic or glass, good quality

Linear amplifier - 70LIN3 or 70LIN3LT (Wood & Douglas)



Trough made from copperclad PC board (good quality) or sheet copper or brass.
Trough height is 20mm.
Trough should be securely mounted and have good connections to ground.
BB105 diode is tipped white and may be taken from ELC1043 types of domestic TV tuners.

It is not good practice to raise the power level excessively before tripling as out of band radiation may occur.

Fig.4 shows one solution to the problem of getting from 70cms to 23cms in the form of a varactor tripler. The tripler was originally designed for 384MHz input and 1,152MHz output, the box used was an RS993, the equivalent Eddystone box is a little smaller.

By using trimmers of a very small minimum capacity, it is possible to make the tripler work on 420MHz input 1,260MHz output. The BXY35A may be a little difficult to come by, but a suitable replacement is the VBC75a which is capable of 4 watts at 23cms.

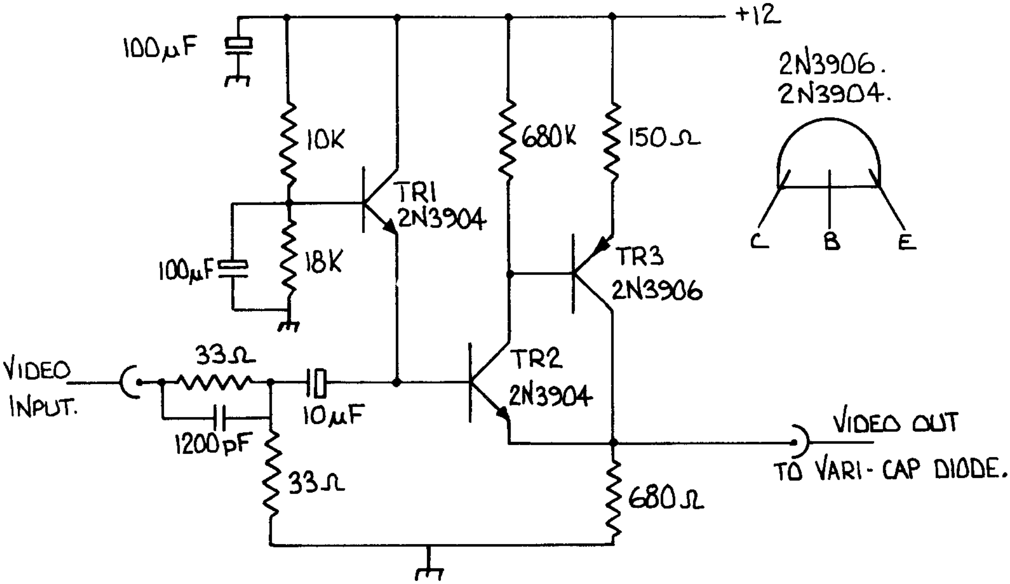
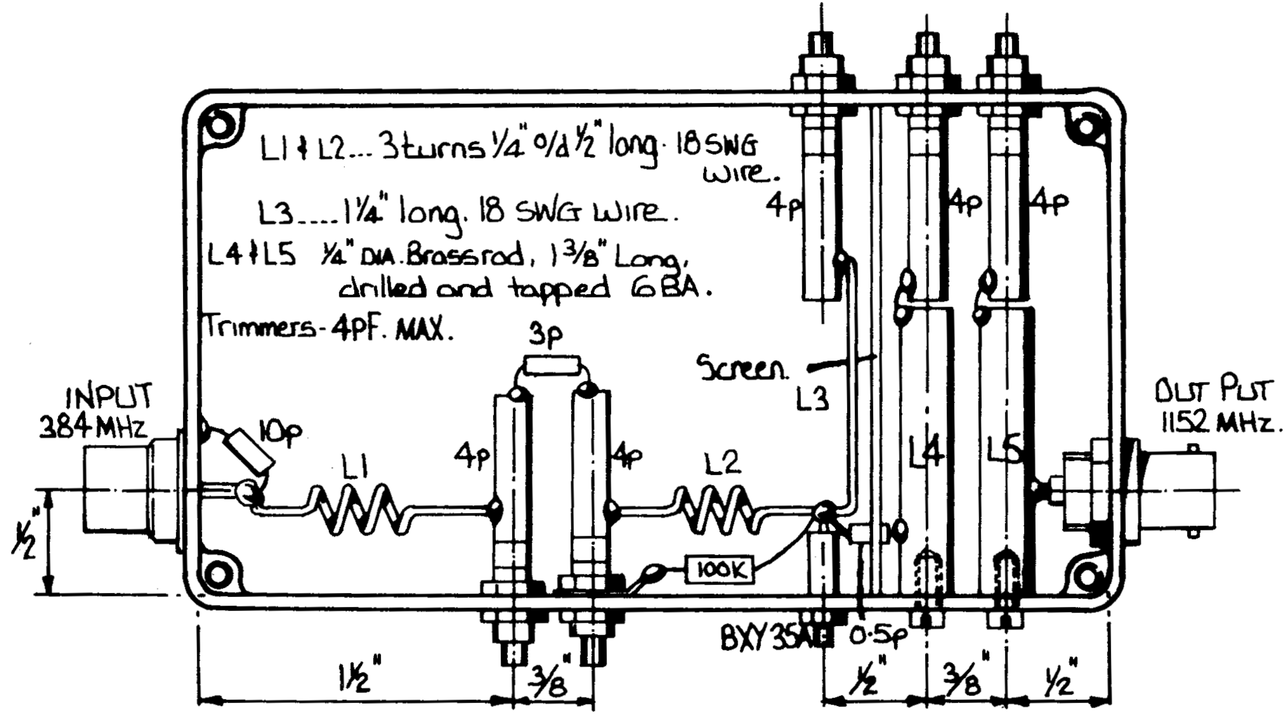


FIG.3.



LAYOUT OF TRIPLER.

24 cms AERIALS

By M. Walters G3JVL.

INTRODUCTION

The Alford Slot antenna, which has been developed for 1.3GHz by G3JVL, is an easy means of obtaining an omni- directional radiation pattern with horizontal polarisation. The antenna has a gain which depends principally upon its length and is typically 5 to 9 dBi. This is a better performance than other simple omni-directional antennae commonly used such as halos or whips.

It is particularly suitable for a beacon or repeater antenna where an omni pattern is required with as high a gain as possible. In this application it is possible to stack two such antennae end to end (as used at the beacon GB3IOW) and nearly double the gain. With higher path losses on 23cm compared to 2m and 70cm the extra gain makes it particularly useful as a mobile antenna.

DESCRIPTION

The antenna consists of a length of slotted tubing as shown in figure 1. The width and length of the slot, the wall thickness and the diameter of tubing are all related and much experimental work has been done by G3JVL and G3YGF to evolve some working designs, details of which are given below :

Tube Dimensions	Slot Width	Slot Length
31.8mm OD, 20swg wall	4mm	510mm
35.8mm OD, 1.1mm wall	8mm	510mm
38.1mm OD, 16swg wall	11mm	510mm

The dimensions cover three common sizes of tubing available (copper, brass and aluminium materials are all suitable). If they are not followed exactly then some experimentation will be necessary for correct operation. In any case, it is advisable to check the field distribution in the slot as explained later.

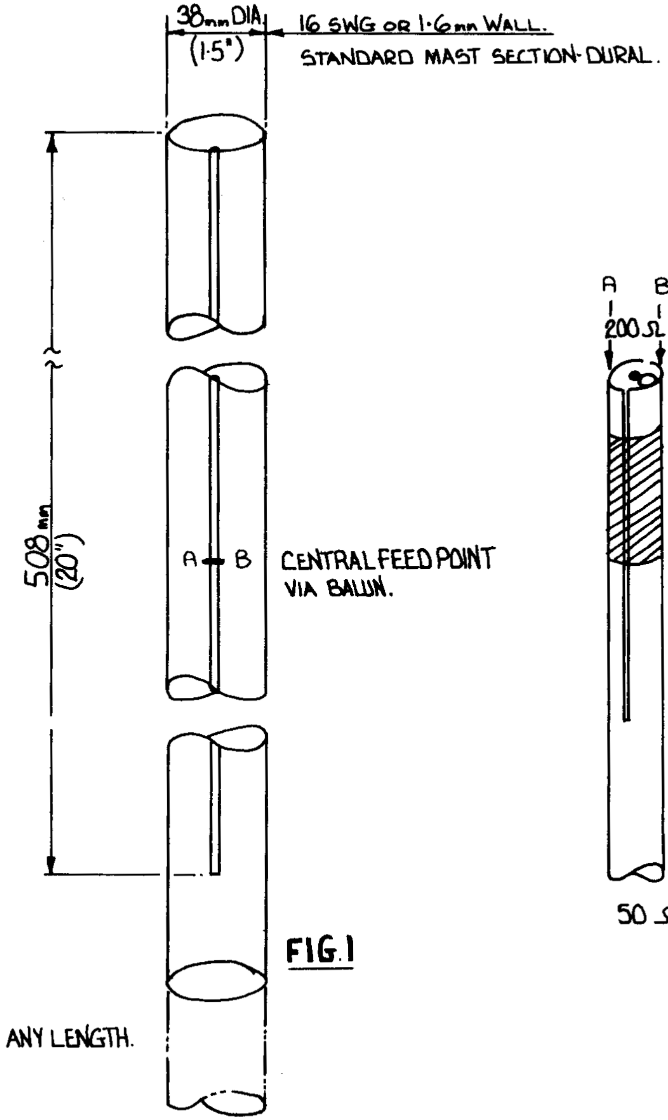


FIG.1

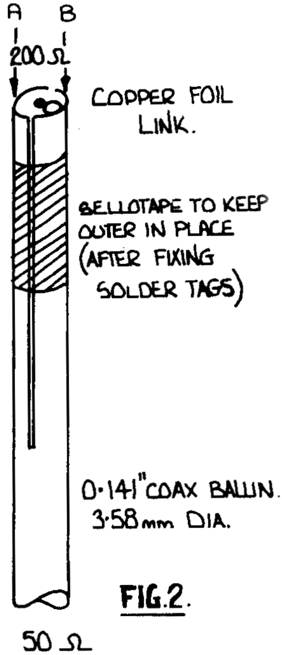


FIG.2.

The length of tube beyond the slot is completely uncritical and the same tube could be used both as a mast and as an antenna! This includes the length of tubing above the short, so that either a simple short across the slot or a disc covering the top can be used, or the tube can be extended upwards in a similar manner to the bottom.

The feed impedance of these antennae is approximately 200 ohms. A convenient method of feeding from 50 ohm coax is to use a 4:1 balun which is fabricated from semi-rigid coax, as shown in figure 2. It consists of a piece of 0.141 inch (3.6mm) semi-rigid with two slots cut along opposite sides of the outer. The two leaves formed by the coax outer form a twin wire transmission line which is a quarter wave long, and short circuited at one end. This quarter wave resonator is excited by connecting the coax inner conductor to the end of one of the leaves. The two sides of the semi-rigid a and b are connected to the feed point of the slot (see figs 1 and 2). A convenient method of doing this is to attach small solder tags to the cable so that small screws can then be used to attach the balun assembly to the sides of the slot.

The cable should be bent round after leaving the feed point so that it sits somewhere between the back wall and the centre as it passes down the tube. The exact arrangement is uncritical so long as the cable does not come too close to the slot and upset its operation (apart from the feed point of course).

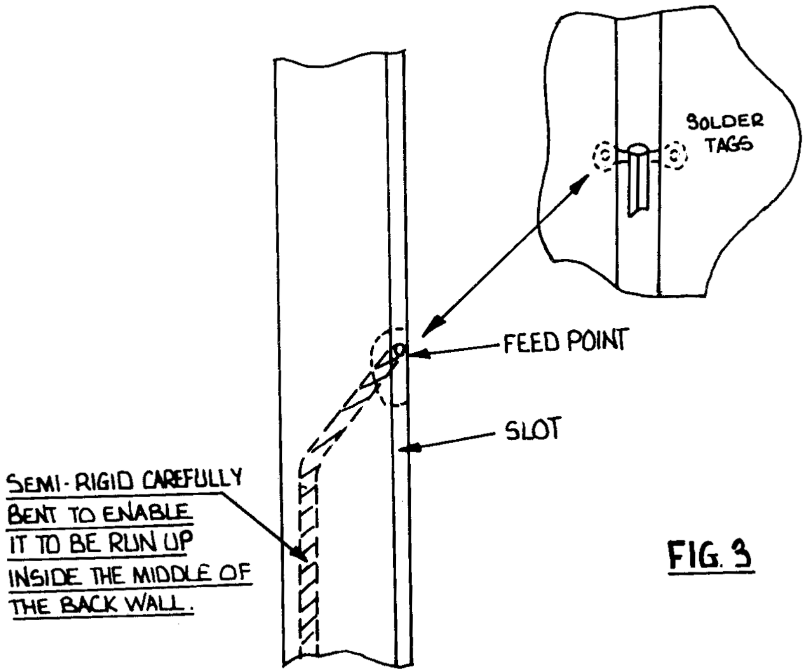


FIG. 3

It is not necessary to connect the cable to the inside of the tube as it passes out of the bottom. However, a convenient method of mounting is to fit a shorting plate of some description across the bottom with an N-type plug or socket in it. The antenna can be mounted entirely by the N-type connector as shown in figure 4. This method is particularly convenient for mobile use where the N-type can be screwed on to a female back to back bulkhead fixed to the roof. This feedthrough in the roof can of course be used for other bands as well. Obviously many other methods of mounting are possible.

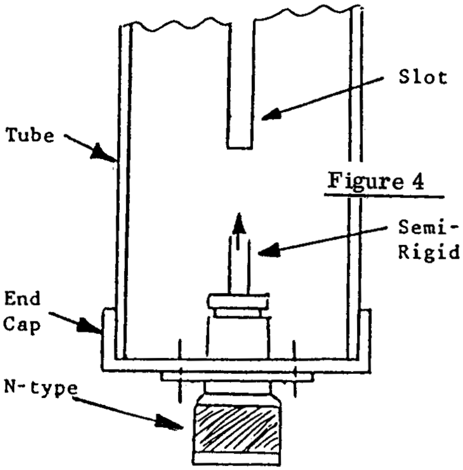


Figure 4

NOTES ON CONSTRUCTION.

1) The slot in the tubing can be cut with a hacksaw blade and filed to size. It will be necessary to drill a few holes to start off with.
2) If the tubing used is a plumbing material (e.g. 35mm copper central heating piping), then other fittings will be available. In particular a pipe blanking cap can be used at the base which will solder or clamp to the tube and in the centre of which an N-type connector can be mounted to bring the coax into the tube from the outside world.
3) The semi-rigid coax for the balun can be held in a vice and bent slightly while the cuts are made. Care should be taken not to cut into the dielectric too much. The leaves should be kept in contact with the PTFE dielectric, and not bent apart at all.

4) At the feed point two holes can be drilled and tapped to fasten the solder tags. Alternatively, the tags can be directly soldered to copper or brass tubing and the balun fastened to these later (a blow torch being needed for the first operation, a soldering iron sufficing for the second).
5) The presence of moisture on the inside of the tube will not affect its operation, apart from the balun getting wet, which will introduce a slight loss. However, water will accumulate in the tube and this is not desirable. The slot can be sealed with PTFE adhesive tape. An alternative approach is to enclose the whole assembly in a container such as a sealed length of plastic drainpipe. This method has been used successfully at GB3IOW.

OPERATION

Slot antennae are not new - a vertical half wave slot is equivalent to a horizontal half wave dipole and produces horizontal polarisation. The novel feature of the Alford is that by making the wave travel up the slot faster than light it is possible to obtain a dipole type field distribution over its length which is many times longer than the free space half wavelength value. The net gain is similar to that obtained by feeding several dipoles in phase, but is obtained without the need for a complicated phasing harness. The gain obtained is directly proportional to the length of the slot in free space in half wavelengths.

The idea that waves are travelling faster than light would at first seem impossible, but in fact it is only a standing wave pattern that appears to travel at this speed; the actual wave travels at a lower velocity than light.

The slot behaves like a transmission line shunted by inductive loops (the solid cylinder is equivalent to an infinite line of closely spaced loops). Cut off occurs when the shunt inductance resonates with the capacitance of the slot. Below the cut off frequency waves cannot propagate at all. At the cut off frequency, the velocity (and hence wavelength) is infinite. Above the cut off frequency the wavelength eventually decreases to the free space value.

In principal, any velocity factor could be used, but the higher the velocity factor (longer the slot), the more critical the dimensions. Velocity factors greater than about 10 are impractical for this reason and the normal operating range is around 5 to 15% above cut off, i.e. with velocity factors of 2 to 5. In the designs given, the velocity factor is approximately 4 and the bandwidth 100MHz at 1.3GHz. The gain achieved for the dimensions given will be about 8dBi.

The dimensions are, to a certain extent, interdependent. The velocity factor will be increased by decreasing the tube diameter, or by increasing the slot width. The wall thickness also has an effect since it determines the capacitance across the slot so that a thinner walled material will also increase the velocity factor. Thus, if a slightly smaller diameter tube was chosen than one of the designs, then this could be compensated for by using a slightly narrower slot so that the same velocity factor is achieved. Alternatively, the length of the slot could be decreased. The antenna would then operate with a lower velocity factor, but this would give a lower gain. For 1.3GHz antenna, the tube diameter should be within the range of those given, any tube much beyond these limits will not operate correctly.

It is important that the operation is checked, particularly if any of the original design paramters are changed. This may be done by feeding the antenna with a signal at various frequencies and looking at the voltage distribution using a power meter, detector or analyser with a small probe to pick up the radiated signal. The probe should be held close to the tube, but not directly in front of the slot (hold it 20 or 30 degrees round from the edge) and moved along its length. The diode current meter described in the microwave newsletter (08/81) would be suitable for this purpose.

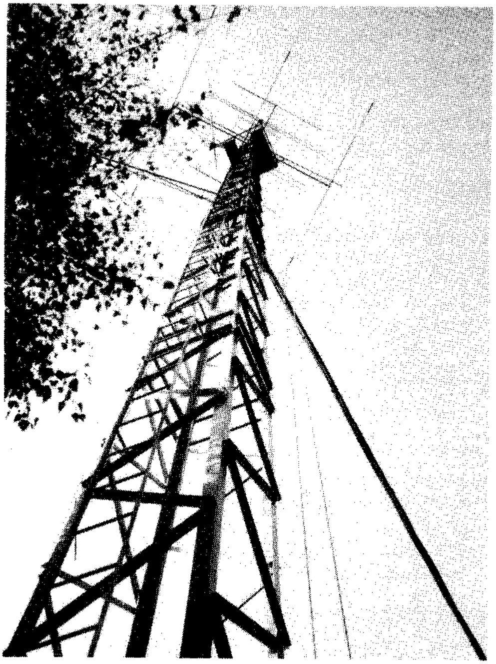
The balun works by taking the voltage on the unbalanced 50 ohm line and producing two output voltages relative to earth (the cable outer) which are equal to the input voltage but are 180 degrees out of phase with each other. The balanced load is connected between these two outputs and sees the difference between them, which is twice the 50 ohm voltage. Hence there is a 4:1 step up in impedance. The balun has a comparable bandwidth to the slot, about 10 to 15%. Note that the length of the cuts in the semi-rigid must be an electrical quarter wave long. Since the space between them inside is PTFE and the space around them outside is air, this gives an effective velocity factor of about 0.86. Thus the length is 0.86 times the free space quarter wavelength. If there is a significant gap between the leaves and the PTFE, then the velocity factor will be slightly higher.

SUMMARY

The antenna represents a very practical means of realising horizontal polarisation with an omni-directional pattern and high gain on 1.3GHz. The bandwidth is sufficient to cover all of the band so that it would be suitable for any modes including TV. The circularity is very good (ratio of max to min gain) being typically 1dB. This type of antenna has also been used on other bands successfully - G3JVL has used it on 2m, 70cm and 13cm. For further details contact Mike Walters G3JVL, or Julian Gannaway G3YGF, or the RSGB Microwave Committee.

BIBLIOGRAPHY

1. Radio Communication: August 1981 page 732 (RSGB).
2. Microwave Newsletter: 02/82 and 08/81 (RSGB).



The above aerial system belongs to Marc Chamley F3YX (Paris). Marc's 70cms TV pictures can often be received in the South of England.

A FM-TV RECEIVER

By J.Wood G3YQC

There is no doubt that frequency modulation is by far the most widely used ATV mode at present in use in the 1.3GHz band. This is probably due to the realisation of the not un-considerable advantages that this mode offers over amplitude modulation. Another leading factor is that all of the proposed ATV repeaters cater for FM-TV.

When presented with the choice between AM or FM the first, and most common, reaction is "....but FM is so difficult to receive as it requires a special demodulator for correct reception". True, it does need a special demodulator but it need not be very complicated or expensive to build and - in this design - needs almost no test equipment to align.

There are various ways of incorporating an FM-TV receiver in the shack and these will be discussed later on.

SYSTEM REQUIREMENTS

1. An FM-TV receive system needs to have sufficient bandwidth to enable the whole of the signal to be demodulated. If the receiver bandwidth is narrower than the signal deviation, video or syncs will be lost, conversly, if the receiver bandwidth is too wide the demodulator will not produce a full amplitude video signal at its output.

2. Front-end gain should be sufficient - when used in conjunction with a domestic varicap TV tuner - to cause limiting in the PLL (IC2) at around the noise threshold, this will ensure that even a weak signal will be correctly received.

3. The system should have a low impedance input and be capable of being driven from a varicap or similar TV tuner.

4. The system should deliver a standard 1 volt peak-to-peak composite video output suitable for feeding a monitor or an RF modulator.

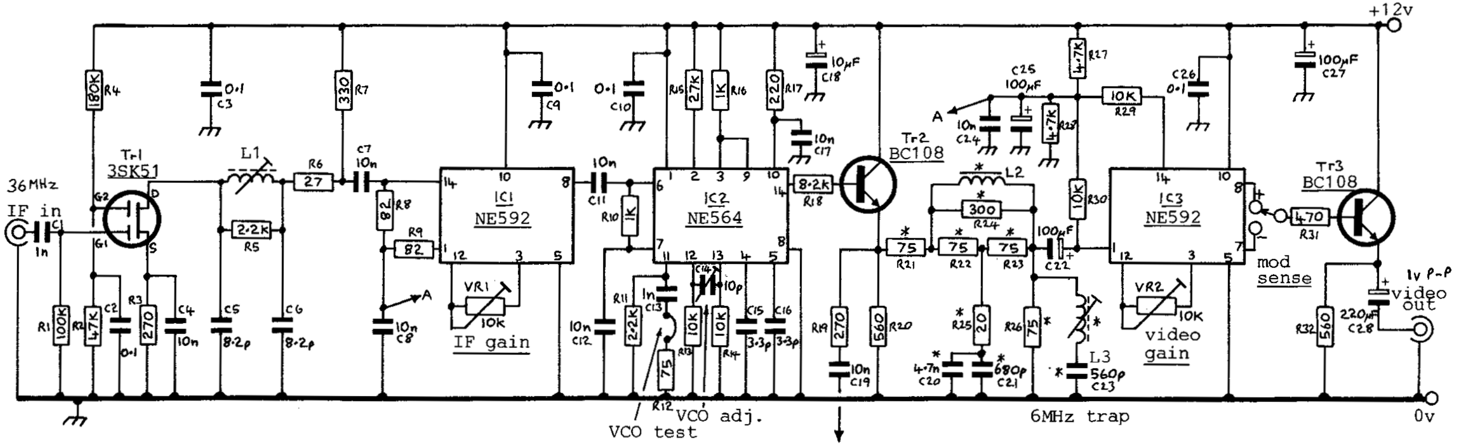
5. Variable front-end gain should be provided to cater for different input levels.

6. CCIR standard de-emphasis should be available as an option.

7. Provision should be made to extract an inter-carrier sound signal.

8. The unit should be powered from a single 12 volt d.c. source (excepting any tuning voltage requirements) to enable portable operation.

9. The whole should be accommodated on a single printed circuit board.



Notes.
R26 should be omitted.
Wire a 100pF capacitor in
parallel with R18.

L1 - Toko TKXCA34732 CN (36MHz)

L2 - 33uH fixed choke 144LY-330

L3 - Toko MKANSK1731 HM (6MHz)

Ambit International

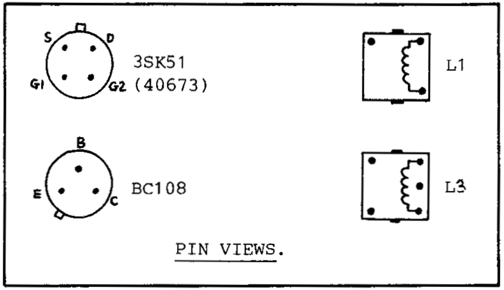


Fig. 1 FM-TV RECEIVER CIRCUIT DIAGRAM

CIRCUIT DESCRIPTION

Input to the receiver is directly from a varicap tuner and is applied to gate 1 of Tr1. A MOSfet is used in order to give high amplification together with low noise performance. The tuned circuit L1 provides some selectivity which helps with the overall noise performance, R5 damps this circuit to provide sufficient bandwidth. The signal passes to an NE592 wideband amplifier i.c. operating at the IF frequency. A gain control is provided but in this design will usually be set to maximum. The output of IC1 passes directly to the PLL demodulator IC2. This device was chosen for its superb linearity and ease of use. The circuit has been described in various forms in previous issues of CQ-TV. C14 sets the voltage controlled oscillator (VCO) which should be at the IF centre frequency. A test point is provided on the board for this purpose. The demodulated video signal passes through an emitter follower (Tr2) where the sound signal is extracted. The following passive circuit is a de-emphasis network whose response is set for the CCIR standard. At present, in the U.K., no emphasis standard has been established and indeed there may not be a need to do so for amateur work. Provision is made on the board though in case de-emphasis is needed in the future or in case the receiver is used for the reception of satellite TV. Video passes to IC3 - a second NE592 - this time acting as a video amplifier. This stage also has a gain control which sets the video output to 1 volt peak-to-peak into a 75-ohm load. There are two outputs from IC3 providing both positive and negative going video signals. Provision is made to switch between these outputs enabling both standards to be received - useful for the continentals! Tr3 is another emitter follower providing a 75-ohm video output.

COMPONENTS

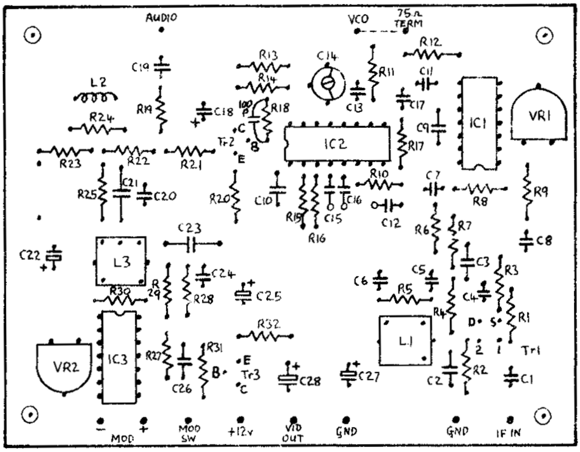
Most of the components are available from AMBIT International. The three integrated circuits are ordinary plastic dual inline packages (suffix 'N'). If de-emphasis is not required the following components should be omitted: R21, 22, 23, 24, 25, 26, C20, 21, 23, L2 and 3. The emitter of Tr2 should then be connected to the negative side of C22. The 6MHz sound trap cannot remain connected in its present position if the de-emphasis components are omitted. It may be possible to connect this later in the circuit if required, perhaps in the base circuit of Tr3. It is not recommended that i.c. sockets be used-especially for IC1 and IC2.

NE592 devices are unfortunately a little hard to come by (see suppliers list). A possible substitute could be the uA733. The device is pin-compatible and similar in concept but has not been tried in this design.

CONSTRUCTION

The printed circuit board is double sided, its component side being predominately a ground plane to ensure circuit stability. Components should be mounted carefully using minimum lead lengths. Where possible leads which connect to ground should be soldered on both sides of the board. Note that C12, C15 and C16 earth leads are soldered directly to the top of the board, there being no holes provided. The component side track connecting R9 and C24 should be soldered on both sides at each end. Care should be taken to insert the active devices the correct way round.

Vero wiring pins should be inserted into the holes provided round the edge of the PC board, these are used for the external connections.



FM-TV RECEIVER COMPONENT LAYOUT

ALIGNMENT

Alignment is very straightforward and may be carried out using no test equipment. However the following sequence should be carried out if possible: Connect +12 volts and ensure that this voltage appears on the i.c. pins and transistor collectors. Connect a frequency counter to the VCO test point and adjust C14 for a reading equal to the IF frequency (36MHz). C14 is usually around half mesh. Switch off and connect a link wire to terminate the test point with R12. Turn VR1 to maximum (fully clockwise) and VR2 to halfway. Connect the IF output from a varicap tuner to the input (see figs. 4 and 5) and a video monitor or oscilloscope to the output. Switch on and make sure there is plenty of white noise (snow) on the screen. Adjusting VR2 should alter the contrast. Peak L1 for best signal, its tuning will be rather flat.

OPERATION

Although it is possible to receive a FM signal on an AM receiver by 'slope' detecting, it is not possible to see an AM signal correctly on a FM receiver, therefore you will need a FM-TV signal to finally check the unit. When you first tune in a picture it is tempting to tune for maximum signal (best contrast) just as you do for AM. With FM though this is not necessarily the optimum position. In practice the receiver should be tuned for best LOCKED picture (correct 7:3 video/sync ratio if viewed on a 'scope).

NOTES

Please realise that tuning in a FM-TV picture is different from an AM one so a little practice may be required to realise the best from the system.

Although the circuit shows a supply of 12 volts, IC1 in fact prefers a little less (say 11v). Since the entire circuit may be powered from 11v it is desirable to provide this voltage rather than run the board from the shack 13.8v supply.

It has been found that pins 3 and 9 of IC2 require between 1 and 1.5 volts on them, this may be adjusted by altering the value of resistor R17, changing this voltage will alter the demodulated bandwidth which is set here to around 10MHz. One user has arranged to vary the main supply rail to acheive this effect, in this case the demodulator was being used to receive the Russian Gorizont TV satellite in the 4GHz band and thus required a bandwidth of some 30MHz! Of course the tuned circuit (L1) was removed.

It is quite possible to change the IF frequency of this unit (due to the fact that no complicated filters are used in the design) which will work quite happily at over 70MHz. If this order of frequency is required it should only be necessary to change the frequency of L1 tuned circuit and reduce C14 from its present 10pF to around 5pF maximum capacity. The VCO frequency will then require setting to the new IF centre frequency.
The sound output is designed to connect directly to a 6MHz ceramic filter as used in TV sound systems. In fact most ordinary TV systems are ideal for providing the sound channel.

For those interested, Fig.3 shows the demodulated waveform obtained by applying a sweep signal to the RF input.

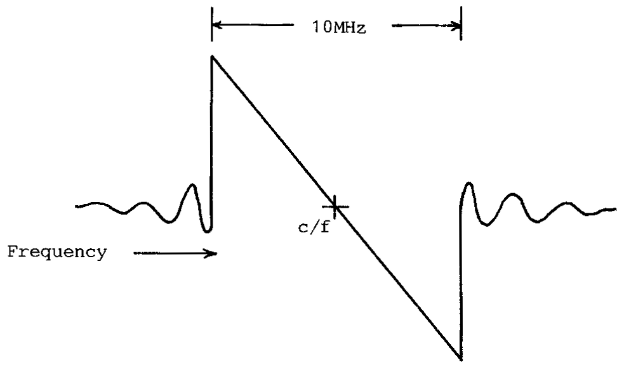


Fig.3 FM DEMODULATOR SWEPT RESPONSE

A measure of the linearity is the straightness of the line, although drawn here it is indeed very straight on an analyser screen.

INSTALLATION

The easiest and most versatile way to construct an FM-TV receiver is to custom-build it. A demodulator can be installed into an existing TV set, especially if the set is not required for AM as well, but this may mean a fair bit of work and will restrict the units veratility. A straightforward system is to simply connect a varicap tuner to the demodulator, provide a tuning control and put it into a metal box. This could, if desired, house a sound board and loudspeaker as well. Figs 4 and 5 give details of the connections for the U321 tuner and for the popular ELC1043 range. It is useful to provide a meter on the front panel to monitor the tuning voltage, this will give some indication of where in the UHF band you are tuned and may be calibrated in frequency or channel numbers if calibration facilities are available.

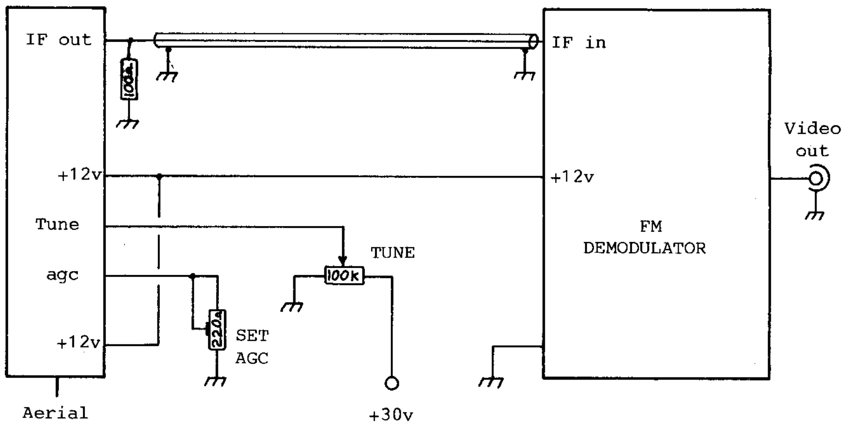


Fig.4 USING THE U321 VARICAP TUNER

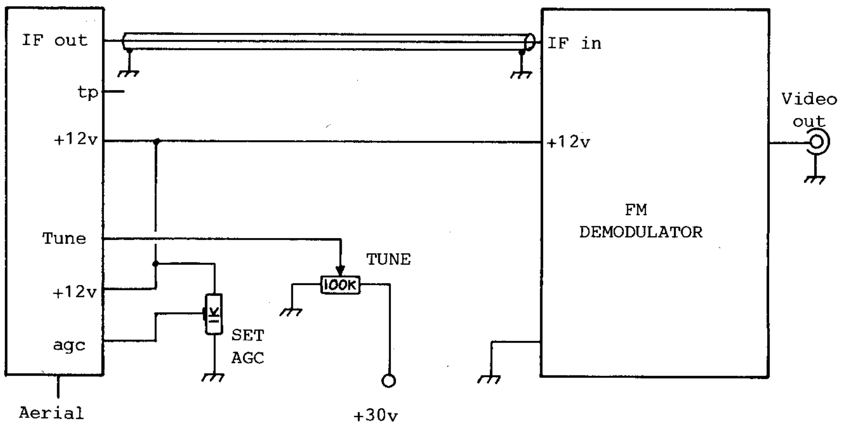
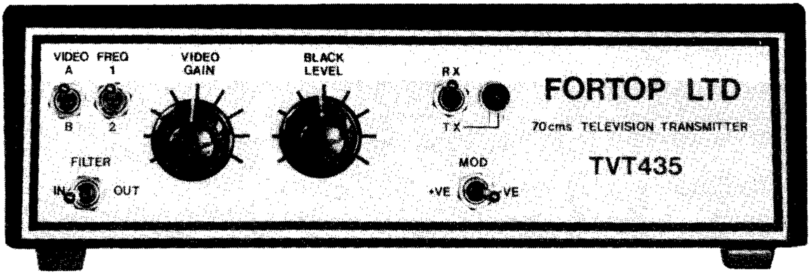


Fig.5 USING THE ELC1043 STYLE TUNER

All components - including the NE's are available from Ambit International, 200 North Service Road, Brentwood, Essex CM14 4SG.

NE592 and NE564 devices are available from Fortop Ltd., 13 Cotehill Road, Werrington, Stoke-on-Trent, Staffs. and from Technomatic Ltd., 17 Burnley Road, London NW10 1ED or Quarndon Electronics Ltd., Slack Lane, Derby.

PRINTED CIRCUIT BOARDS are available from Members Services.



THE TVT 435 AMATEUR TV TRANSMITTER IS BASED ON OUR HIGHLY SUCCESSFUL TVT 432 TV TX UNIT BUT INCORPORATES ADDITIONAL FEATURES FOR THE SERIOUS ATV ENTHUSIAST.SWITCHES CONTROL THE CHOICE OF TWO VIDEO INPUTS, TWO VIDEO CARRIER FREQUENCIES, INSERTION OF A VIDEO BANDWIDTH LIMITING FILTER, POSITIVE OR NEGATIVE MODULATION SENSE AND POWER ON-OFF.VIDEO GAIN AND BLACK LEVEL CONTROLS ALLOW PRECISE ADJUSTMENT OF THE TRANSMITTED VIDEO SIGNAL AND OUR SYNC PULSE CLAMP CIRCUIT (WHICH WE DEVELOPED FOR THE TVT 432 UNIT) ENSURES MAXIMUM RF OUTPUT ON THE SYNC PULSE TIPS. THE OUTPUT FROM THE TRANSMITTER IS SPECTRALLY VERY CLEAN WITH VERY LOW LEVEL OF OSCILLATOR OR HARMONIC FEEDTHROUGH WITH NO VIDEO BUZZ ON YOUR 2 METRE TALKBACK CHANNEL OR BREAKTHROUGH ON TO BROADCAST TV CHANNELS.THE TVT 435 IS HIGHLY COMPACT AND OFFERS AN EXCEPTIONALLY HIGH STANDARD OF PERFORMANCE AND FACILITIES

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* AERIAL CHANGEOVER FOR RX CONVERTER BUILT IN
* 12-13·5v @ 3·5A SUPPLY

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