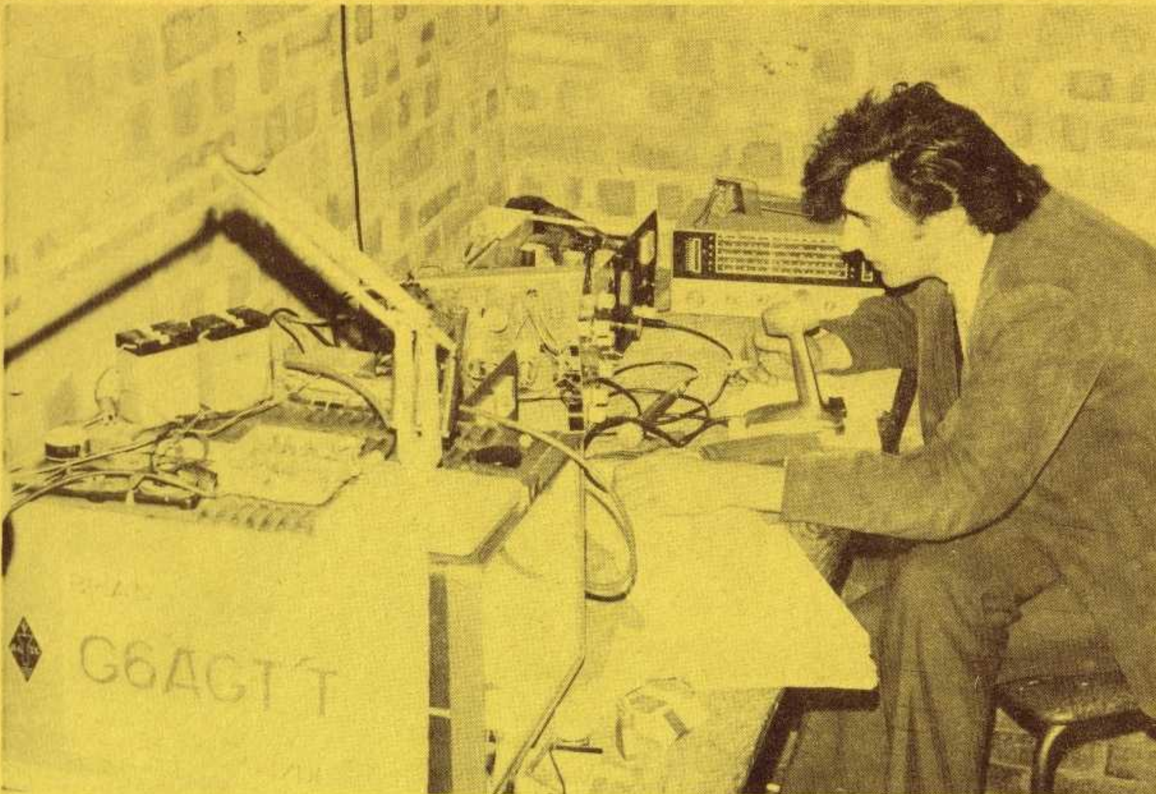


CQ·TV 82

THE BRITISH AMATEUR TELEVISION CLUB.

MAY 1973

THE BRITISH AMATEUR TELEVISION CLUB

Committee Members and Club Officers

C Q - T V is published quarterly by the British Amateur Television Club and is posted free to all members. Single copies are available from the Editor at 25p each; back numbers are also available to members at reduced prices.

Overseas members may have their copy of C Q - T V sent by airmail, for a surcharge depending on their country. Details are available from the Treasurer.

Members wishing to have material published in C Q - T V should send the manuscript and drawings to the Editor; articles are invited on all subjects of interest to amateurs and should be of about 1500 words; larger articles should be divided into convenient Parts for publication in consecutive issues of the journal.

EDITORIAL

A new committee member this month is G6AGT/T, Brian Kennedy who has been co-opted as Contest Organiser. The recent 70cm atv contests have proved very successful, and the services of an organiser are now required to make the programme work as successfully as it should. If you are licensed please read the new "atv contest news" column and enter the contests - support so far has been good but, dare we say it, some areas have seemed a little disinterested.

On a similar subject, would there be any support for a purely British SSTV Contest? Any comments to Brian Kennedy please.

February saw the inauguration of a Midlands Video Group, with regular meetings planned. Anyone within range of Oldbury, Worcestershire, (and this seems to cover a large area if those attending the first meeting was anything to go by) should contact the Chairman whose address is-
Arthur Burington G6AFV/T
53 Knottsall Lane,
Oldbury,
Worcestershire.

The last issue of C Q - T V contained a mistake of course, we usually manage to slip one in! In the article by Malcolm Sparrow G6KQJ/T on Receiving Amateur tv that "link standard" you may have been worrying about was intended to read "line standard". Also, on the circuit diagram the terminal labelled -12v should have read earth; the supply needed is only 12 volts, not 24.

Malcolm has also written the article on the 405 line SPG in this issue, and as he points out, this line standard is rapidly dying out, although remaining very popular with amateurs. The 1972 report of the TAC* urges the broadcast authorities to complete their 625 uhf networks as soon after 1980 as possible such that broadcast 405 can cease by 1985. This means, and amateurs please note, that 405 line tv receivers will be difficult or impossible to obtain atfer 1975. You have been warned!

We are very pleased to report that our most recent past President I.J.P. James has been awarded a Fellowship of the Royal Television Society. Congratulations from B.A.T.C.

THE EDITOR

* "Report of the Television Advisory Committee 1972" published by H.M.S.O. at 14½p.

CONTENTS

atv contest news

INTERNATIONAL AMATEUR TV CONTEST 1973

This event will probably be very much as last year; negotiations are being carried out with A.G.A.F. and A.T.A., and final details will be sorted out in time to be published in the August issue of C Q - T V.

NATIONAL AMATEUR TV CONTEST 1973

Organised by B.A.T.C.

Dates and Times 1700 - 2300 hrs G.M.T. Saturday 30th June 1973
0800 - 1200 hrs G.M.T. Sunday 1st July 1973.

N.B. The same station may be contacted in each of the two sessions, but not twice in the same session.

Eligible Entrants All amateurs licensed to transmit or receive amateur television. There will be three sections

A Portable Stations
B /A and Fixed Stations
C Stations who can only receive amateur tv.

Calling Call "C Q Video Contest" by sound on either 70cm or 2m and announce which band you will be listening on. In order to increase the number of QSOs, the calling frequencies normally used by the Midland Video Group, namely 144.25 and 432.75 will be available. (No video on 2m of course!)

Modes of Transmission A5 with A3, A3J or F3

Contest Exchanges shall consist of:

a) Serial no given by sound. The serial no shall start at 001 and increse by one per contact throughout the two sessions of the Contest.
b) The QTH (QRA) Locator and station location which shall be given by the distance in Km and bearing from a well known town or city.
c) The vision signal report based on the B.A.T.C. Reporting Chart scale 0 - 5.
d) The frequency of the vision signal received, as given in the vision caption (no points will be deducted if this is not given)

Contest Entry Logs should contain the following information in the following order:

1. Date and time in G.M.T.
2. Call sign of station contacted.
3. QTH (QRA) Locator received.
4. Station location as received.
5. My report on his vision signal.
6. His report on my vision signal.

7. The frequency of his vision as transmitted on his vision caption(to two decimal places)
8. Points calimed for the contact.

Scoring All entries must be postmarked not later than 23rd July 1973 and should be sent to:

The Adjudicator, B.A.T.C.
10 Pilgrim Road,
Droitwich,
Worcestershire. WR9 8QA

A cover sheet giving the following information should be enclosed with each entry.

1. Name and address for correspondence.
2. Call sign used.
3. QTH (QRA) Locator as transmitted.
4. Station location as transmitted.
5. Frequency of vision carrier as given by vision caption.
6. Claimed total score.
7. Brief details of vision station.
8. Best contact with distance.
9. Any other contacts.

N.B. All entrants must operate within the terms of their licence.

R E S U L T S O F 1 9 7 2 I N T E R N A T I O N A L A M A T E U R T V C O N T E S T

The results of the 1972 amateur tv contest are printed here, with the scores calculated as directed by the Regulations printed in C Q - T V No. 79. Section A was for those transmitting sound and vision, Section B for those transmitting sound only and Section C for those receiving vision only.

Brian Kennedy G6AGT/T runs the winning station, and for this contest he was assisted by Mervyn Dyke G6AHR/R; the operation was conducted from Turners Hill, 3Km south east of Dudley, Worcestershire (QRA is YM50B, 290 metres above sea level). Here are some details of his station.

Transmitter	QQV03 - 20A P.A. 25watts dc input, positive modulation.
Aerial	Single 46 element Multibeam.
Receiver	Transistor uhf Tuner feeding 14 inch Pye receiver.
Vision Source	Vidicon camera operating on 405 lines.

A	1	G6AGT/T	3309	B. Kennedy, 10 Pilgrim Rd., Droitwich, Worcestershire.
	2	G6AFW/T	3102	D. Stanley, 2 London Rd., Telford, Shropshire.
	3	DC8QQA	2205	R. Holstiege, 4401 Havixbeck, Altenberger Str 22.
	4	G6KQJ/T	1450	M. Sparrow, 64 Showell Lane, Wolverhampton, Staffordshire.
	5	DCØDD	1445	P. Smolin, 46 Dtmd-Hombruch, Grotenbachstr 9.
	6	DJ7HY	1396	G. Kiehl, 454 Lengerich, Postr 40.
	7	DC6MR	1254	H.Venhaus, 46 Dtmd-Hochsten, Wesengutstr 20.

	8	DJ4EZ	1062	G. Neugebauer 586 Iserlon, Liebigstr 1
	9	ON4UB/T	853	Rode Kruis van Belgie, Steenweg op Vleurgat 80, Brussels.
	10	G6GDR/T	679	L.V. Dent, 65 Tibbs Hill Rd., Abbots Langley, Hertfordshire.
	11	ON4HV/T	622	P. van Elsen, St-Hubertus laan 7, 2232 s'Gravenwezel.
	12	DJ3ZU	498	J. Hoever, Kempen, Bahnstr 45.
	13	DC6LC	388	H.Kohls, 4902 Bad Salzuflen 5, Lockhauser Str 10.
	14	DJ6TA	80	H. Schmidt, 53 Bonn 1, Brusselerstr 33/6/6
	15	DKIAQ	73	H. Gebauer 4811 Heepen, Parkstr 2F
B	1	DK6QM	849	G. Wartmann, 44 Munster, Biederlackweg 33.
	2	G3YQC	712	J.L. Wood, 54 Elkington Rd., Yelvertoft, Warwickshire.
	3	DC6FMA	272	M. Futterer, 463 Bochum-Sudern, Blankensteinerstr 200.
	4	DC8KJ	100	W. Gaich, 454 Lengerich, Munsterstr 72.
	5	DL8KT	49	W. Pruss 454 Lengerich, Diersmannweg 4.
C	1	DJ7RZ	40	E. Topper 4937 Lage/lippe, Aufden Sand 16.
	2	SWL	13	J. Ronnebaumer 4405 Nottuln, Billerbeckstr 92.
	3	DK6Q0	12	M. Seidel 4902 Bad Salzuflen, Grochteweg 35
	4	DK3HU	5	W. Kabuth 4902 Bad Salzuflen, Grabenstr 10.

RESULTS OF B.A.T.C. 432MHz CUMULATIVE ACTIVITY CONTEST 1973.

A	1	G6KQJ/T	854	Malcolm Sparrow, Wolverhampton.
	2	G6ACR/T	715	Alan Griffiths, Solihull.
	3	G6AGT/T	299	Brian Kennedy, Droitwich.
B	1	G3YQC	296	John Wood, Yelvercroft.
	2	G8CTT	85	Richard Buckley, Chislehurst.
	3	G8DXD/A	61	David Horro, Fernhill Heath.

During this contest the active stations included seventeen television stations and thirteen sound only stations.

A good "SSTV Handbook" has recently been published by "73 Magazine" and at Ø 4.50 is marvellous value - it is a mine of information. Authors are Don C. Miller W9NTP and Ralph Taggart WB8DQT, and it contains circuits of monitors, cameras, flying spot scanners and test equipment.

CIRCUIT NOTEBOOK No 13

J. Lawrence GW6JGA'T

Transistor Field Scan Circuits

The purpose of the field scanning circuit is identical to that of the line scanning circuit in that it has to provide a linear scan current and fast flyback.

However, as the scan coils are substantially inductive at line frequency and substantially resistive at field frequency, the circuitry employed for generating the field scanning current is quite different from that providing the line scan.

The basic arrangement is shown in Fig. 1 and consists of an oscillator, a ramp generator with resetting clamp and an amplifier. The oscillator is locked to the field sync pulses from the station pulse generator or to the 50Hz mains and provides pulses at 20mS spacing and having a duration of about 1mS or so. If field drive or blanking pulses are available these may be used directly in place of the oscillator, but then loss of drive means no scan and possibly a damaged camera tube.

The ramp generator may be a simple R.C. circuit, a miller integrator or other circuit for generating a linear voltage ramp. Pulses from the oscillator are arranged to reset the voltage ramp by clamping the rising output voltage back down to its starting point, thus producing the conventional sawtooth voltage waveform.

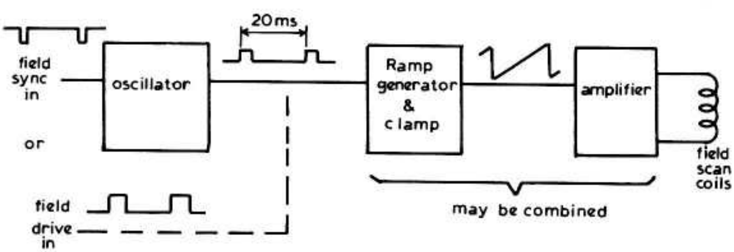


FIG.1

The output amplifier accepts the sawtooth voltage waveform and converts this into a current, either by feeding a replica of the input voltage to the coils directly or by additional circuitry providing series negative feedback for non-linearity correction.

Fig. 2 shows a typical field oscillator multivibrator circuit providing positive going pulses at field rate. The multivibrator may be synchronised by negative going field pulses applied to C1.

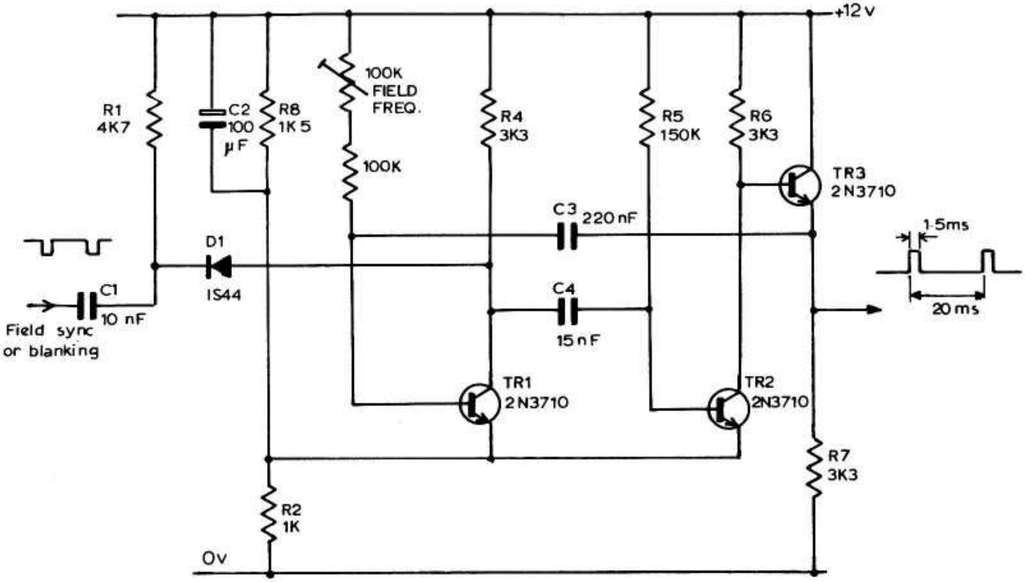


FIG. 2. Field Oscillator

A simple R.c. integrator and output stage is shown in Fig. 3. During the field scan Tr1 is turned off, C2 charges from RV1 and R4 producing a positive going voltage ramp at Tr2 base. Tr2 is an emitter follower driving the output transistor Tr3. At the end of the field scan Tr1 is turned on and discharges C2 producing a negative voltage step at Tr3 base and thus producing the conventional sawtooth voltage waveform. The inclusion of R5 provides the square addition to the sawtooth to compensate for the inductive effects on the scan coil voltage during flyback. The sawtooth current in Tr3 collector is cuupled to the scan coils by C4. Linearity correction is provided by negative feedback from Tr3 emitter through RV2, R7 and C3 to the bottom of C2.

The circuit in Fig. 4 uses a 'bootstrap' arrangement to generate an extremely linear scan current. During the scan C2 is charges through VR1 and R5. The rising voltage feeds the multi-

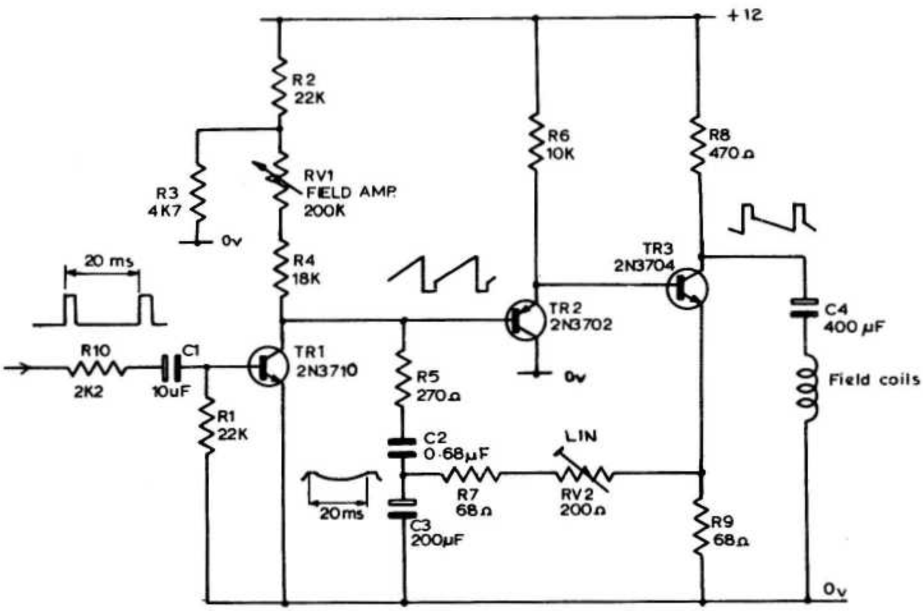


FIG. 3. R.C. Integrator and output stage

ple emitter follower configuration Tr2, Tr3 and Tr4 producing a linearly rising voltage at Tr4 emitter. The linear rise of voltage is passed via C6 to the top end of Vr1. This reverse biasses D1 and the charging current to C2 is then derived from the output.

This 'bootstrap' action produces an extremely linear scan voltage at Tr4 emitter and this is directly coupled to the scan coils. At the end of the scan, Tr1 is switched on, discharging C2 and providing the conventional sawtooth waveform at Tr4 emitter. Any charge lost from C6 is replaced through D1 during the flyback.

C8 provides decoupling for the shift control and as this decoupling is not perfect at field frequencies the resultant parabolic waveform across C8 is fed back to the bottom end of C2 via C3 and C4 to ensure correct linearity.

References Televisinn Engineering Vol 4
Amos & Birkinshaw Iliffe
Field Scan Generators p 188-215

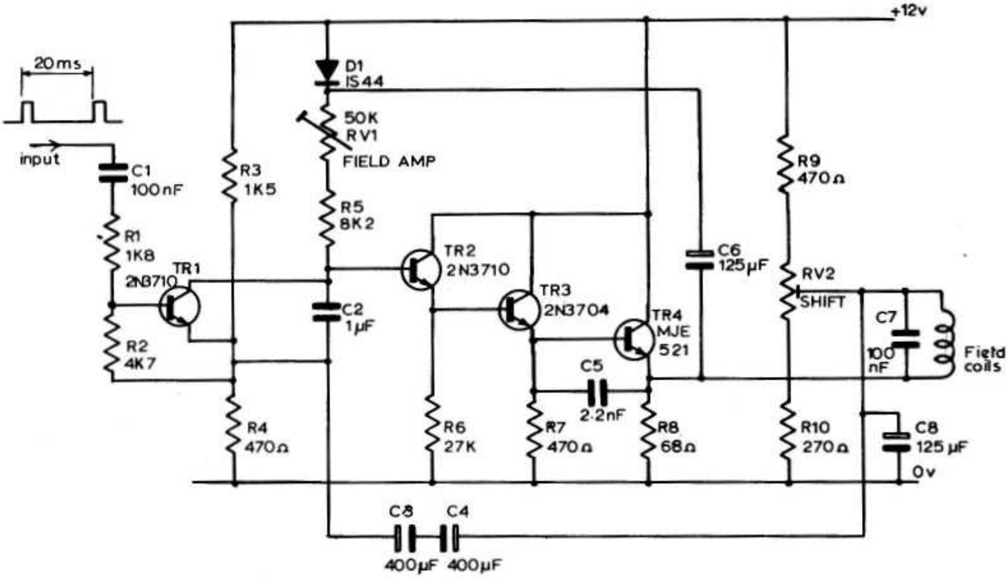


FIG. 4. Bootstrap field scan circuit

Pulse, Digital and Switching Waveforms
Millman and Taub McGraw Hill
Bootstrap scan generator p 555-567

Service Manual for EL8000 Camera
Philips Electrical Ltd.

Technical Handbook for 101 Camera
Link Electronics Ltd.

Circuit Concepts. Sweep Generator Circuits
K.A. Kinman Tektronix Ltd.
Bootstrap sweep generator p 25-41

A 405 line Pulse Generator

Malcolm Sparrow G6KQJ'T

A 4 0 5 L I N E S. P. G. U S I N G T T L I. C. s

Whilst 405 line television will eventually be phased out in the U.K., there is still quite a lot of amateur tv activity in the provinces on 405 lines, and so this S.P.G. was developed some three years ago, partly to replace a 26 valve unit, but mainly as a self training exercise in the use of TTL I.C.s.

The S.P.G. consists of two sections; the timing chain and the waveform and gating and adding circuits. It is designed to produce a mixed syncs waveform similar to that used by the BBC and IBA on their 405 line transmissions, and in addition gives pulse outputs being of 1½ volts amplitude when terminated in 75 ohms.

TIMING CHAIN

The timing chain commences with the Master Oscillator which uses the 7413 Schmidt Trigger I.C. as a variable oscillator on 1,012,500Hz. Capacitor "C" should be chosen to ensure that the M.O. speed control can be adjusted to make the Timing Chain produce 50Hz at the output. (This output can be easily checked by comparison with the mains frequency). In the writer's case, capacitor "C" consists of 1000pf, 500pf and 470pf all wired in parallel. The second half of the 7413 is used as a buffer, with all its inputs connected together.

The remainder of the Timing Chain consists of a series of divider stages, mainly using 7473 J.K. flip flop I.C.s Each J.K. flip flop will divide by two if the input signal is connected to the CP (Clock Pulse) pin, the output appearing at Q with the inverted version of the output appearing at Q. As the output signal of a J.K. flip flop only changes on the negative going edge of the input signal, each of the divider stages in this S.P.G. is fed from the Q output of the previous divider stage.

By using the J and K input of these slip flops it is possible to make them count by numbers other than multiles of two. The circuit for "divide by three" and "divide by five" circuits are given in Figure 1.

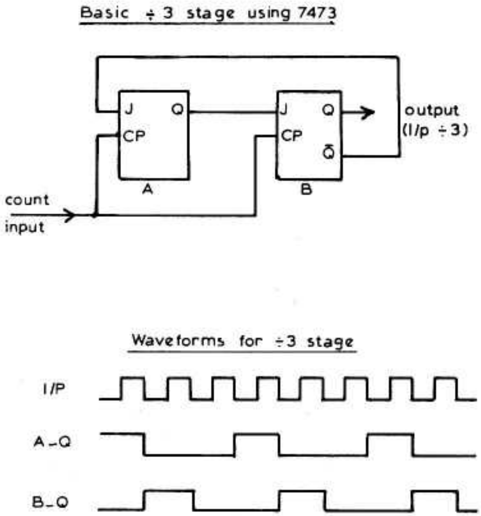


FIG. 1A

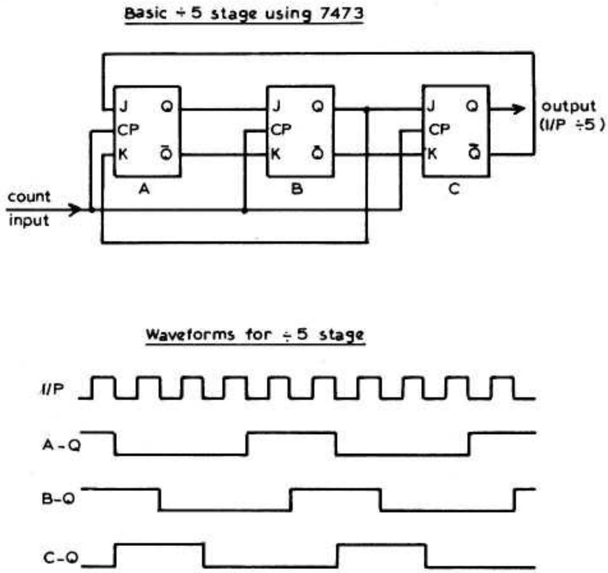


FIG. 1B

The overall block diagram of the Timing Chain is given in Figure 2, in which the interconnections for each divide by three and divide by five circuit have been omitted for clarity; they should be wired up as shown in Figure 1.

The one other I.C. in the Timing Chain is also a divide by two stage but this uses half of a 7474 I.C. (V). The other half of this is required as a shift register in a later part of the S.P.G.

WAVEFORM GATING AND ADDING CIRCUITS

The circuit of this part of the SP.G..is given in Figure 4, and with one exception, all functions are carried out using TTL NAND gates; some of these have their inputs strapped so that they act as invertors.

The action of a NAND gate is best explained by the study of the waveforms, and these are drawn in Figure 3, together with the conclusions which can be drawn.

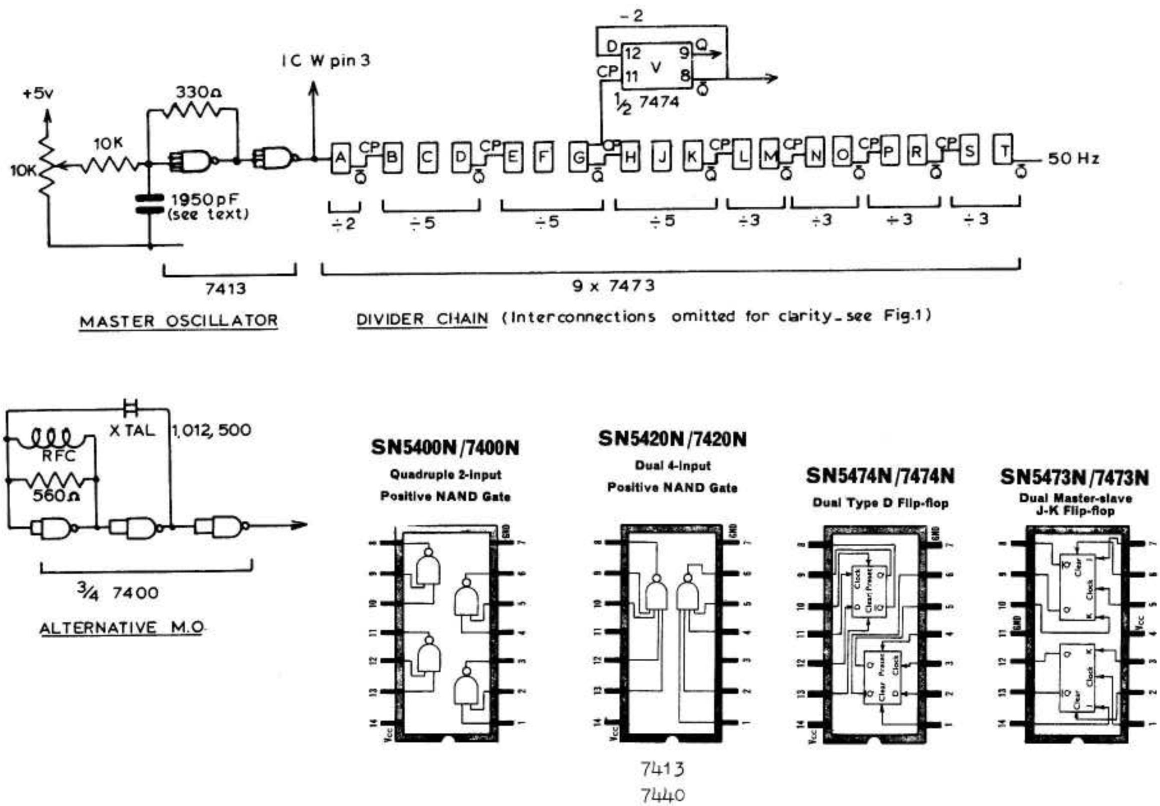
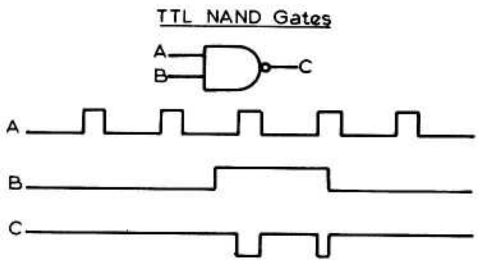
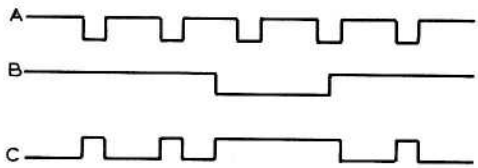


FIG. 2. TIMING CHAIN



Conclusion
With positive going pulses on each input the NAND gate will act as a co_incedent gate and then invert the resultant waveform.



Conclusion
With negative going pulses on each input the NAND gate will add all inputs and then invert the resultant waveform.

FIG. 3

Frame blanking is obtained by first gating out a 15 line pulse, then subtracting from it the 15th single line pulse leaving the required 14 line frame blanking pulse. Line blanking is obtained by first gating out front porch, line sync and back porch separately, and then combining them in gate X. This combined pulse is then fed through shift register W, which delays the combined pulse by approximately 0.5 sec, to position line blanking correctly with relation to line sync. This shift register also removes the slight gap between front porch and line sync, which was caused by inherent circuit delays.

Frame sync is first produced continuously, and then the four line frame drive is applied to the frame sync gate which thus only allows the 8 broad frame pulses required for each frame to pass. Mixed syncs are now simply obtained by adding the line and frame syncs together, and mixed blanking is likewise obtained by a similar process.

A 1 MHz crystal oscillator was initially used when the S.P.G. was first built, but this resulted in a frame frequency of 49.38Hz, which was noticeable on pictures as a slight

WAVEFORM SELECTION_ GATING & ADDING CIRCUITS

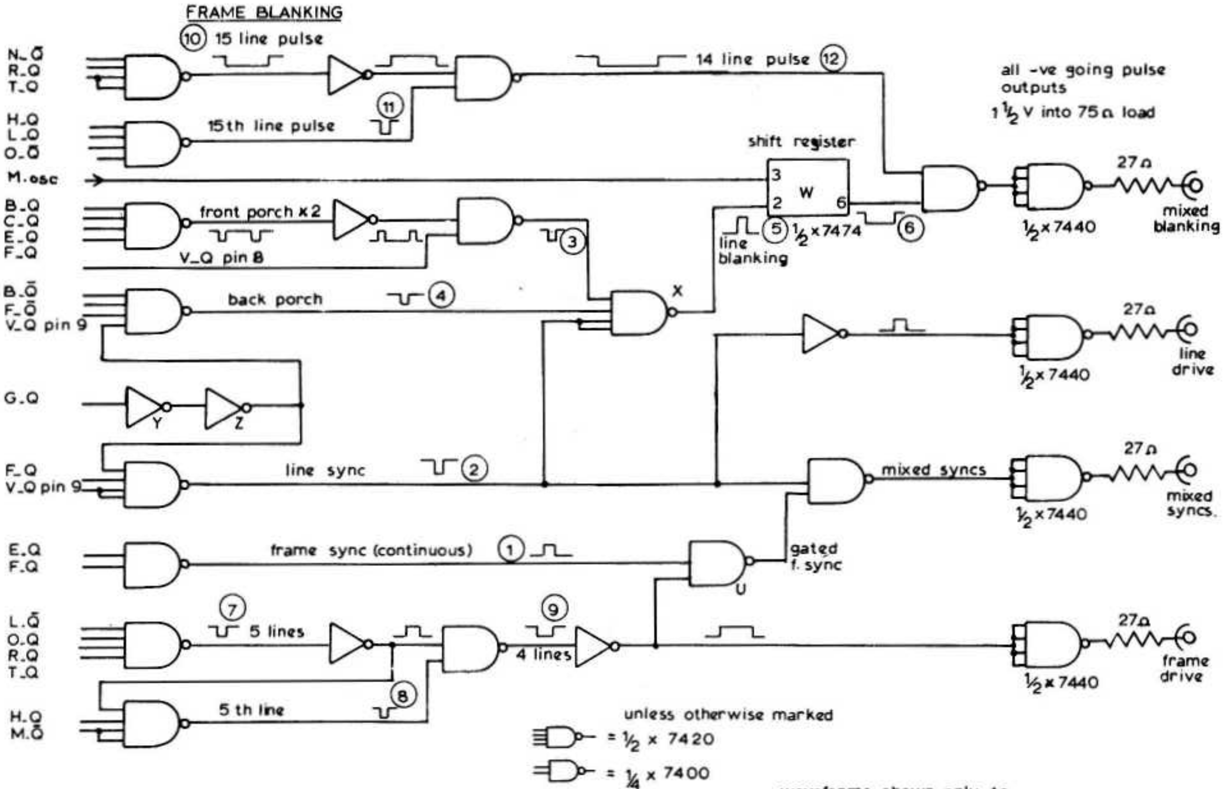
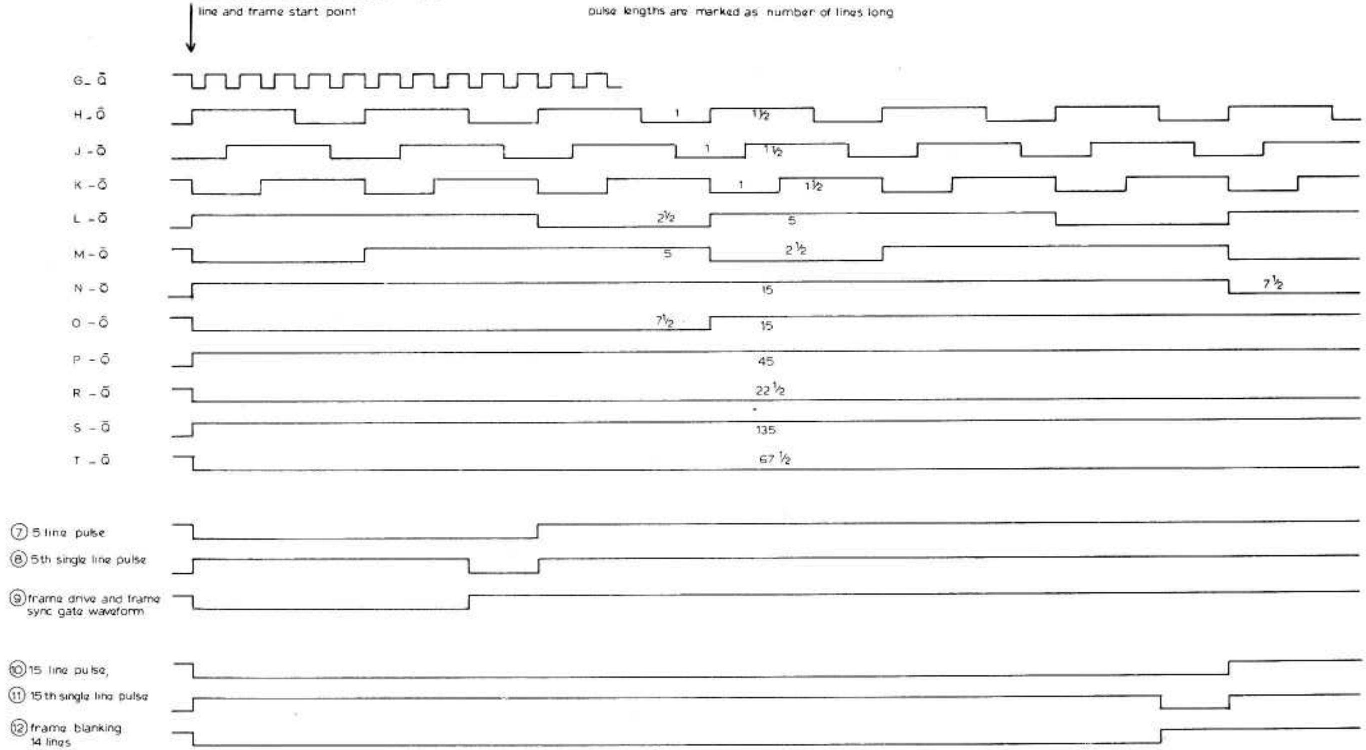
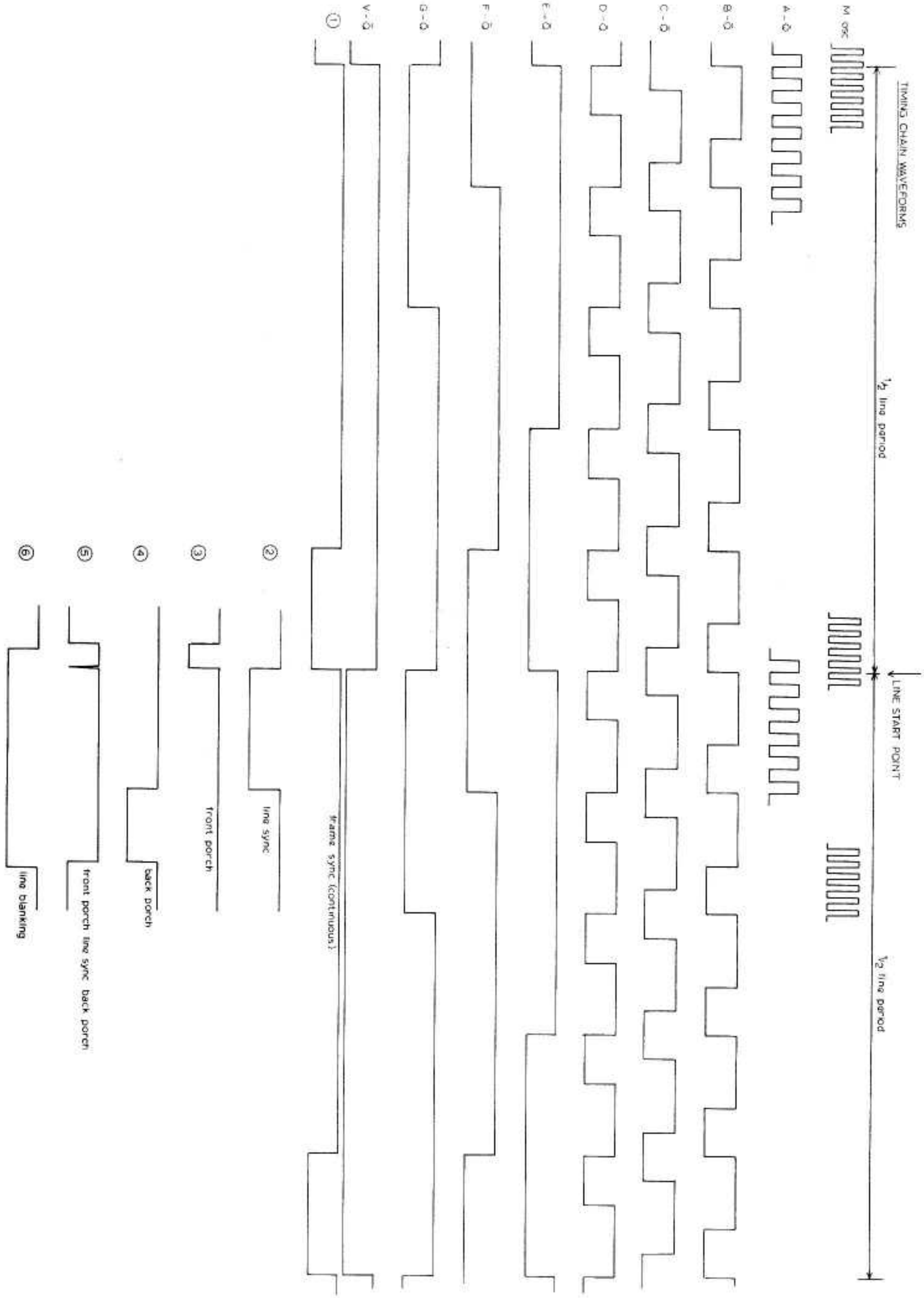


Fig. 4.

TIMING CHAIN WAVEFORMS (continued)





TIMING CHAIN WAVEFORMS
½ line period
LINE START POINT
½ line period
M osc
A - Q
B - Q̄
C - Q̄
D - Q̄
E - Q̄
F - Q̄
G - Q̄
V - Q̄
1
frame sync (continuous)
2
line sync
3
front porch
4
back porch
5
front porch line sync back porch
6
line blanking

movement rolling through the picture vertically (probably caused by bad ht smoothing in the monitor) as well as the wrong line frequency. The correct frequency crystal, as on the diagram, cures this problem.

Another problem, whcih was noticed when the S.P.G. was first commissioned, took the form of a vertical line superimposed on the picture in the centre of the screen. This was eliminated by inserting Invertors Y and Z to delay the appropriate waveform sufficiently to remove it.

The S.P.G. was built on a standard Veroboard using "third dimension" wiring, with different colour wires to distinguish between each section and function; it only uses eight components other than the I.C.s Layout can be arranged to suit individual requirements, and is not critical. The gates used were reclaimed off surplus computor boards, whilst the J.K. flip flops were obtained from Bi.Pak for economy.

A double beam oscilloscope was used during development, but the S.P.G. has since been duplicated by G5KS-G6AFV/T with no apparent snags; provided that no dud I.C.s are used, or wiring errors made, the unit should work first time, as there are no other controls to adjust apart from the Master Oscillator.

Finally, the writer would like to acknowledge the help and encouragement given by Arthur Critchley and Gordon Sharpley when I.C.s first became available on the amateur market, and to assure everyone who has not yet dabbled with these "little black boxes" that the more one plays with them the more fascinating they become.

SLOW SCAN NEWS

GM3PIB , P. Kaminski, has been going into the problem of SSTV monitors, and although he is building the G3RHI design (from "Slow Scan Television" published by B.A.T.C.) he has also investigated the availability of Kit-form monitors. After reading an article in QST by W9LUO, he wrote to him asking advice and came up with a kit produced by W6MXV. The details of this looked so attractive that GM3PIB thought that other B.A.T.C. members might be interested. The kit is produced at a price of approximately £65 by

Mike Tallent W6MXV
6941 Lenwood Way
San Jose, CA95120
U.S.A.

from whom full details are available. The design uses a 5FP7 tube, an EM84 tuning indicator and is mainly I.C. with some transistor.s

A Video Attenuator

Dave Lawton G6ABE'T

The circuit to be described is based around the Motorola MFC 6040 Electronic Attenuator. The video input to this I.C. is taken via a 6dB pad, as the maximum input permissable is 0.5volts. The output of the I.C. (at pin 5) is inverted and has a range of +12dB to -80dB w.r.t. the input. Attenuation control is achieved either by a variable resistor connected between pin 2 and earth, or by means of a variable voltage applied to pin 2.

Attenuation	Control Voltage	Variable Resistor
0dB	3.5volts	4Kohm
90dB	6.0volts	33Kohm

In the circuit of Figure 1 a variable resistor is used as the attenuation control. Incidentally, as the control input is d.c. and does not carry signal, this control can be easily

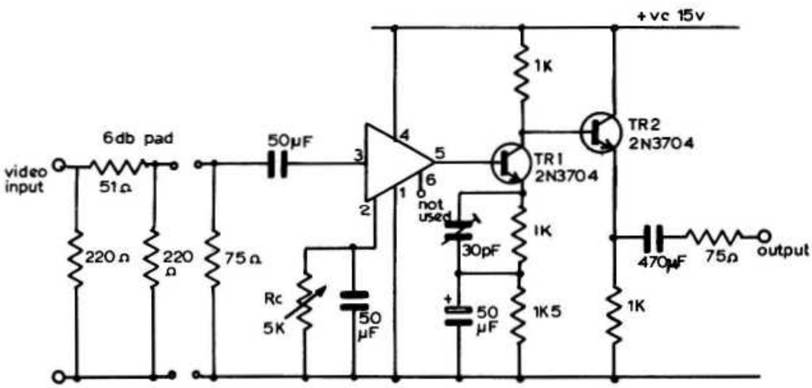


FIG. 1

remoted. Tr1 inverts the I.C. output, and is d.c. coupled to Tr2, an emitter follower. The bandwidth is more than adequate for monochrome use, but for colour, slight h.f. correction is added by the use of a 30pf trimmer. If only monochrome use is envisaged, this trimmer can be omitted. The circuit is arranged such that it has unity gain when Rc is minimum, and as Rc is increased in value, the attenuation also increases.

FIG. 2

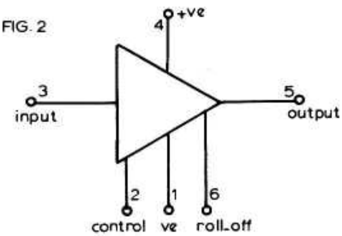
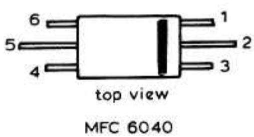


FIG. 3



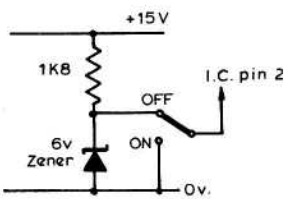


FIG. 4

Another application is to use the device as an audio gain control. In this case a capacitor of approximately 100pf must be connected between pin 6 and earth. The pin connections to the device are shown in Figs. 2 and 3.

An obvious application of this circuit is to use several of them to form a vision mixer. A "CUT" facility could be added, as shown in Fig. 4, to make a vision mixer "CUT/FADE Amplifier".

POSTBAG

Ted Groves VK2KK/T in New South Wales, Australia, has built the slow scan tv monitor by G3RHI, but has had to make modifications to the circuit as the transistors specified are not available in Australia. He reports that it works quite well, but can and will be improved as time goes by. The camera is Teds' next step, and he is now trying to accumulate the bits and pieces for it.

David Ellis-Jones from Anglesey writes with a useful hint for members building a PAL coder using the MC1596 Integrated Circuit. As this I.C. costs over £2, a coder using three would eat up £7 straight away; however the electrically and mechanically identical MC1496 is not often mentioned in circuits is available for only 80p. The disadvantages are a temperature range of 0° to 70° (as against -55° to 125° for the 1596) so unless you are a strong-willed /T/P/Colour going out in midwinter followed by the tropics, the saving is quite justified!

H.A.A. Grimbergen PAOLQ in Leiden is unhappy about the new high flats built around him, making u.h.f. impossible and v.h.f. a local band only; this has not stopped him from building tv gear though! His latest S.P.G. uses TTL I.C.s and with a 4MHz clock source providing exact start/stop control pulses generates full CCIR 625 line pulses, together with cross bar and chess board test patterns. However, a friend, using a Karnaugh Map, has discovered that PAOLQ used too many I.C.s! A current project is the design and construction of an all solid state colour tv receiver. Harry sends his greetings to all B.A.T.C. members; thanks O.M.

Gorm Helt-Hanson OZ6GH from Denmark is a SSTV fan and has built a successful monitor using a design by SMOBUO; he is now making a flying spot scanner using the G3RHI circuit published in C Q - T V No. 81. There is apparently much interest in slow scan in Denmark these days and many amateurs are constructing equipment to work on this system.

J.A. Walton of Preston Lancashire has just moved house, so not only is his shack in small pieces and his aerials in need of re-erection but in the chaos of the move he lost an almost complete vidicon camera, including a hand wound scan and focus yoke. So there is a lot of hard work to come! Joe has been interested in colour for about ten years now and would be glad to offer help and advice to any B.A.T.C. members who have problems with colour receivers, particularly with reference to Rank-Bush-Murphy and Hitachi.

James Porter is a new member attracted by slow scan and the recent booklet by G3RHI. James is building the monitor described in this book and hopes to be able to receive pictures soon. As for transmitting, a licence will have to be aquired, so there are no immediate plans for a transmitter. We hope a callsign will eventually be yours!

Franklyn Brooker 9Y4VU whose address is Instrument Dept., Texaco, Pointe-a-Pierre, Trinidad, asks B.A.T.C. members to note that he is available on any band for SSTV contacts.

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PART 12

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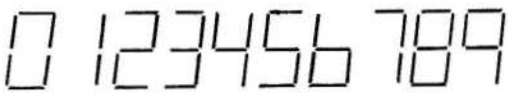
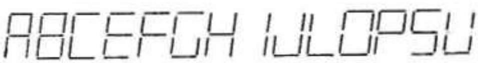
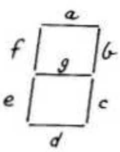
SEVEN-SEGMENT NUMBERS, DISPLAYS & DECODERS.

These displays are sometimes known as Bar-matrix displays. The first diagram shows a typical seven-segment display and the ten numerals which it will make by illuminating combinations of the segments. There are also some letters which can be made.





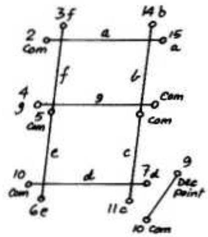
The standard manner of identifying the segments is shown in the next diagram - lower case letters being usual.



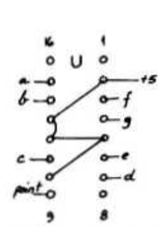
The numbers are by no means perfect but they are legible and since only seven wires are required instead of ten they are easier to use. Hence the popularity of seven-segment displays compared with Nixie-types.

There are two main forms of display devices - lamps or LED's. Neon tubes are not generally used. Filament displays vary from the Minitron 3015F dual-in-line package to very large systems with separate lamps consuming many watts. There are also valve-type envelopes with filaments for side or end viewing - one type being known as the Atron.

MINITRON 3015F

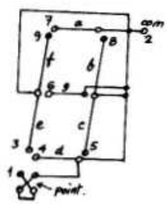


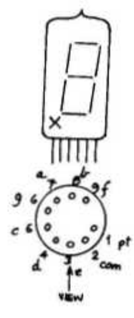
Underside



Pins 1,8 & 16 not to be used.

ATRON





The 3015F takes 8 mA per segment at the TTL rail of five-volts and provides characters of 9 mm height. The segments have a slant to improve the readability and there is also a right-hand decimal point formed from another filament. The Atron is a B9A-type glass envelope with a left-hand decimal point.

Special TTL IC's are made to drive the Minitron,or Atron,or any other low-power display. These convert the inputs, not from decimal, but from Binary-Coded-Decimal - BCD - to seven-segments. This is done for two reasons. Firstly, fewer wires are necessary (4 instead of 10) and secondly most TTL circuits requiring a numerical display count in binary or BCD code anyway, e.g. the 7490.

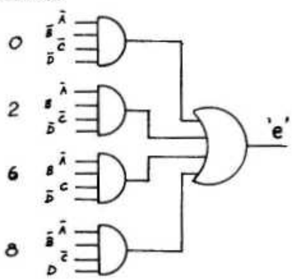
The decoder required to drive a Minitron or Atron is a 7447 which will in fact drive lamps taking 40 mA at up to 15 volts whilst the 7446 will handle 40 mA at 30 volts.

So what does a decoder do? The table shows the various segments which have to be lit according to the input number data. Note that a 0 represents a lit section rather than a 1 because the indicators are usually connected between the IC and +5 volts i.e.they go low.

Inputs	Outputs							
BCD	7446/7							
D.C.B.A	a	b	c	d	e	f	g	No.
00000 0	0	0	0	0	0	0	1	1
0 0 0 1	1	0	0	1	1	1	1	1
000 1 0	0	0	1	0	0	1	0	2
0 0 1 1	0	0	0	0	1	1	0	3
0 1 0 0	1	0	0	1	1	0	0	4
0 1 0 1	0	1	0	0	1	0	0	5
0 1 1 0	1	1	0	0	0	0	0	6
0 1 1 1	0	0	0	1	1	1	1	7
1 0 0 0	0	0	0	0	0	0	0	8
1 0 0 1	0	0	0	1	1	0	0	9

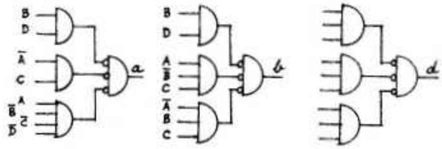
There are also two other decoders which are used to drive TTL or other transistors and these give the inverse outputs.

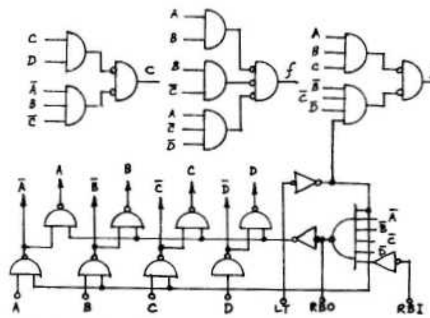
The decoder is basically a collection of multi-input gates. One way to convert BCD to seven-segment is to use a four-input gate to detect every required combination of BCD states but this is costly and very complicated.



A lot of short cuts can be made in the design of the logic by means of Karnaugh Maps and Boolean Algebra and other such mathematical tools to end up with the system shown in the next diagram. Some of the reduction can be done by inspection though.

Consider the reqirements of the 'e' segment. The numbers are seen to be all even and the only missing even number is 4. The logic can therefore be simplified to $A + \overline{B}C$ This is shown next. A provides the five even number outputs and $\overline{B}.C$ suppresses number 4. Similar reasoning can be applied to the other outputs.

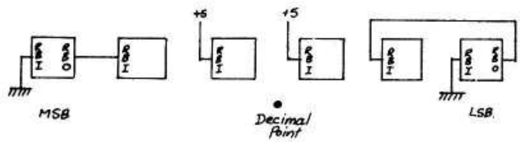




Note that all the gates are AND-gates but that the collecting gates have inversions at their inputs to give Negative logic - i.e. the NOR function to Positive logic. All the collecting gates are followed by open-collector stages to drive the indicators.

The rest of the logic consists of input buffers and invertors and a lamp-test input (LT). This simulates the BCD number 8 (1000) by over-riding the A,B & C inputs to make zero and then adds 'g' to make eight. A further piece of logic is used to suppress the figure 0 (zero) and this feature is known as Ripple-Blanking (RBI).

Ripple-blanking is useful in multi-digit displays where one might get, say, 2.500 or 003.20 RBI reduces these to 2.5 and 3.2 by removing the leading and trailing zeroes. It does not suppress zeroes between digits or between digits and the decimal point, e.g. 001.0900 becomes 1.09 The RBI feature is cascadable between decoders to make the suppression automatic.

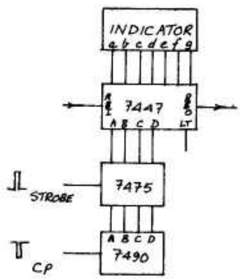


The Ripple-Blanking output can also be used as an input to give total blanking. All three of these inputs require a 0 to operate them.

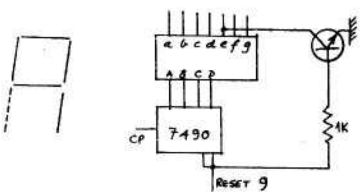
The 7448 and 7449 differ from the 7446 and 7447 in that both have 'high' ON outputs. The 7448 is similarly a 16-pin DIL package but the 7449 has only 14 pins and has the LT and RBI facilities omitted. It does, however, retain the total blanking feature.

Using the Decoders

The decoders and displays are fine when the input information is changing only at a slow rate, but at high rates the numbers become blurred. To overcome this problem a four-bit latch (7475) is interposed between the BCD source and the decoder. The latch is clocked at some convenient time and stores the BCD data for display as long as required whilst the source can keep on changing.



The outputs of the 7446/7 being open-collector can be Wired-OR connected. This can be useful to modify the characters.

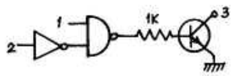


For example, to make A a 9 is formed from BCD 1001 with 'e' added. This could be useful on a tennis scoreboard where the only numbers used are 0,1,3,4 & 5.

This leads to a way to improve the numbers 6 and 9. These do not have the serifs (tails) when the 7446-9 are used and are not quite as legible as they might be. Simple logic can be used to detect the presence of a 6 or a 9 and add the appropriate serif. There is one slight snag in that simple blanking of the decoder does not blank these additional serifs as well.

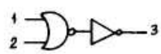
The 7 can have a serif too and details are given to modify the 6,7 & 9 for all decoders.

7446/7



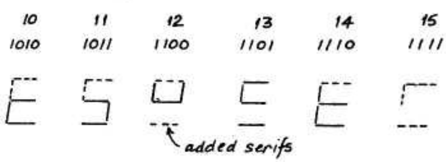
DIGIT	FROM DEC	FROM DATA	TO IND
6	a	B	a
7	f	C	f
9	d	D	d

7448/9

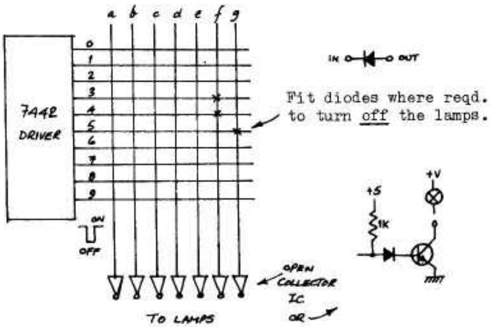


The full sequence of four input bits results in 16 possible states of the inputs but BCD covers only 10 of them. So what happens if the other six are applied?

As might be expected certain shapes are produced which are meaningless but are shown here for the curious.



A seven-segment decoder is not essential to drive a seven-segment display; a diode matrix can be used with a BCD-to-decimal decoder 7442, or other form of driving gate, to make a matrix. e.g. a 74154 to give 16 characters.



Turning OFF the lamps requires fewer diodes than turning them on. The action is that a 0 from the driver takes current via the 1 KΩ and the matrix diode. Since the transistor and the series diode are across the driving transistor with a bottoming-voltage of some 0.1 v, no current will flow into the base of the transistor and the lamp will not light.

Light-emitting diodes (LED's) in the form of seven-segment displays are becoming cheap - almost as cheap as Minitrons. These have the obvious advantage of being more robust than filament lamps. Not so obvious is their advantage in a matrix system. There they act as both diode and indicator.

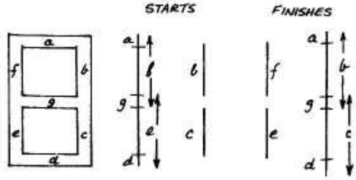
Seven-segment displays with LED's are usually made with closely spaced dots but small displays can be made with bars.

The forward voltage-drop of an LED is of the order of 1.6 volts - about twice that of a silicon diode and like a diode it requires a series resistor to limit the cuurent to some 5 or 10 mA. However, multi-dot types have diodes in series which multiplies the minimum voltage requirements.

SEVEN-SEGMENT NUMBERS ON TV RASTER

This is not the easiest of things to achieve but with TTL is not all that difficult if worked out in a logical manner. A system is now described that was demonstrated at the recent VHF/UHF Convention in the West London area.

The system involves the creation of the seven segments in a form in which they can be scanned. To do this the basic display is split into starts and finishes in the horizontal direction

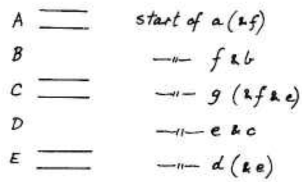


Combining these in a J-K bistable gives the final video signal. The J-K bistable has the various start signals fed to the J-input and the finishes to the K-input. Suitable clock pulses define the exact positions of the edges of the numbers.

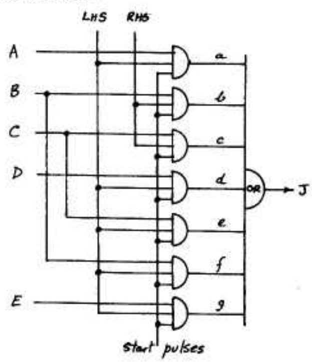
There is more to it than this of course. The start signals have to be controlled by a source of numbers but the finish signals can be present all the time because the bistable ignores them once it has be clocked to the finished state. Similarly, the finish pulse frequency can be high. The only restrictions are that the pulses must not occur until required in the horizontal direction after which they may occur at any times.

The finishing timings for the three horizontal bars have to be delayed longer than these for the vertical bars.

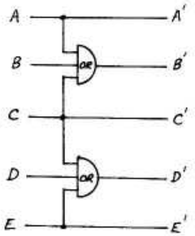
Looking at the vertical requirements it will be seen that five pulses are required. In descending order these are the bar 'a', the bars 'f' & 'b', the bar 'g', the bars 'e' & 'c' and the bar 'd'. These five pulses are used to modify the horizontal timing pulses.



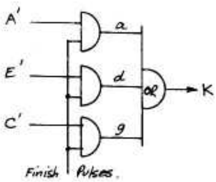
Looking more closely at the horizontal timings shows that the starts occur in only two places - for 'a','f', 'g','e', & 'd' and later for 'b' & 'c'. The starting logic is therefore :-



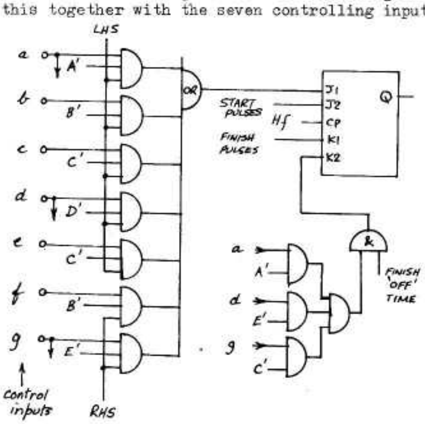
In order to make more legible characters the vertical bars are made to overlap the horizontal ones by gating the vertical pulses together:-



The finish logic is relatively simple as it only involves the suppressing of the h.f. finishing pulses during the three horizontal bars - if the pulse frequency is chosen to give the correct horizontal thickness of the vertical bars.

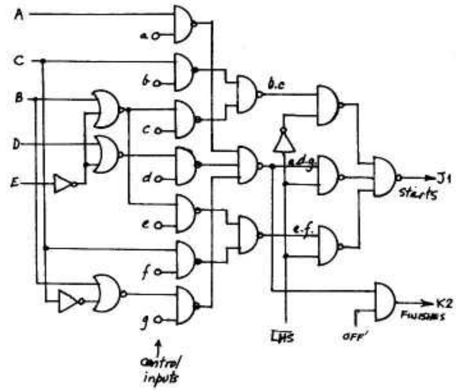


A triple-input J-K bistable can be employed to reduce some of the gates and the next diagram shows this together with the seven controlling inputs.



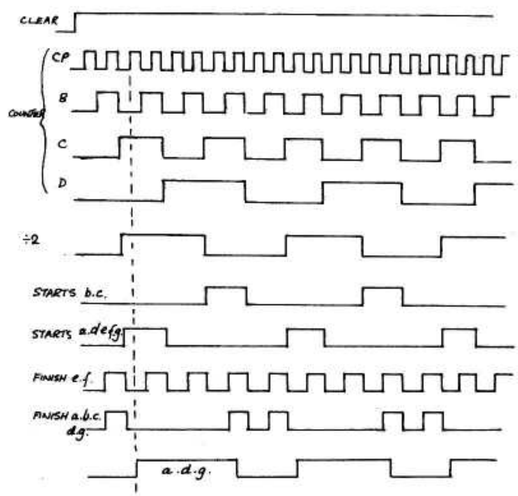
The A,B,C,D & E, LHS & RHS inputs are obtained from counters. The finish logic is a duplicate of part of the start logic apart from the LHS feed. Also the LHS and RHS waveforms can be LHS and $\overline{\text{LHS}}$ if the LHS signal changes polarity at the vertical centre of the numbers.

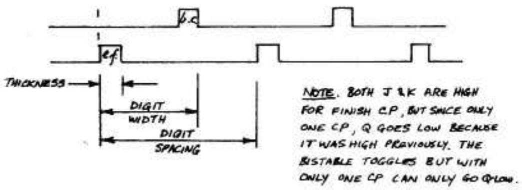
Re-arranged with IC logic gates this becomes :-



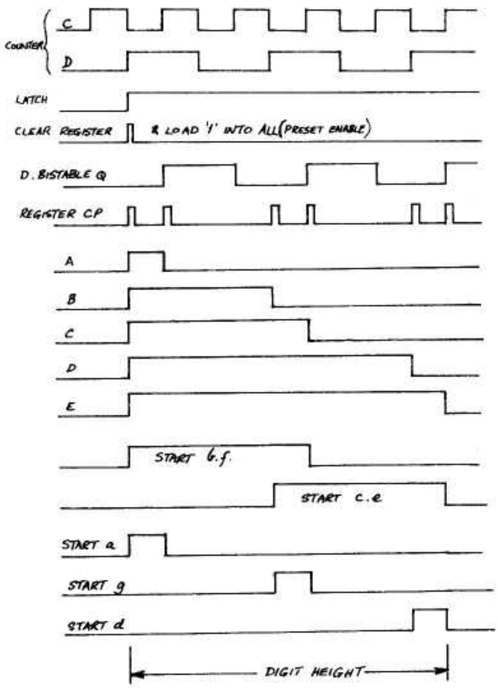
This circuitry now defines the seven bars in the raster - each of which can be turned on or off.

The next problem is to generate the various input waveforms. The horizontal ones, obtained from an oscillator and counter system are :-





For vertical-rate waveforms a counter and shift-register can be used with a delay system to give uneven clock pulses.



The final system diagram includes all the previous arrangements together with two monostables to position the first digit and a gating system to give a certain number of digits in one horizontal block. It also includes a seven-segment decoder to reduce the seven input controls to four in BCD code so that any BCD source can drive it.

The only problem now is that only one digit at a time can be made and the row has up to sixteen identical digits. A second 4-bit counter in the horizontal chain is now used to provide addresses for these sixteen places. By using the same addresses to drive selection gates it is then possible to write any number in any position. Each of these numbers is entered by placing 1's in BCD code to the selection gates.

This system will now display, on a TV raster, up to sixteen separate digits from, say, a chain of counters. There is no need for any other seven-segment decoders than the one in the circuit.

A few points - without the four selectors the digits may be selcted in sequence simply by using the address bits as the data to the 7448. Those who visited the VHF/UHF Convention would have seen this type of display on the BATC stand. A fifth selector can be used to give zero suppression but a better method is to have a zero detector.

This system of character generation is somewhat similar to the BBC'Anchor' system but much simpler.

So much for seven-segment decoders.

It is hoped that there will be two more parts in this series concerned with TTL IC's - after which the booklet will be produced about TTL IC's based on this series. The two articles will cover bistables, which seem to have been overlooked, and Karnaugh Maps, logic and counters.

At the same time Linear IC's will continue to be described and eventually CMOS devices.

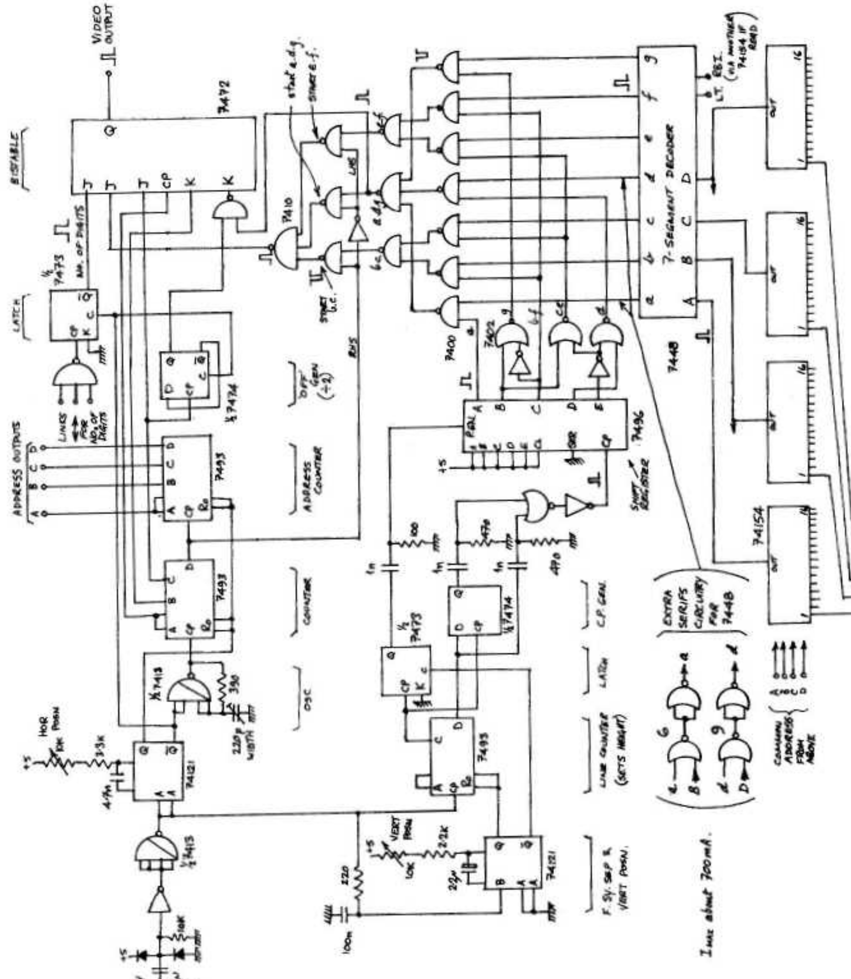
The writer wishes to thank all those who have said nice things about the articles - also to apologise for the haphazard order of certain items and non-appearance of others. This is due to many factors such as lack of spare time and having to work for one's living and not least in despatching 108 CQ-TV SPG's. But then this is an amateur magazine and I do NOT get paid even though I type the articles as well !

Would Mr Taylor of Preston area, who asked me for Plumbicon Yokes, please send me his address - I have lost it. A.W.Critchley.

Re the advert in CQ-TV 81, The Vidicon Yoke is still available at £4. The Pincushion corrector for the BRC 3000 colour TV is too at £3 - there is normally no such corrector in this TV. One 8½" long-persistence CRT remains at reduced price of £2.50 - buyer collect.

Acknowledgement

The author wishes to thank the Directors of EMI Sound and Vision Equipment Division for permission to publish this article.



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Deflector and Focus Coil Assemblies per set	£ 7.50p
Vidicon sockets (paxolin)	.17p
Vidicon sockets (moulded)	.25p
"C" mount in Aluminium for use with cine lens	.50p
931A Sockets (including post & packing)	.10p
Lapel Badges	.20p
Lapel Badges with Call sign(to special order)	.30p
Adhesive emblems (for decorating gear with Club badge)	.15p
Windscreen stickers	. 6p
B.A.T.C. Notepaper and envelopes (100 sheets)	£ 1.00p
B.A.T.C. Reporting Chart (a visual scale of video noise)	. 6p
E.E.V. Co. Ltd. Camera test charts	£ 1.65p
Film strips of C Q - T.V. 10 issues on each film (Please state which decade you require eg. 41-50 etc.)	£ 1.00
Back nos. of C Q - T V as available Members price	.20p
Non-Members price	.25p
"Slow Scan Television" by B. Arnold G3RHI	.25p

Please send cash, together with post and packing, with order to:

B.A.T.C. Sales
"Kyrles Cross"
Peterstow
Ross-on-Wye,
Herefordshire.

On April 1st Value Added Tax came into effect and this will result in an eventual 10% increase in the price of most items. This applies now to camera tubes and camera test charts which are ordered from the manufacturers when required. We shall try to keep prices as low as possible and there will be no increase on goods already in stock. As stocks run out, however, new supplies will carry 10% V.A.T. and may also carry an increase due to general upward trends in prices. Postages are now a considerable item and you are requested to send something towards the cost of postage and packing of the goods you have ordered. Please note that we do not intend to issue C Q - T V Nos. 71 to 80 as a filmstrip.

PLEASE NOTE THIS LIST CANCELS ALL OTHERS