

JANUARY 1977

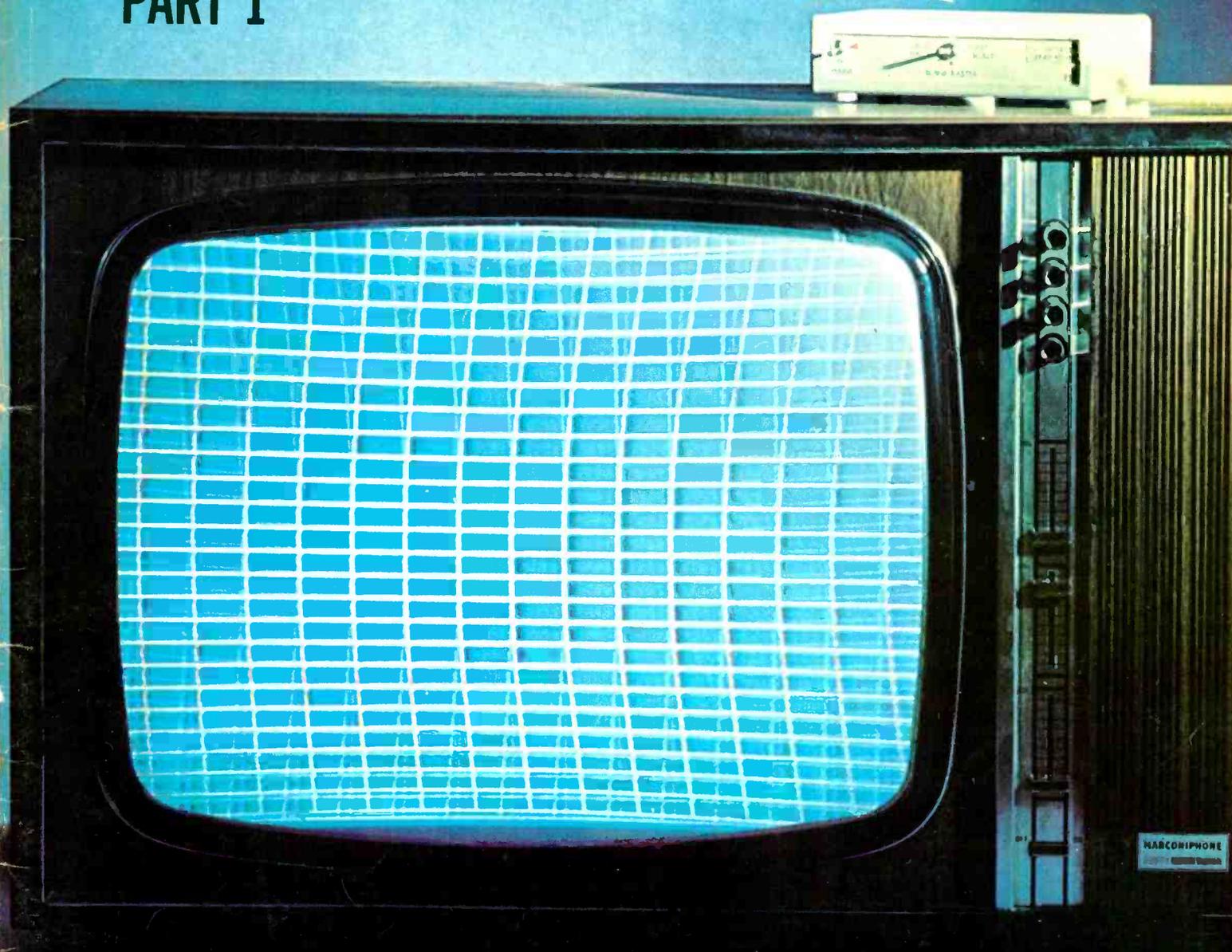
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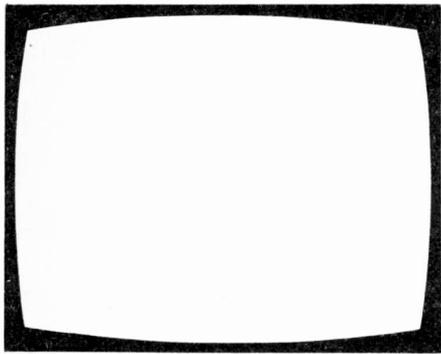
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# TELEVISION

January  
1977

Vol. 27, No. 3  
Issue 315

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## CORRESPONDENCE

All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", Fleetway House, Farringdon Street, London EC4A 4AD. All other correspondence should be addressed to the Editor, "Television", Fleetway House, Farringdon Street, London EC4A 4AD.

## BINDERS AND INDEXES

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## QUERIES

We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope. Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved".

## this month

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Leader.
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Notes on faults and how to tackle them.
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A compact, portable generator giving crosshatch, grey-scale and blank raster patterns. Uses CMOS i.c. technology.
- 130 **Servicing the ITT CVC1 and CVC2 Chassis** *by E. Trundle*  
The ITT CVC1 and CVC2 were the only hand-wired colour chassis released in the UK. A detailed account of the faults you can expect to find on these sets.
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Can you solve this fault? Plus the answer to last month's problem.

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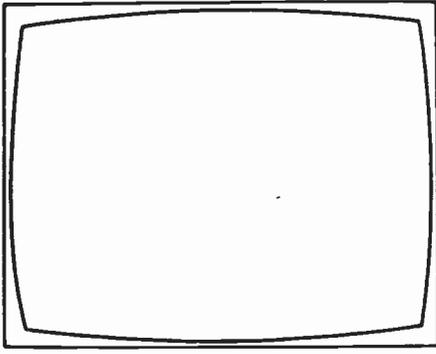
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## WHO CALLS THE TUNE?

The old saying is that he who pays the piper calls the tune. The whole purpose of the elaborate structure of ITV in the UK however is to ensure that this isn't so, and the system seems to have worked remarkably well in practice. We were somewhat concerned therefore to read that an American advertiser running a pre-Christmas advertising campaign had threatened not to advertise again unless "better" programmes were produced, and even more by the comment that "the threat must be taken seriously – he's a big customer". In fact it should be totally ignored.

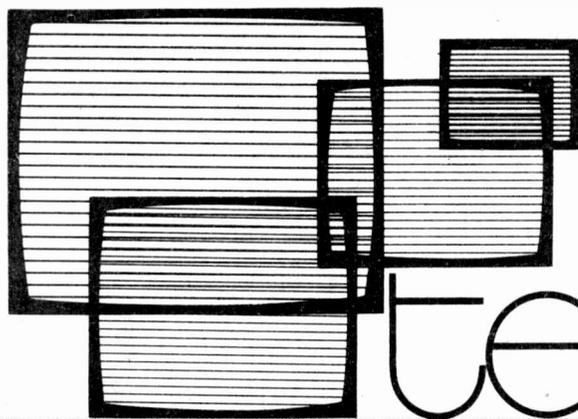
It's hard to see that advertisers have much to complain about. TV reaches a wider audience than any other medium, and there is only one channel that carries advertising. So you pay your money and are certain to reach a much larger audience than you could in any other way. For their part the ITV companies have it rather good. With nothing else that can offer such a substantial audience they don't have to try all that hard and should certainly be beyond pressure from advertisers. It's not quite as simple as that of course. What advertisers are charged is related to the audience it's estimated they will get. So there is some justification for an advertiser's disgruntlement should he feel he's been given less than what he'd been led to expect and had paid for.

But any such feeling of dissatisfaction should be a matter of haggling over the fees. In practice the advertiser is pretty well assured of his audience by the fact that the ratings have proved to be pretty stable over the years. Had ITV's share of the viewing public fallen well below 50% and stayed there for any length of time it would certainly have indicated that the ITV companies were not providing a competitive viewing programme. This hasn't happened however and is unlikely to do so. Though the BBC is not subject to the same pressures, it would nevertheless indicate that the Corporation was not attuned to viewers' requirements if its share of the public's viewing fell to a disproportionately low level and stayed there for any length of time.

But the situation with the BBC and ITV sharing the TV audience fairly evenly continues year after year. One could wonder whether this is in fact a good thing. Might it not indicate a more adventurous approach to programme production if there were more substantial swings in the viewer ratings? Or would public inertia have the effect of evening things out?

ITV and the BBC have kept to the rules of the TV game as laid down in the UK. There is not much one can complain about. It is quite something to fill all those hours day after day on three channels, and it would be unrealistic to expect a continuous diet of outstanding fare. One thing that could well help would be the extra stimulus of a fourth channel run independently. That would at least give greater opportunities to those with new ideas. But at present this seems to be something which we won't be able to afford for some time. Meanwhile the present set up serves us all reasonably well, which is perhaps not too surprising since it was established after very careful consideration.

But one of the most important conditions as far as ITV is concerned is that advertisers don't have any direct influence on policy. That's vital, and it is alarming when even the slightest hint that the principle is not being strictly followed arises.



# teletopics

## TELEVISION RECEIVER DEVELOPMENTS

IT'S likely that we are now almost at the end of the era of new colour receivers being fitted with delta-gun shadow-mask tubes. We have commented at length in past issues on the new generation of in-line gun slotted-shadowmask c.r.t.s. These have already put in an appearance in several recent chassis, notably the Thorn 9000, the ITT CVC20, the Rank Z718 and the Decca 80. Right now UK TV setmakers are facing a rather agonising choice. The main tube contenders are the Philips/Mullard 20AX and the 110° version of the RCA PIL tube. Both seem to give good results with considerable savings in circuit complexity, but the choice depends to some extent on economic considerations relating to the likely value of the pound. With the economic situation as uncertain as it is at present you can appreciate that this is a tricky matter to say the least.

There are other sections of the TV set where changes are imminent. One notable development is the switch-mode field timebase. The basic idea here is to reduce the dissipation of the field output stage so that the whole timebase can be incorporated in a single, reliable, i.c. If a transistor is simply switched between its non-conducting (no dissipation) and fully-conducting (very little dissipation because of its negligible resistance) states, we have an arrangement whose total dissipation is greatly reduced compared to a stage which is handling say a field-frequency sawtooth waveform. The problem is to convert the basic 50Hz signal from the field charging circuit into a modulated squarewave train which switches the output devices on for increasing periods of time as the field scan progresses, and then to convert this varying mark-space ratio squarewave back into a sawtooth waveform to drive the scan coils. The technique has been developed by Mullard in their new TDA2600 field timebase i.c. which has already been adopted by one leading setmaker in an important new chassis to be released very shortly. In view of the fact that this new approach to field deflection is about to appear it seems worthwhile offering an attempt to explain the action.

At the output end, i.e. at the point where we convert the i.c.'s modulated squarewave output into a sawtooth to drive the coils, we can use a simple low-pass filter consisting of an inductor and capacitor. The principle is shown in Fig. 1 (a) and (b). At (a) we have a switch coupling the inductor for equal periods of time to 30V and chassis. As a result of the smoothing action of the filter we get a d.c. output of 15V. Now suppose that instead of a squarewave train with equal periods at maximum and minimum we apply to the filter a

squarewave train whose "on/off" periods vary over the time of the field scan – as shown at (b). At the start the input consists of brief positive-going pulses and in consequence the output is virtually zero. As the scan progresses however the width of the pulses is increased and in consequence the output of the filter builds up to give the required sawtooth.

At the other end, the problem is to generate the varying pulse-width squarewave train. The TDA2600 does this by feeding a sawtooth and a triangle waveform to a modulator. This consists of a differential amplifier with the two waveforms fed to the two inputs. We must have a 50Hz sawtooth to time the whole operation of course, and this is provided as usual by an RC charging network with the oscillator being used to discharge the capacitor at the end of each scan, thus initiating the flyback. A triangle waveform is used because it is easy to generate and does the required job in conjunction with the sawtooth. This is illustrated in Fig. 1(c). The top waveform shows the sawtooth superimposed on the triangle waveform. The output obtained is shown in the lower waveform and, as can be seen, as the sawtooth slices through the triangle waveform at a higher point each time so a modulated pulse-width squarewave output is generated. The frequency of the triangular waveform is 150kHz.

A simplified block diagram of the i.c. is shown in Fig. 2.

The diode-split line output transformer (DST), which does away with the need for a separate e.h.t. multiplier (the diodes are linked into the multi-section overwinding, with the interlayer capacitance providing the charge storage required), is another development about to appear in production chassis here. The device is now in quantity production by Mullard and is already being used by several continental setmakers. Mullard say that the results of lengthy reliability tests indicate that the life expectancy of the DST is "excellent". We have mentioned this device before and plan to publish an article on it shortly.

Finally, a letter from Plessey on a later page points out that the surface acoustic-wave i.f. bandpass shaping filter, which Luke Theodossiou described in some detail in our October issue, has now been adopted by several setmakers.

## SOLID-STATE IMAGE SENSORS

One of the main topics at the recent Edinburgh CCD (charge-coupled device) conference was solid-state image sensors. GEC launched an all solid-state camera using a CCD device as the image sensor. The sensor has 150 by 120 elements (photodiodes) on the 4.5mm (diagonal) chip and is intended for surveillance, process control and general

purpose CCTV applications. Fairchild revealed what they claim is a broadcast quality image sensor with 448 by 380 elements on a  $1 \times 1.2\text{cm}$  chip. It is understood that the array will be available in the UK in about six months' time, at a price of around \$5,000.

B. Cornelissen of the Philips Research Laboratories cast doubt on the use of CCD devices in TV cameras, suggesting that the image quality would be too low for professional use while the price would remain too high for consumer applications. He suggested that an 800 by 600 element array would be required to give broadcast quality pictures. While CCD image sensors have the advantages of

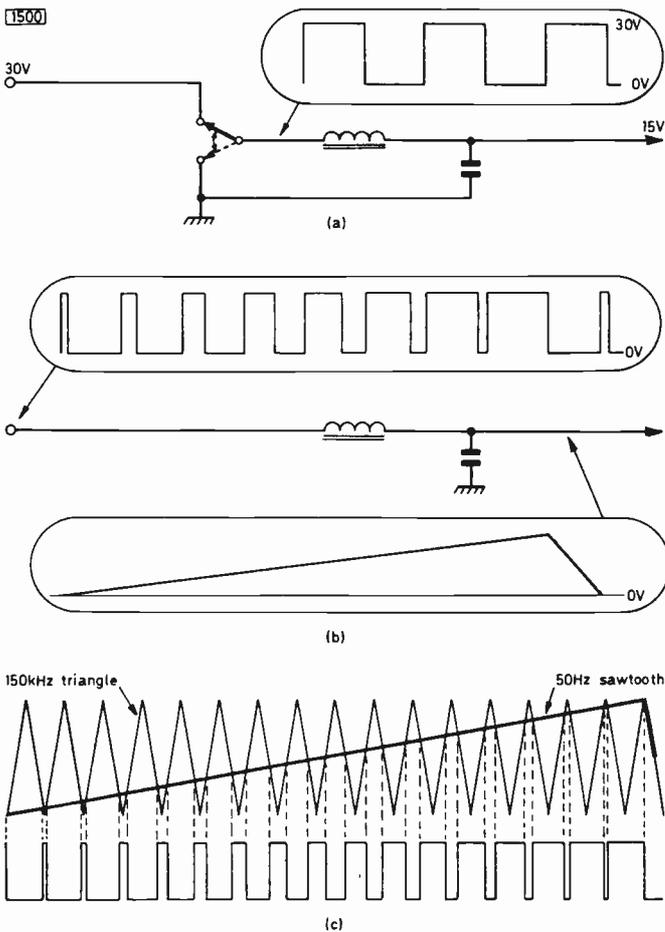


Fig. 1: (a) An LC filter fed with a switched 0-30V squarewave input gives 15V d.c. output. (b) With a modulated, variable mark-space ratio squarewave input the LC filter gives a sawtooth output. (c) Generating a varying mark-space ratio squarewave by mixing a sawtooth waveform with a higher frequency triangle waveform.

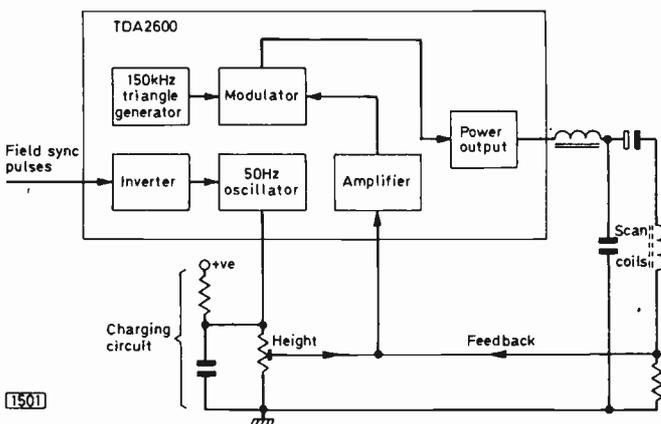


Fig. 2: Block diagram of the TDA2600 class D field timebase.

immunity to shock vibration and electromagnetic fields, reliability and long life and sensitivity to infra-red, he pointed out that problems remain, chiefly the blooming effect produced when a bright spot is in the field of view, and also the spreads in the photodiode characteristics and the low yield (percentage of usable devices out of the total production). Fairchild are using filters to overcome the blooming effect which cannot at present be eliminated by on-chip means.

### TELETEXT DECODER KIT

We understand that a Teletext decoder, called the Logiscan, is to be introduced shortly by Technalogs (8 Egerton Street, Liverpool L8 7LY). The price is expected to be in the region of £175 and the decoder is at present undergoing rigorous testing. The decoder requires a video input and produces red, green, blue and insert signals (TTL) to feed an interfacing board inside the set. It provides upper and lower case letters as well as graphics displays, in colour, steady or flashing, with boxing for subtitles or newsflashes and several other features.

### LATEST RELAY TRANSMITTER OPENINGS

The following relay stations have now come into operation: Auchtermuchty (Fife) ITV channel 49 carrying Grampian Television programmes.

Cow Hill (Fort William) ITV channel 43 carrying Scottish Television programmes.

Newtown (Mid-Wales) ITV channel 41 carrying HTV Wales programmes.

Vertically polarised group B aerials should be used for all these transmissions.

### NATIONAL PANASONIC SETS BEING PRODUCED IN UK

Matsushita Electric, manufacturers of the National Panasonic range of consumer electronics goods, has now started trial manufacture of 22in. colour sets at its new Pentwyn factory near Cardiff. Production is expected to be built up to a level of around 3,000 a week by Summer 1977. Matsushita is one of the world's largest electronic companies, with plants in 28 countries. The Pentwyn factory is its first TV plant in Europe – it now joins Sony in going into production of TV sets in the UK. Like Sony, it claims that as many components as possible will be purchased locally. Up to half the production will be earmarked for export.

### SIMPLIFICATION OF 20AX CONVERGENCE

Following the production by Philips/Mullard of over half a million 20AX tubes, an analysis of the various convergence errors resulting from manufacturing tolerances has led to a proposition for simplifying the convergence circuits required. The study reveals that after some adjustments to production techniques, it is possible to omit or substantially simplify the line balance parabola control without a significant sacrifice in performance.

As this section of the convergence circuit represents about half its total cost, this modification is of considerable interest to setmakers. It has also been suggested that the errors compensated by the field balance parabola control are relatively small and that these can be tolerated in cost-conscious designs. The simplification by the omission of this part of the circuit is fairly modest – several components are saved and there is one less control to adjust.



## No Results

Neither sound nor vision on a Philips Model G18C570 (A4 chassis) was found to be simply a blown mains input fuse. Since checking for possible shorts and looking for any signs of component damage or overheating failed to produce any evidence as to the possible cause, the only course left was to fit a new fuse and switch on. Perfect sound and vision developed and continued during a good test run. A couple of days later however the owner phoned to say that while he was watching the set there was a loud cracking noise followed by loss of sound and vision. On inspection we found that a small hole had been blown in the side of the e.h.t. doubler. No other fault was apparent, so it was a case of fitting a new doubler and another fuse after which perfect results were obtained once more. The set has been working for several weeks without further reports of failure, so it seems that the initial unexplained fuse failure must have been due to a flashover inside the doubler, the resulting transient causing excessive current flow through the thyristor h.t. rectifier. Incidentally, this is the same chassis as the Pye 713 chassis.

## Collapsed Field

The owner of a Decca hybrid colour set fitted with the 30 chassis said that on several occasions the picture had collapsed to a horizontal white line, then opened again within minutes. On examination, the set was found to be working normally, and though tapping the field timebase valves (PCF80 and PL508) failed to produce any significant effects new ones were fitted to see whether this cured the trouble. After a few days however the owner phoned to say that the picture had collapsed permanently. This was found to be the case on arrival.

Advancing the height control towards maximum produced a distinct buzz from the field output transformer,

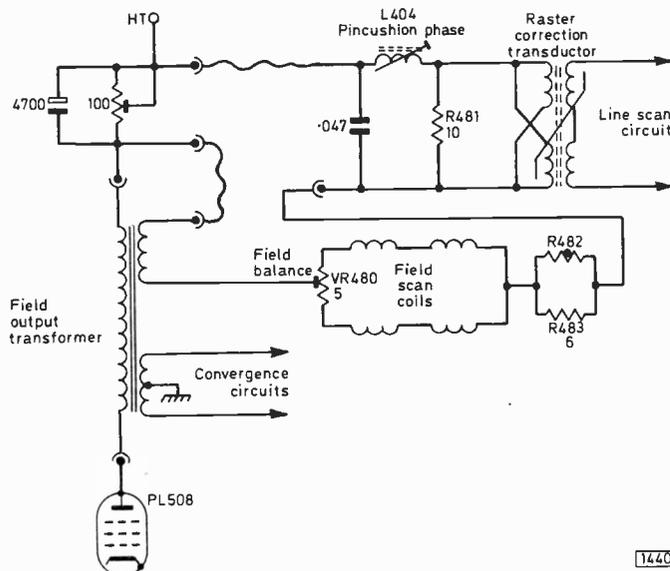


Fig. 1: Field scan circuit, Decca 30 series chassis.

so clearly the circuit was oscillating and the PL508 was giving a hefty output. It was apparent therefore that the trouble was no feed from the output transformer to the deflection coils. The plug and socket connections were naturally the first suspect, but these proved to be in order. The circuitry concerned is shown in Fig. 1. Clearly if R481 was open-circuit current would still flow through the pincushion correction transducer and vice versa, while if either R482 or R483 was open-circuit a large deflection current would flow and if one of the deflection coils was open-circuit the result would be a badly distorted raster. Suspicion was centred therefore on the pincushion phase coil L404 and the field balance preset control VR480. The latter was right to hand on the convergence panel – and immediately it was touched the raster pulled out. There was no break, merely a bad spot where the slider had been positioned, and after applying a little switch cleaner perfect operation was restored.

These field balance controls pass a considerable current, and after some years' service can easily develop a high-resistance point between the slider and the track.

## No Sound or Vision

A Philips dual-standard monochrome receiver fitted with the 210 chassis and a six push-button tuner came in with the complaint "no sound or vision". There was ample grain on the screen and hiss from the speaker, denoting continuity of the signal stages, but it was impossible to tune in a station on any of the push buttons. This might suggest a faulty mixer stage, but turned out to be caused by a broken spiral spring which holds the tuning spindle at the point determined by the setting of the push buttons. Once the tuner is removed, a replacement spring is easily fitted.

## Rank A823 Series

Field jitter in RRI single-standard colour sets using the various versions of the A823 chassis is often caused by a defective BT106 thyristor h.t. rectifier, as a result of which spikes are introduced on the d.c. output pulses it provides. After changing this thyristor in a Bush Model CTV192 there was considerable improvement but the effect was not completely cleared. The set was an early version, so we decided to adopt a modification to deal with this trouble recommended by the manufacturer – changing the value of 8R13 (see Fig. 2) from 22kΩ to 1kΩ or 1.2kΩ. On fitting a 1kΩ resistor in this position all signs of jitter had disappeared – so in cases where field jitter is experienced on these sets it's worth checking the value of 8R13. It's mounted to the left of the big VDR on the power supply panel, just above the vertically mounted resistor 8R5. The diac 8D3 can also be responsible for field jitter. The recommended replacement is type 4EX581, with 8R12 increased to 47Ω.

These models have proved to be very reliable. As with most colour receivers, the majority of the faults that develop occur in the power supply and timebase circuits.

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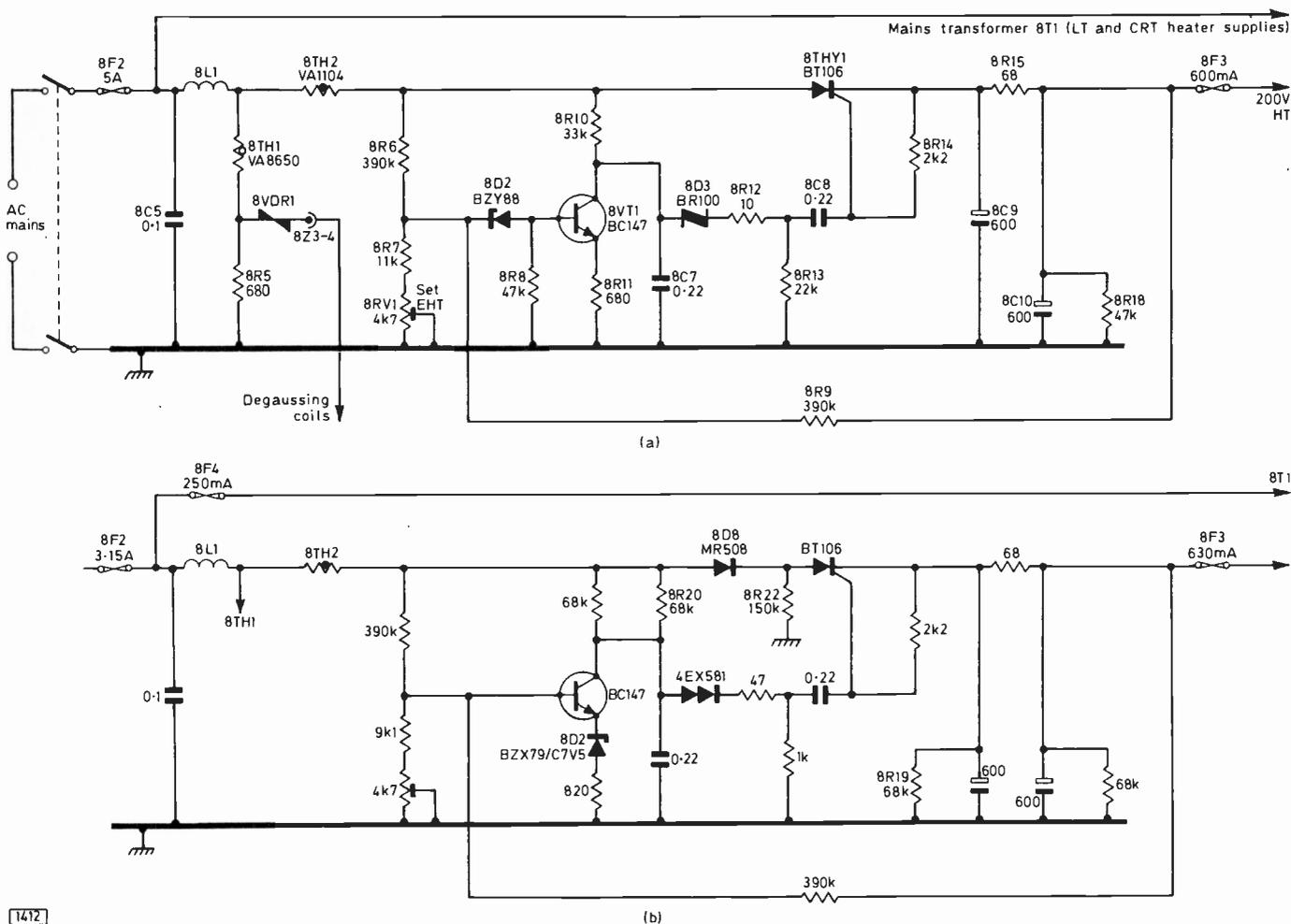
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AD149	0.50	BC134	10.20	BC268C	0.14	BF125	0.25	BF597	10.15	BSY78	0.40	OC72	0.32	2N914	0.19	2N3391A	0.23	2N5087	0.32
AD161	0.48	BC135	10.19	BC294	0.37	BF127	0.30	BF641	10.30	BSY91	0.28	OC73	0.51	2N916	0.20	2N3501	6.99	2N5294	0.35
AD162	0.48	BC136	10.20	BC300	0.60	BF158	10.25	BF641	10.30	BSY95A	0.27	OC75	0.25	2N918	0.42	2N3702	10.13	2N5296	0.58
AF114	0.25	BC137	10.20	BC301	0.35	BF159	10.27	BF642	10.30	BT106	1.50	OC76	0.35	2N930	0.35	2N3703	10.15	2N5298	0.57
AF115	0.25	BC138	0.20	BC303	0.60	BF160	10.22	BF743	0.54	BT116	1.20	OC81	0.53	2N1164	3.60	2N3704	10.15	2N5322	0.58
AF116	0.25	BC142	0.30	BC307B	10.12	BF161	0.45	BF743	0.54	BU105/02	1.90	OC81D	0.57	2N1304	0.21	2N3705	10.11	2N5449	1.90
AF117	0.20	BC143	0.35	BC308A	10.10	BF162	0.45	BF743	0.54	BU108	3.25	OC139	0.76	2N1305	0.21	2N3706	10.10	2N5457	10.30
AF118	0.50	BC147	10.13	BC309	10.15	BF163	0.45	BF743	0.54	BU126	2.99	OC140	0.80	2N1306	0.31	2N3707	10.13	2N5458	10.35
AF121	0.32	BC148	10.12	BC323	0.68	BF167	0.25	BF743	0.54	BU204	1.98	OC170	0.25	2N1307	0.22	2N3715	2.30	2N5494	0.85
AF124	0.25	BC149	10.14	BC377	0.22	BF173	0.25	BF743	0.54	BU205	1.98	OC171	0.30	2N1308	0.26	2N3724	0.72	2N5496	1.05
AF125	0.25	BC152	10.25	BC441	1.10	BF177	0.30	BF743	0.54	BU207	3.00	OC200	1.30	2N1309	0.38	2N3739	1.18	2N5627	0.65
AF126	0.25	BC153	10.20	BC491	1.58	BF178	0.33	BF743	0.54	BU208	3.15	OC211	0.92	2N1613	0.34	2N3766	0.99	2N6178	0.71
AF127	0.25	BC154	10.20	BC493	0.36	BF179	0.33	BF743	0.54	BU209	2.55	OC236A	0.65	2N1711	0.45	2N3771	1.70	2N6180	0.92
AF139	0.35	BC157	10.15	BC492	0.16	BF180	0.35	BF743	0.54	BU209	2.55	ORP12	0.55	2N1890	0.45	2N3772	1.90	2SC643A	1.36
AF147	0.35	BC158	10.13	BCY71	0.22	BF181	0.33	BF743	0.54	BU209	2.55	R2008B	2.05	2N1893	0.48	2N3773	2.90	2SC1172A	2.80
AF149	0.45	BC159	10.15	BCY88	2.42	BF182	0.44	BF743	0.54	BU209	2.55	R2010B	2.95	2N2102	0.51	2N3790	4.15	3N140	1.21
AF178	0.55	BC161	0.48	BD115	0.65	BF183	0.44	BF743	0.54	BU209	2.55	TC44	0.29	2N2217	0.36	2N3794	10.20	40250	0.60
AF179	0.50	BC167B	10.15	BD123	0.98	BF184	0.26	BF743	0.54	BU209	2.55	TC46	0.44	2N2218	0.60	2N3819	10.35	40327	0.67
AF180	0.55	BC168B	10.13	BD124	0.80	BF185	0.26	BF743	0.54	BU209	2.55	TC47	0.58	2N2219	0.50	2N3820	10.49	40361	0.48
AF181	0.50	BC189C	10.13	BD130Y	1.42	BF194	10.15	BF743	0.54	BU209	2.55	TC48	0.58	2N2221A	0.41	2N3823	1.45	40362	0.50
										ME6001	10.16	TIP29A	0.49	2N2222A	0.60	2N3866	1.70	40429	0.80
														2N2270	0.41	2N3877	0.25	40439	2.67

LINEAR IC'S		Type	Price (£)	DIODES		Type	Price (£)	DIGITAL IC'S		Type	Price (£)	BASES		Type	Price (£)
CA3045	1.80	TAA550	0.80	AA113	0.17	FSY41A	0.51	7400	0.20	7460	0.28	DIL8	0.21	DIL14	0.27
CA3046	1.02	TAA611A	2.30	AA119	0.13	OA10	0.37	7401	0.22	7470	0.38	DIL16	0.30		
CA3065	1.90	TAA611B	1.85	AA129	0.28	OA47	0.15	7402	0.22	7473	0.57				
MC1307P	1.32	TAA830Q	13.91	AA143	0.18	OA81	0.17	7404	0.23	7474	0.44				
MC1310P	2.94	TAA630S	14.18	AAZ13	0.30	OA90	0.10	7406	0.64	7475	0.72				
MC1327PQ	1.86	TAA861B	1.75	AAZ17	0.16	OA91	0.12	7408	0.33	7489	4.32				
MC1330P	0.93	TAA700	3.90	BA100	0.24	OA95	0.15	7410	0.22	7490	0.73				
MC1331P	0.90	TAA840	12.38	BA102	0.25	OA200	0.10	7411	0.45	7491	1.25				
MC1352P	0.90	TAA861A	10.95	BA110	0.80	OA202	0.13	7412	0.28	7492	1.00				
MC1358PQ	1.85	TAD100	12.66	BA115	0.15	OA210	0.69	7413	0.40	7493	0.95				
MC1496L	0.88	TBA120S	10.99	BA141	0.17	OA2237	0.78	7416	0.43	7494	1.44				
MC3051P	0.55	TBA240A	13.98	BA145	0.19	S2M1	7417	0.43	7495	1.02					
MFC4000B	0.85	TBA281	12.07	BA148	0.19	TV20	2.25	7420	0.22	7496	1.44				
MFC4000A	0.98	TBA480Q	11.84	BA154	0.19	IN914	0.07	7425	0.37	74100	2.00				
NE555	1.12	TBA500	11.99	BA155	0.19	IN914E	0.06	7430	0.22	74121	0.82				
NE556	1.34	TBA510	11.99	BA156	0.15	IN916	0.09	7440	0.22	74150	2.10				
SL144A	1.91	TBA520Q	12.98	BA157	0.25	IN1184	1.10	7441A	1.33	74151	1.38				
SL901B	4.10	TBA530	11.98	BAX13	0.08	IN1195	1.30	7445	1.90	74152	2.10				
SL178	6.														



1412

Fig. 2: The thyristor regulated power supply circuit used in the Rank A823 solid-state 90° colour chassis. (a) Original circuit. (b) The current version, showing modifications.

The power supply panel itself is easily accessible and particularly straightforward to work on. Since the chassis was first introduced several minor component value changes and modifications have been made, as shown in Fig. 2(b).

As well as causing field jitter, the BT106 thyristor can fire erratically. This results in h.t./e.h.t. variations and a pulsating picture. If the thyristor is open-circuit there will be no h.t. of course, while if it goes short-circuit the 5A mains fuse will blow. On occasion the thyristor can be responsible for excessively high h.t. which cannot be adjusted by means of the set e.h.t. control 8RV1. This fault can also be due to failure of the transistor (8VT1) regulator circuit to operate – for example as a result of 8R6 or 8R9 going open-circuit.

The zener diode 8D2 is mainly included to provide temperature compensation. It can also cause unstable h.t. and a fluctuating picture, as can the diac 8D3. A short-circuit or open-circuit diac, though quite rare, will result in no output. A fairly common but easily spotted cause of no output is failure of the surge limiting thermistor 8TH2. After some years of service it tends to get brittle, powders away and is finally held by only one securing lead.

As in all power supply circuits loss of capacitance in a reservoir electrolytic will cause low output while loss of

capacitance in a smoothing electrolytic will show up as speaker hum, a raster hum bar and possibly poor picture quality and impaired field timebase locking.

8R9 sometimes goes high-resistance to cause the high h.t. with limited control by 8RV1 symptom.

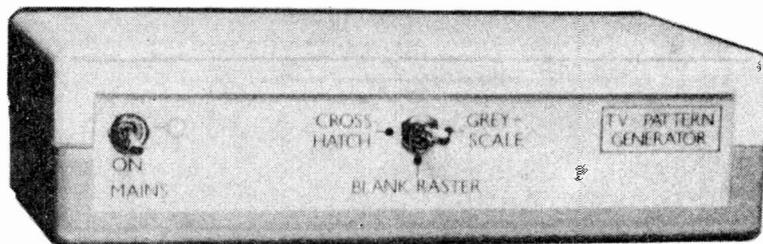
On the l.t. side 8R4 (15Ω) which feeds the audio stages can burn out as a result of a short in the audio output transistors. If the 2A fuse 8F1 which feeds the BY164 l.t. bridge rectifier is blown the cause will probably be that one or more of the diodes in the bridge has gone short-circuit. The best policy is to replace the BY164 with four BY127 rectifiers.

## IC SOUND CIRCUITS

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The sizes of the two printed circuit boards are as follows: Fig. 2: 3 x 2½ in., Fig. 7: shown full size. R6 is not required in the second circuit (Fig. 6) if a loudspeaker is connected to it permanently. Add R6 if the unit is to be used as a general purpose amplifier to which a loudspeaker may or may not be connected.

# TV



P.J. STONARD

PART 1

# PATTERN GENERATOR

VARIOUS patterns are required for checking and setting up colour receivers. In particular it's necessary to have a pattern to enable the red, green and blue rasters to be converged. Test Card F helps, with its centre cross for static convergence and background crosshatch which can be used for dynamic convergence. It's much handier to have a portable source of suitable patterns however. Many designs have been published in recent years but have generally had one of two disadvantages. They've either required access to the receiver's innards, or they've taken up a lot of space in the tool box. The design featured in this article is completely self-contained, can be operated from a battery or the mains supply, provides outputs at video frequency or at u.h.f. for feeding into a set's aerial socket, and is of compact dimensions. Three patterns are provided, a crosshatch, an eight-step grey scale, and a blank white raster.

## Patterns

The crosshatch pattern consists of a grid of white lines on a black background and can be used to show up colour fringing (misconvergence), beam misalignment (impurity), raster distortion and picture tearing. Sixteen vertical lines are displayed. The horizontal lines occur on every tenth line. This gives approximately thirty horizontal lines of which twenty-five are visible, the others occurring during the blanking period or off screen.

The grey-scale pattern enables the c.r.t. drive circuits to be set up for correct monochrome reproduction, from black to peak white. The bars are approximately  $6.5\mu\text{s}$  wide and descend from peak white to a clamped black. The display is similar to that given by the luminance component of a colour bar pattern. In the prototype versions each bar is one unit greater than the adjacent lower one, i.e. the scale has

equal changes. This can be changed to correspond with a 100% saturated, 100% amplitude colour bar pattern by altering the values of three resistors.

The peak white blank raster enables hum bars and other such picture disturbances to be examined.

To simplify the design, slight changes from the normal practice have been adopted for the video signal. The standard 1V video signal rises to +0.7V for peak white and falls to -0.3V for the sync pulse tips, with the blanking level at 0V and the black level on a pedestal 50mV above this. This unit provides a 700mV video and 300mV sync signal, but the blanking level is at 0.3V. This greatly simplifies the power supply arrangements.

## Outputs

The video signal is available at one output, for use with closed-circuit equipment. The second output, at u.h.f., is provided by a modulator similar to those used in TV games units.

Operation is straightforward. There are two switches on the front panel, one controlling the power and the other to select the pattern. A red l.e.d. is illuminated when the power is applied. A third switch, on the rear panel, introduces a  $75\Omega$  terminating resistor. Thus the video output can be matched at either the generator or the load (the monitor). The latter is preferable since an unterminated cable will result in poor quality pictures. With termination at the generator the cable feeds the high load impedance and the resulting voltage standing wave shows up as reflections or ghosting on sharp verticals.

There are three internal preset controls. These set the oscillator frequency, the field sync pulse timing, and balance the grey-scale display. The latter operation should ideally be

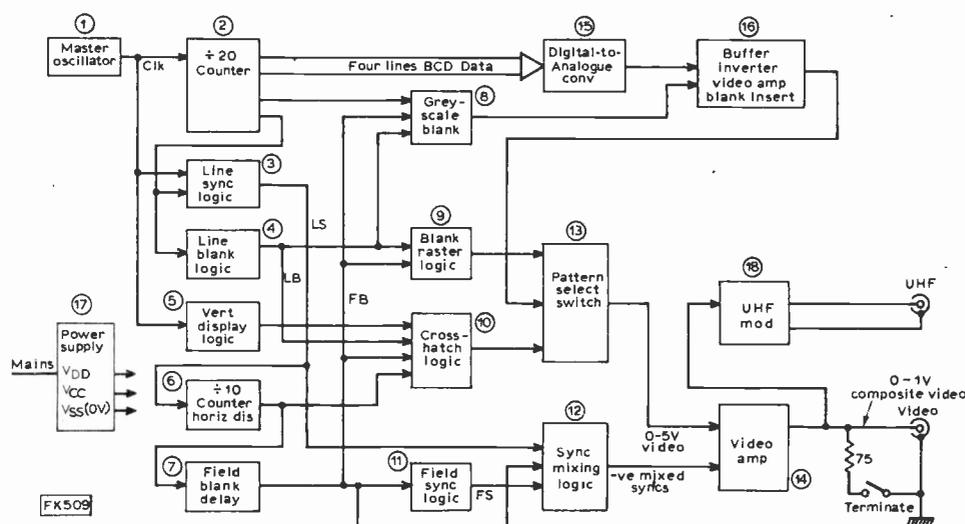


Fig. 1: Block diagram of the complete pattern generator.

done while observing one line of the display on an oscilloscope. Since not everyone has ready access to a scope however, a setting up procedure using a standard TV receiver will be given later.

An i.c. master oscillator (see Fig. 1) is used, with a trimmer to set the frequency. One bonus of this arrangement is that the behaviour of the monitor's or receiver's timebases can be observed under different pulse rates. This was not the prime consideration of course. The oscillator provides a  $1.6\mu\text{s}$  pulse every  $3.2\mu\text{s}$  and is set to give a line period of  $64\mu\text{s}$ .

The field frequency waveforms are obtained from monostable multivibrators which are triggered, after division by ten, from the line sync pulses. Thus the field timing can be set independently of – though synchronised to – the line rate. This approach makes it possible to remove a lot of dividers that would otherwise be necessary.

### Waveforms

Before discussing the operation of the circuit we'll look at the basic pulse waveforms. The CCIR System I signal parameters are used for all u.h.f. TV transmissions in the UK. For our purposes however it is not necessary to produce a waveform to this full specification. A large saving in the amount of circuitry that would be required is achieved by omitting the broad and equalising pulses from the field blanking period. The line blanking period is  $12.8\mu\text{s}$  instead of  $12.05\mu\text{s}$  and the line sync pulse  $4.8\mu\text{s}$  which is the top limit ( $4.7\mu\text{s} \pm 0.1\mu\text{s}$ ) of the broadcasting specification. The field sync and blanking pulse durations are set by monostable multivibrators. The field sync pulse is adjustable, as we have seen; the blanking time is  $1.6\text{ms} \pm$  the tolerance of the monostable's CR network  $\pm 1\%$  tolerance for the i.c. Calibration to set the line and field rates can be done with an oscilloscope or by using a television set as a "transfer standard".

So far as the patterns are concerned, the following considerations apply. First, since 2:1 interlacing is used in the broadcast specification to improve the vertical resolution this is not required – random interlace is used instead. Eight vertical bars are required for the grey-scale pattern. The duration of the forward scan is  $52\mu\text{s}$ , and one eighth of this is  $6.5\mu\text{s}$ . By choosing  $6.4\mu\text{s}$  the line consists of ten equal units, eight appearing during the forward scan and two during the flyback. This is the reason for adopting  $12.8\mu\text{s}$  as the line blanking period. A period of  $4.8\mu\text{s}$  was adopted for the line sync pulse since there is a common factor of  $1.6\mu\text{s}$  between this and the  $6.4\mu\text{s}$  grey-scale bars. The clock pulse length is in fact  $1.6\mu\text{s}$  and this is also very close to the front porch period of the broadcast line sync pulse. The vertical crosshatch pattern lines are obtained from the positive-going edges of the  $1.6\mu\text{s}$  clock pulses, giving a stable vertical display. The horizontal crosshatch lines are obtained from a divider which counts the line pulses, producing a crosshatch line every tenth line.

### Block Diagram

The block diagram (Fig. 1) shows the functions carried out in the unit. This is a simplified diagram and it should be noted that some of the i.c.s are used to perform more than one group of functions. The master oscillator (1) provides our  $1.6\mu\text{s}$  clock pulses. The divide by twenty counter (2) provides data for the grey-scale pattern. The line sync logic (3) is used to provide a  $4.8\mu\text{s}$  pulse every  $64\mu\text{s}$  while the line blanking logic (4) provides a  $12.8\mu\text{s}$  blanking pulse. The vertical display logic (5) uses a CR network to produce a bright-up pulse from negative-going clock pulse

transitions. The divide-by-ten counter (6) produces an output on each tenth line. The 20ms multivibrator (7) is triggered at line/10 rate to control the field waveform timing. The grey-scale blanker (8) cuts off the grey-scale amplifier during the eighth (black) bar and during the line and field blanking periods. The blank raster logic (9) gives the required raster bright-up output. The crosshatch logic (10) provides OR gating to give the vertical and horizontal components of the grid, along with the necessary flyback blanking. The field sync logic (11) is triggered every 20ms by (7) to give a  $1.6\text{ms}$  blanking pulse, a  $160\mu\text{s}$  delay during the first equalising pulse period, and a  $160\mu\text{s}$  output for the broad pulse and field sync periods. The sync mixing logic (12) adds the sync pulse waveforms and drives the video amplifier. The pattern selection switch (13) consists of a double-pole, double-throw, centre-off toggle switch plus diode gates to suppress the waveforms not required, i.e. to prevent crosshatch on grey-scale interference. The video amplifier (14) drives the  $75\Omega$  output lines and provides the signal for the u.h.f. modulator (18) which produces an output at about 500MHz.

The digital-to-analogue converter (15) consists of a passive resistor network which generates the basic grey-scale. The buffer amplifier (16) steps down the high-impedance output from (15) and inverts the signal to produce a descending grey-scale signal.

### Logic Families

The timing of the various waveforms is controlled by logic circuits. These operate on the principle that an open switch indicates "false" and a closed switch "true". Perhaps the most common family of i.c. logic devices is the TTL (transistor-transistor-logic) variety which, operating with a single supply, have come to be known colloquially as "5 volt logic". In more recent times a new breed of logic devices has appeared, the CMOS family used here. The same logic principles apply but the electronics is somewhat different. CMOS stands for complementary-metal-oxide-silicon, i.e. the active devices are f.e.t.s of either the n- or p-channel type. The input impedance is thus very high, which means that care is required in handling CMOS devices. A charge which will not leak away quickly can build up on the input and will eventually destroy the device. Internal protection is provided but relies on the device being connected to the supplies. The problem is in getting them from their packing to the board. In the author's experience CMOS is a lot tougher than is sometimes suggested – but do avoid the cat! Notes on handling CMOS devices will be given later.

CMOS offers some important advantages, though there are disadvantages as well. Two useful gains are supply voltage freedom, allowing 3-15V operation (18V for /B devices), and the fact that the dissipation is a lot less than is the case with TTL logic. This latter point brings with it one disadvantage however, output impedance. Thus CMOS cannot drive loads such as l.e.d.s (with standard family devices that is).

### Circuit description

In the following circuit description reference should be made to both the block diagram (Fig. 1) and the complete circuit (Fig. 2).

The master oscillator consists of IC1a and IC1b along with R1, C1 and VR1. These components form an astable multivibrator whose frequency is set by VR1. The output from pin 4 of IC1b is the master clock pulse train. The pulses are of  $1.6\mu\text{s}$  duration (see Fig. 4 – next month).



Waveform *J* is the delayed master clock, integrated by R2 and C2, which is used in place of the direct clock to compensate for the 350ns propagation delay in IC7a. Waveform *K* is then added to waveform *N* in AND gate IC5d to produce waveform *P*, inverted line sync.

When displaying a grey scale, the output signal should be at blanking level from the beginning of bar eight until the beginning of bar one on the succeeding line, and also during the field blanking interval. This blanking waveform (*S* shows the line component only) is generated by gate IC3b which combines waveforms *AD* the field blank, *R* inverted bar eight blank, and *M* the line blank signal. The output of IC3b is fed to the base of Tr3 via limiting resistor R17. The parallel capacitor C9 serves to speed up the leading edge of the pulse.

### Crosshatch

The crosshatch is formed from two picture components. The vertical lines occur at each positive transition of the master clock. Waveform *A* is differentiated by C3 and R13 and the resulting spikes applied to IC6b as waveform *W*. The input diodes on IC6b clip any excursions above  $V_{DD}$ . A train of positive-going spikes will appear at the output of IC6b so long as its other input (waveform *V*) is at 1. The width of the spikes depends upon the differentiator time constant and the gate threshold. With the values shown, the width is approximately 324ns, and this defines the vertical bar width.

The network D1, R12 is part of a switching arrangement which removes the fast-rising pulses of the crosshatch verticals when other patterns are selected, preventing interference with those patterns. When S1b is set to crosshatch, D1 anode is connected to 0V ( $V_{SS}$ ) while its cathode is returned to  $V_{DD}$  via R13; it is therefore reverse-biased and the differentiated clock pulses are applied to IC6b.

If a pattern other than crosshatch is selected, D1 anode is returned to  $V_{DD}$  via R12, and the diode will conduct when the negative clock pulses fall 0.6V below  $V_{DD}$ . Thus the clock pulses will not reach the threshold of IC6b and the crosshatch verticals will be inhibited.

The other component of the crosshatch pattern, the horizontals, consists of a white line every tenth line. Counter IC7b is driven in similar fashion to IC7a, in this case by the Qd output of the latter. Waveforms *T* and *U* represent the counter outputs. Note that waveforms for this part of the line-related circuit are drawn as 16 $\mu$ s/division. Waveform *G* is shown again on this part of the diagram, but for 10 cycles and not one as seen at the top of Fig. 4.

The outputs of IC7b, waveforms *T* and *U*, are applied to NAND gate IC6c whose output (waveform *V*) will be at 1 for nine lines, falling to 0 for the duration of the tenth line. Thus waveforms *V* and *W* when applied to NAND gate IC6b will produce an output (*X*) which is the complete crosshatch pattern, containing all picture details, but not including picture blanking.

The output of gate IC6b is applied to NAND gate IC3c together with line and field blanking waveforms *M* and *AD* respectively. The output of IC3c is inverted by IC1d to form the final blanked crosshatch signal and passed to the pattern select switch, S1a.

### Blank Raster

To display a blank raster the video signal is switched to white, except during the line and field blanking periods. This is achieved by AND gate IC5b, whose inputs are the

blanking waveforms *M* and *AD*. The output of IC5b is passed to S1b, the pattern selector switch.

### Pattern Selection

Pattern selection is achieved by S1, a double-pole, double-throw, centre-off toggle switch plus some switching diodes. For the blank raster and crosshatch, the drive is from the logic. The grey-scale is an analogue signal.

From Fig. 2 it will be seen that the lower end of resistor R23 is returned to  $V_{SS}$  via D2 or D3 and S1b when crosshatch or grey-scale are selected. When S1 is set to the grey-scale position, the signal from Tr2/Tr3 is fed via R22 and S1a to Tr4 input and R23/D3. This parallel combination together with R22 attenuates the signal from Tr2/Tr3. For a white bar, Tr2/Tr3 collectors are at approximately  $V_{DD}$  of 10V, while only 4V is required at Tr4 base for an output from SK1 into 75 $\Omega$  of 1V. The 6V difference is dropped across R22. As the input impedance of Tr4 is determined by its  $h_{FE}$  the value of R22 may need to be changed from its nominal 5.6k $\Omega$  to produce exactly 1V at the output.

The blank raster signal from IC5b is fed through R19. When crosshatch or grey-scale is selected R19 is connected to  $V_{SS}$  via S1b and D2 or D3, thus the blank raster signal is bypassed. When the switch is set to the centre position (the state shown in Fig. 2) neither R18 nor R22 are connected to R23 since S1a is centre-off. S1b is also centre-off, removing the bypass to  $V_{SS}$  via D2 or D3, and the output of IC5b is fed to the bottom end of R23 via R19. The attenuator network comprising R19, R21, R23 and the input impedance of Tr4 is arranged to provide a 1V peak white signal at SK1 (into 75 $\Omega$ ) with blanking and syncs.

With crosshatch selected, S1b removes the blank raster by returning R23 to  $V_{SS}$  via D2, and also applies reverse bias to D1, allowing the vertical pattern to be generated as already described. Crosshatch signals from IC1d pass via S1a and are attenuated by R18, R23 and Tr4 input impedance in the same manner as the grey-scale input.

### Video Amplifier

The video amplifier stage, comprising Tr4 and Tr5, converts the 10V logic signals and the grey-scale amplifier output into a +0.3V to +1.0V output. The mixed syncs are added to the video and switch the output from +0.3V to near 0V.

During the front and back porches neither video nor sync signals are present. Both Tr4 and Tr5 are non-conducting and the voltage at the output is determined by R26 plus R25 in parallel with the load of 75 $\Omega$ . This voltage is the blanking level and is approximately +0.3V. Mixed line and field sync pulses from IC8b are applied via R20 to the base of Tr5, causing it to conduct heavily and pull the collector down almost to 0V ( $V_{SS}$ ). The peak white level of +1.0V is reached when Tr4 conducts and pulls the top of R24 to +4.0V.

When the video output from SK1 is not required a 75 $\Omega$  terminating resistor is switched in by S3 (see Fig. 3) to maintain the correct signal levels.

### Field Blanking and Sync Logic

As indicated earlier, the field timing is set by means of a monostable. In fact two are used, based on the dual timer IC2. The first mono, IC2b, is fired by the negative step of waveform *V* (see Fig. 5), which occurs every 640 $\mu$ s. The period of IC2b is set by means of VR2, R11 and C5 to 20ms. When fired by waveform *V* the output goes high for 20ms (waveform *AB*) and then returns to 0 until the next pulse from IC6c, giving a delay of up to 640 $\mu$ s.

## ★ Components list

### LOGIC AND POWER SUPPLY

#### Resistors:

R1	15k $\Omega$	R16	12k $\Omega$
R2	3.3k $\Omega$	R17	33k $\Omega$
R3	39k $\Omega$	R18	12k $\Omega$
R4	18k $\Omega$	R19	3.9k $\Omega$
R5	10k $\Omega$	R20	100k $\Omega$
R6	3.9k $\Omega$	R21	8.2k $\Omega$
R7	1.2k $\Omega$	R22	5.6k $\Omega$
R8	6.8k $\Omega$	R23	15k $\Omega$
R9	2.2k $\Omega$	R24	220 $\Omega$
R10	68k $\Omega$	R25	150 $\Omega$
R11	100k $\Omega$	R26	1.5k $\Omega$
R12	680 $\Omega$	R27	91 $\Omega$ 1W
R13	4.7k $\Omega$	R28	47 $\Omega$
R14	12k $\Omega$	R29	1.5k $\Omega$
R15	15k $\Omega$		

All resistors except R27 are 5%.  $\frac{1}{4}$ W carbon film.

#### Potentiometers:

VR1 50k $\Omega$  VR2 100k $\Omega$  VR3 1k $\Omega$

All sub-miniature horizontal presets

#### Miscellaneous:

T1 18V 100mA secondary, sub-miniature  
 S1 D.p.d.t. min toggle with centre off position  
 S2 S.p.s.t. min toggle  
 S3 S.p.s.t. min slide switch  
 SK1 B.N.C. socket  
 Case, 155 x 85 x 40mm Verobox  
 Printed circuit board (see next month)

#### Capacitors:

C1	27pF polystyrene
C2	100pF polystyrene
C3	100pF polystyrene
C4	22nF polyester
C5	0.1 $\mu$ F tantalum bead
C6	1nF polystyrene
C7	47nF polyester
C8	10nF polyester
C9	150pF polystyrene
C10	150pF polystyrene
C11	1000 $\mu$ F 25V elect.
C12	33 $\mu$ F tantalum bead
C13	100 $\mu$ F 10V p.c. elect.

#### Semiconductors:

Tr1 2N3906 Tr4 ZTX300  
 Tr2 2N3904 Tr5 ZTX300  
 Tr3 2N3904 Tr6 2N3904  
 D1 - D3 1N916  
 D4 Silicon bridge rectifier type WO2  
 D5 TIL209 I.e.d. (Texas)  
 D6 BZY88 C10 zener (400mW, 10V)  
 IC1 CD4069AE IC6 CD4011AE  
 IC2 NE555 IC7 CD4518BE  
 IC3 CD4023AE IC8 CD4011AE  
 IC4 CD4013AE IC9 TBA625B  
 IC5 CD4081AE

### UHF MODULATOR

#### Resistors: (all 5%, $\frac{1}{4}$ W carbon film)

R1	12k $\Omega$	R5	220 $\Omega$
R2	3.3k $\Omega$	R6	100 $\Omega$
R3	560 $\Omega$	R7	3.3k $\Omega$
R4	75 $\Omega$	R8	75 $\Omega$

#### Capacitors:

C1 270pF polystyrene  
 C2, C3 1.8pF sub-min plate ceramic

#### Semiconductors:

Tr1 BFY90 Tr2 2N3704 Tr3 2N3706

#### Miscellaneous:

L1, L2, L3 see constructional details next month  
 Printed circuit board (see next month)  
 SK1 Standard TV coaxial socket  
 Tinplate for screening  
 Ferrite bead, Mullard FX1115 (for L1)

At the end of 20ms the negative edge fires IC2a which has a fixed period of 1.6ms set by R10 and C4. This is equivalent to 25 lines and after inversion by IC6d forms the field blanking waveform AD.

A gated oscillator similar to the master oscillator is formed by IC8d, IC8a, R14, R15 and C8. When the output of IC2a goes to 1 (waveform AC) this oscillator produces a train of pulses 160 $\mu$ s in duration at intervals of approximately 320 $\mu$ s. Five negative-going pulses are produced before IC2a output returns to 0, thus inhibiting the oscillator (waveform AE). Between pulse trains, IC8d is biased as a linear amplifier by R14 and R15, so that any noise pick-up would be injected into gate IC8a causing interference with the displayed pattern. To prevent this C6 acts as an a.c. short to  $V_{DD}$  bypassing noise at IC8d inputs.

A delay circuit formed by C7 and R16 allows IC5a to pass the first positive 160 $\mu$ s pulse from IC8a. The positive

step of waveform AC charges C7 via R16. As C7 charges, the voltage at IC5a input falls exponentially (waveform AF), remaining above the logic 1 level for the first 320 $\mu$ s. Thus, when the first 160 $\mu$ s pulse from IC8d is generated, the output of IC5a also produces this pulse (waveform AG). This is the field sync pulse which starts 160 $\mu$ s after field blanking and lasts 160 $\mu$ s. Between the end of this pulse and the following 160 $\mu$ s pulse from IC8a the voltage at the top of R16 must fall below the threshold of IC5a. The time to reach this threshold is 400 $\mu$ s  $\pm$  80 $\mu$ s. If it is outside this tolerance, the field sync pulse will shorten or become two pulses.

#### Sync Mixing Logic

The line timebase of a receiver or monitor will revert to its natural frequency if line sync is not maintained during field sync and field blanking. When this happens, the

receiver or monitor may take several lines to recover, causing the picture to tear at the top of the screen, a failure of some simple pattern generators. To prevent this the syncs are mixed by a logic network comprising IC1e, IC1f, IC6a, IC8c and IC8b, see waveforms P, AH, AJ, AK, AL and AM. The output of IC8b feeds Tr5 via R20/C10.

This concludes the description of the logic and video stages. The remaining parts are linear, being the grey-scale electronics, u.h.f. modulator and power supply.

### Grey-scale Electronics

Generation of the grey-scale steps has already been described. These come from the digital to analogue converter, but this waveform is ascending and must be inverted to produce a white to black display. Transistor Tr1 is a non-inverting amplifier which buffers waveform H. When signals at its base are zero the emitter sits at +0.6V; the steps move in units of 0.3V and so at step seven this voltage reaches 2.1V + 0.6V = 2.7V. The behaviour after step seven is not important as Tr3 will be driven into saturation by the grey-scale blanking signal. When Tr3 conducts its collector (and that of Tr2) is pulled down to near 0V, causing Tr4 to be cut off and thus leaving the output signal at blanking level.

At the end of line blanking, IC7a output will be at binary 0000, Tr1 base will be at 0V and its emitter at +0.6V. Inverting amplifier Tr2 will be almost cut off under these conditions and the voltage at its collector will be determined by the current drawn through R22.

When IC7a output goes to binary 0001, the emitter of Tr1 rises by 300mV, causing Tr2 emitter to rise by a similar amount. The current in Tr2 (set by VR3) rises, causing its collector voltage to fall. The drive to Tr4 falls and a less white (i.e. grey) picture results. This process continues until step seven.

### Power Supply

The unit requires two rail voltages. The modulator uses a VCC supply of +12V, while the remainder of the circuitry is driven from a VDD rail of +9.4V, both with respect to the 0V (VSS) rail. All supplies are derived from a smoothed source of approximately 23V, provided by T1, D4, R27 and C11.

The +12V VCC line is regulated by IC9 and decoupled by C12. This line also supplies bias for D6, the reference diode for Tr6 which stabilises the +9.4V VDD supply. The logic is decoupled by C13 which is located down the supply line at the field circuits.

### UHF Modulator

The u.h.f. modulator is required to simulate the transmitter signal that would be applied to the TV receiver, the video and syncs information being modulated onto a u.h.f. carrier.

In the present design a self-oscillating modulator is used, an r.f. oscillator whose output is varied in amplitude by modulating the supply to the transistor. The circuit is shown in Fig. 3. A +12V supply is used and R1, R2 set the base voltage of Tr1, a BFY90 high frequency device, the base being decoupled by C1. The transistor operates in the common-base mode, with a collector current set by R3 to 3.5mA. Oscillation occurs through the physical layout, and L2, C3 are tuned to the centre of Band V. Capacitor C2 provides d.c. isolation for L2. The r.f. output is coupled into L3 which feeds the output socket SK1 via R4, a

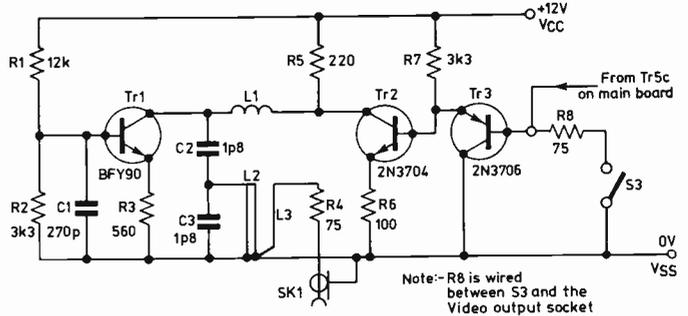


Fig. 3: Circuit diagram of the u.h.f. modulator.

matching resistor. Choke L1 prevents the r.f. signal from being shorted out in the modulator.

During syncs the signal from Tr5 collector is near 0V. The emitter of Tr3 is then at +0.6V, Tr2 is cut off and the collector supply to Tr1 is at a maximum, producing a 100% amplitude carrier. At peak white the video signal is at +1.0V, the emitter of Tr3 is at +1.6V and 10mA flows through R5 and R6. The modulator supply falls by 2.2V and the r.f. carrier amplitude is reduced. A full 80% modulation is not attempted, as this would be likely to upset the oscillator frequency, causing an unusable picture on the associated TV receiver.

## TO BE CONTINUED NEXT MONTH

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# Servicing the ITT CVC1 and CVC2 Chassis

E. Trundle

AT the start of colour TV in the UK in 1967 most setmakers immediately brought out dual-standard colour receivers. They were ponderous and temperamental machines, and in many cases are best forgotten! ITT was the last major setmaker to introduce a colour receiver, and their first models were unique in the UK in boasting a hand-wired chassis and the largest electrolytic capacitor the author has ever seen. These remarkable sets were not made in great numbers and are comparatively rare outside the circle of independent retailers. The earlier CVC1 chassis was a dual-standard one and is even thinner on the ground than the later single-standard version, the CVC2. It is the purpose of this article to summarise some common idiosyncracies of the CVC2, covering also the CVC1 which is very similar except for the "extras" required for dual-standard operation. The list is not claimed to be complete, but you'll find most of the common faults.

Before preparing the article we studied the careers of a couple of dozen CK402s which had been out on rental for a period of about five years. One of the main features to emerge was that they are very light on c.r.t.s. Most colour sets of this vintage contain very tired c.r.t.s, but very few CVC2s have been found to need a replacement tube to date. There doesn't seem to be any particular reason for this. Any ideas?

First a brief note about the circuitry. Most of this follows the usual lines adopted in hybrid colour chassis. Colour-difference tube drive is used, but unusually a BD119 transistor is used as the luminance output device. There are one or two unexpected features in the decoder however. First, colour-killing takes place in the emitter circuits of the B-Y and R-Y preamplifier transistors. Secondly an automatic grey-scale shift circuit operates via these preamplifiers: this gives a slightly different grey-scale on colour and monochrome. Thirdly a bridge rectifier driven by anti-phase outputs from the ident amplifier is used as the PAL switch, and in conjunction with a transformer with a centre-tapped primary winding inverts the R-Y chrominance signal on alternate lines. Finally the reference oscillator feeds two subcarrier amplifiers, one driving the R-Y demodulator and the other, via a 90° phase shift coil, the B-Y demodulator. The feedback signal to the burst detector comes from the B-Y subcarrier amplifier. One consequence of this arrangement is that demise of the B-Y subcarrier amplifier transistor will shut down the burst detector and thus remove the colour.

## Hand-Wiring Problems

The question of dry-joints will appear like a refrain throughout this article, and justifies explanation. Apart from normal dry-joints and shorts between adjacent tags, these chassis suffer from corrosion problems on earth joints. Wherever a wire is soldered to chassis earth it is wrapped round a "finger" formed from the steel chassis. This is fine initially, but after a period of time corrosion sets in and the earth connection becomes intermittent. "Off-earth" faults are difficult to diagnose at the best of times, but when combined with intermittency many fruitless hours

can be spent tracing the source of the trouble. Whenever intermittent problems are encountered a healthy tug at the earthing wire will often move it on its tag: a beefy soldering iron and plenty of flux-cord solder will then put matters to rights. Another problem inherent in hand-wiring is the risk of burning the insulating covering of a passing wire where it is in contact with a hot solder-tag during the soldering process. This can lead to frustrating intermittent problems.

## Tuners

The CVC1 is fitted with conventional rotary tuners after the style of the contemporary monochrome models. These are comparatively trouble-free. The CVC2 has a four-channel push-button tuner, with a small printed panel on the main chassis to make up for the gain lost by removal of the v.h.f. tuner. The CVC2's tuner is notorious for poor resetability, and slight readjustment of the tuning on changing channels is usually necessary. Although the trouble is mechanical, the lack of a.f.c. aggravates the problem. The tuner may be one of two types, as used in later ITT monochrome receivers. The type with the "wheel and spring" selector mechanism is the more reliable from the reset point of view. If ever a set was a worthy candidate for conversion to varicap tuning this is it! (See *Television* October 1972.)

## IF, AGC and Luminance Stages

The i.f. strip is often responsible for low-gain, instability and various intermittent problems. The a.g.c. department should be eliminated first, by overriding its potential (across Ck75, see Fig. 1) with a low-impedance bias box. The vast majority of i.f. problems stem from faulty transistors and poor jointing. Transistor failures are usually easily tracked down with a d.c. voltmeter.

Txk10 and Txk11 are suspect for a.g.c. faults, with Txk10 favourite. Txk12 is concerned only with the tuner a.g.c.

The luminance output transistor Txf1 (BD119) carries the world on its shoulders in this chassis, but is remarkably reliable provided it is firmly in contact with its heatsink.

## Brightness Faults

Brightness faults are not uncommon, and usually stem from the beam limiter transistors on the line timebase chassis. These are Txh1 (BC116) and Txh2 (BC118) – see Fig. 2. Varying brightness can often be traced to leakage in the 12.5μF luminance coupling capacitor Ck77 – uncontrollable brightness is the fault should it go short-circuit. Another cause of brightness troubles is the line output valve's cathode decoupling capacitor Ch29 (200μF) – the cathode voltage is used as the basis of the beam limiter action. A brightness fault that's difficult to diagnose is when R24 (470kΩ) which returns the c.r.t. first anode preset controls to chassis goes open-circuit or high resistance. The first anode voltages rise and the increased beam current brings the beam limiter circuit into operation.

The result is negative voltages around the beam limiter transistor Txh2, at the base and emitter of the d.c. restorer transistor Txk13 and at the base of the luminance output transistor Txf1. The potential divider network in the collector circuit of the luminance output transistor – from the 290V rail to chassis – prevents the collector voltage rising to the full h.t. potential but leaves a bright screen with flyback lines. A possibility in case of brightness variations is the two 50 $\mu$ F electrolytics Cp2 and Cp3 which smooth the -20V rail. A glance at Figs. 2 and 6 will show why.

### Sound Circuits

Apart from the bogey of dry-joints etc the sound department gives little trouble. Occasionally the capacitors which tune the intercarrier sound transformers have been found open-circuit. These are Ck17, Ck18 and Ck21, and are polystyrene types. When the PCL86 audio valve is replaced the earthing and value of its cathode resistor Rf5 (120 $\Omega$ ) should be checked.

### The Decoder

No colour or intermittent colour are amongst the most common failings of the CVC2. The decoder is easily detachable for replacement but exchange decoders are hard to come by and the return of the entire decoder to ITT for repair necessarily involves some delay. Earthing and wiring problems are rife in the decoder and should be the first thing to look for. Our old friends the polystyrene capacitors come high on the list of suspects, Cd62 (0.03 $\mu$ F), Cd57 (0.0022 $\mu$ F) and Cd59 (0.22 $\mu$ F) in the ident stage and the

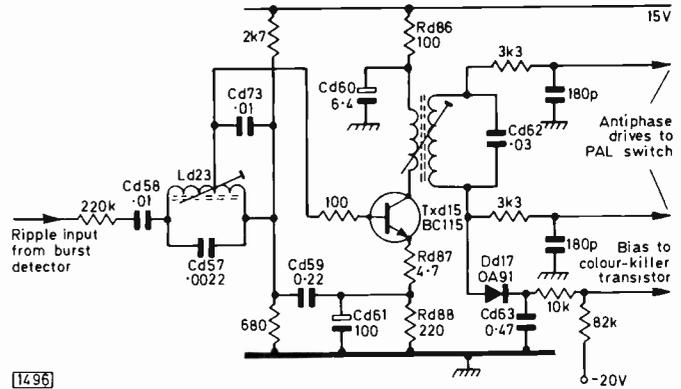


Fig. 3: The ident amplifier and colour-killer circuits.

colour-killer reservoir capacitor Cd63 (0.47 $\mu$ F) being particularly troublesome (see Fig. 3). In fact all polystyrene capacitors in the decoder should be treated with suspicion. Where the colour-killer is erratic due to low ident signal (at least 6V d.c. is necessary at the cathode of the colour-killer rectifier Dd17) Rd87 (4.7 $\Omega$ ) may be bypassed. This modification, we hastily add, is quite unofficial.

Erratic performance of the burst department is often curable by the replacement of the can containing Ld21 and Ld22 – the phase detector can. When working in the burst phase detector area it should be borne in mind that the subcarrier reference feed comes via Txd7, the B-Y subcarrier amplifier/demodulator driver. Thus failure of this transistor will delete the ident and activate the colour-killer.

The reference oscillator transistor Txd16 (BC118) and its crystal can be responsible for intermittent colour while the 8.2V zener diode Dd19 in this circuit can cause erratic colour sync.

The collector circuits of the burst gate pulse generator (Txd12), the gated burst amplifier (Txd14) and the ident amplifier (Txd15) transistors incorporate RC decoupling networks in which the capacitive element is an electrolytic. The capacitors are Cd44 (50 $\mu$ F), Cd45 (2 $\mu$ F) and Cd60 (6.4 $\mu$ F) respectively. They tend to go open-circuit or to dry up, reducing the efficiency of the relevant stage(s).

Turning to the chroma channel, the transistors Txd1-3 can fail, the electrode voltages betraying the culprit. Several deep and mysterious cases of intermittent or no chroma have been tracked down to the colour control plug and socket on the front panel coming adrift! A strange kind of chroma instability, with multicoloured patterning, sometimes results from the failure of Ld2, the primary winding in the second chroma can.

Absence of either the R-Y or the B-Y outputs from the decoder chassis is usually caused by failure of one of the BC118 subcarrier amplifier transistors in the demodulator circuits. The chokes Ld16 and Ld17 via which the demodulated chroma signals pass out of the decoder to the colour-difference output stages are prone to dry-joints, leading to similar symptoms.

An unexpected no colour situation arises when the screen grid voltages on the three PCL84 colour-difference amplifiers disappear due to failure of the common feed resistor Rf17 (12k $\Omega$ ). The auto grey-scale shift circuit is tied to the operation of the colour-killer. Thus where the auto-shift circuit operates but no colour is present, Rf17 is the first suspect. Fading of one or more colour-difference signals when the set is thoroughly warm calls for replacement of the appropriate PCL84, while drifting grey-scale or colour shading should lead to investigation of the 0.001 $\mu$ F coupling capacitor and the 10M $\Omega$  resistor in the appropriate clamp stage. When investigating wrong colours

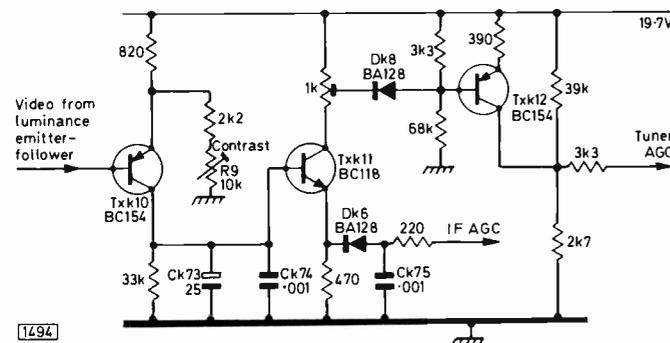


Fig. 1: The a.g.c. circuit.

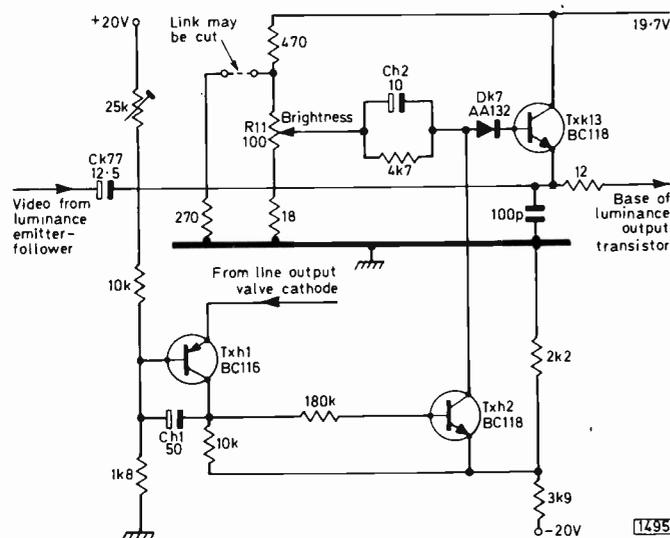


Fig. 2: The beam limiter and brightness/d.c. restorer circuit.

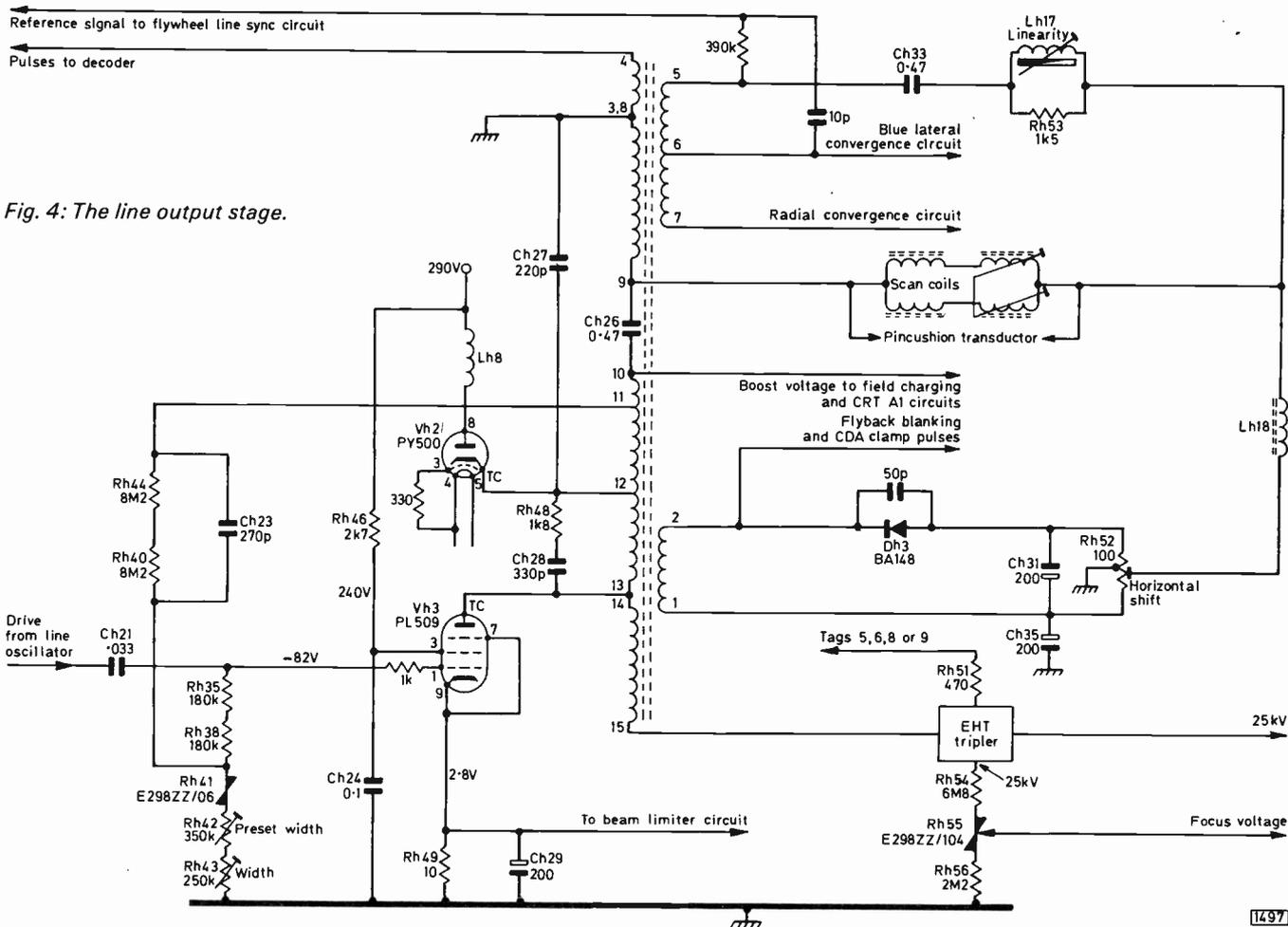


Fig. 4: The line output stage.

note that G-Y matrixing is carried out in the anode circuits of the PCL84 R-Y and B-Y output pentodes.

### Line Timebase

The PCF802 line oscillator circuit is similar to that used in the VC51-VC53 monochrome chassis and will need no introduction to the service technician. Reluctance to strike up from cold is commonly due to the feedback coupling capacitor Ch18 which is an 800pF (guess!) polystyrene type. Line frequency troubles follow reduction in the value of the triode cathode bias resistor Rh26 (47kΩ to HT) as they have done for so many years in ITT's wired monochrome sets. The diodes and capacitors in the flywheel sync discriminator stage can be responsible for a particularly horrible type of line twitch, but here again joints and earthing should be checked first. A "watery" twitch (he talks gibberish, this man!) on the line is often caused by corrosion in the line oscillator coil Lh6/7.

Having sorted out the line oscillator we can follow the line drive pulses to the line output stage (see Fig. 4). Several horrors await us here. The two 8-2MΩ resistors Rh40 and Rh44 in the width circuit predictably go high, resulting in low width. On the same panel is the 220pF ceramic capacitor Ch27 whose function is to tune the line output transformer and whose habit is to go dead short. The PY500 then glows until the 1.6A h.t. fuse Fp4 blows.

On the secondary side of the line output transformer the main offender is the 1.5kΩ line linearity coil damping resistor Rh53. This burns and goes open, resulting in heavy striations down the left of the picture. A 5W replacement is much better. The e.h.t. tripler is quite reliable, but when replacement is necessary it's important to obtain the correct

component. Many trade suppliers list the CVC2 tripler as being identical to the CVC5 type. Although they look the same, the CVC2 tripler has two output leads carrying 25kV and the CVC5 type tripler will not work. The best course is to order direct from the manufacturer. The focus voltage is derived from a long VDR, à la Pye, and focus problems are often traceable to failure of the 6-8MΩ series resistor in the VDR "top hat".

Before leaving the line output stage, two occasional trouble spots are the shift rectifier Dh3 (BA148) which sometimes shorts to the detriment of its reservoir Ch31, and the AC131 convergence clamps which can be responsible for convergence drift.

### Sync and Field Timebase Circuits

The sync separator transistor Tx2 (BC116) is sometimes responsible for lack of sync, but the trouble is more commonly due to the following sync amplifier Tx3 (U14551/1) - see Fig. 5. This is a high-voltage type, working from the 290V line, and while suitable substitutes can be found, none of your BC107s if you please! The condition of the vulnerable OA91 emitter diode Df1 should be checked when replacing Tx3. No or erratic field sync is often caused by a bronchial BAX21 in the Df2 position.

Lack of height with good linearity is, as on most sets, caused by low anode voltage on the field oscillator valve. In this chassis increased resistance of Rh12 (820kΩ) and leakage in Ch3 (1μF, 500V) are common. The 330kΩ resistor Rf57 and the VDR stabiliser E298ED/A258 (Rh15) are not above suspicion, however.

The field output stage is often afflicted by linearity problems, cramping at the bottom being the most common.



# next month in Television

## ● DIAL-A-LINE

It's useful to be able to examine individual lines of the TV transmission – particularly the test signals inserted on lines in the field blanking period. Scopes with delay timebases are expensive however. This digital TV line extractor is an external accessory enabling you to select any of the 625 (or 525) lines for display on a scope.

## ● PROBLEMS WITH PORTABLES

The number of monochrome portables in use has escalated in recent years, with large quantities being imported. They have their own peculiarities, which are the subject of Les Lawry-Johns' next feature.

## ● MULTI-CHANNEL RECEPTION

In many areas more than one ITV programme can be regularly received, given suitable aerials and ancillary equipment. James Burton-Stewart comments on suitable equipment and advises on its use.

## ● THE RRI Z179 CHASSIS

John Coombes reports on faults experienced on the 110° Rank colour chassis.

## ● THE DIODE-SPLIT LOPT

The era of the separate e.h.t. multiplier tray could well be drawing to a close. Several manufacturers are now producing diode-split line output transformers which combine the two functions. Luke Theodossiou explains the technical aspects.

## ● THE ART OF ALIGNMENT

Part 3 deals with the differences between the continental European and UK standards and how to convert from one to the other, then proceeds to the sound channel.

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# The Art of

THE ultimate aim is to have a bench at which you can align all the i.f. strips you work upon using one carefully set up group of equipment. There is no real reason why this should not be done. A basic alignment procedure carried out on sets of some age will always produce an improvement. If the main brand you work on has a practical, workable and understandable method in its manuals, then use it in preference to anything you read here since it is likely to follow on consistently from one generation of sets to the next. Try and spend a whole day just getting to know your way round the gear, using if you can a new set with good alignment to give you some idea of what to expect.

## Hooking up the Gear

The basic equipment hook-up is shown in Fig. 1 and is the same for all sets. All test gear should be earthed, with correctly polarised mains leads, as a nasty punch is delivered from the combined charge on all the mains suppression capacitors. Isolate the work. As mentioned above check the operation on a set of known goodness, and double check by plotting a response graph as described last month, using a signal generator and meter. You may need to fit an inverting switch to the display if – as with the writer – you cannot work on upside-down traces. Iron out as many snags as you can. Huge markers may spoil the trace. If so remove the mixing unit and couple them in loosely. Try a small capacitor across the input to the display to clean noise off the trace.

## Display Input

Take the display input from the vision detector diode which if wired with respect to chassis should be d.c. coupled to preserve the baseline. If the diode is up in the air, as in many dual-standard sets, blocking capacitors of the order of 0.1 $\mu$ F are needed in both inner and outer leads and the baseline will float up and down, involving constant resetting by the display Y shift. The Y gain should be set to take about 2V peak-to-peak from the detector and produce a full trace. Use a slow sweep rate (25-50Hz) or mains via a transformer as previously described.

## Connecting the Work

To start off, try and get a strip which can be powered from the bench supply and has a convenient tuner test point. The one in our diagram is pure fiction but is like a number you could encounter. Starting off with a strip working in a mains-fired set can be disheartening, as little spikes of line timebase radiation will crawl up and down the trace like a chair lift. Once accustomed to them they do not bother you unduly. If you must use a set, ensure that the isolating transformer's wattage is adequate. Modern sets with thyristor power supplies saturate isolating transformers with the unwanted half-cycle, so although a set is rated at say 200W a 500W isolator may be needed for continuous running and an undistorted mains supply. Check that fitting an isolator doesn't alter the preset h.t. voltage if the set has one.

# Alignment

Harold Peters

Part 2

## Injecting the Signal

The short cut is to introduce the signal at the tuner i.f. test point and align right through. To do this is to run the risk of tilting the trace by the mere act of adding the probe. Today's tuners commonly demand a probe of 1pF or less, and this has to make contact with a component joint deep in the works via a little hole in the side. Earlier tuners were more gentlemanly and provided a spare feedthrough capacitor to which a probe of greater admittance could be connected. Suppose we start by doing this. We should get a noisy trace on the display, and a full sweep with the wobblator attenuator set well down.

## Biasing

We now apply bias from our battery or other unit via a series resistance of higher impedance than the signal but lower than the a.g.c. Typical values are 100k $\Omega$  for valves, 2k $\Omega$  for transistors. This should clean up the trace, and an increase in the wobblator output of the order of 30dB should be needed to restore full trace amplitude. The trace should now look something like the one in the manual. It pays to get this bias setting right. Most i.f. strips are factory aligned at minimum gain, that is to say at a point where the signal is heavily attenuated by a.g.c. but where delayed a.g.c. has not yet been applied to the tuner. You can get these conditions by putting the strip under test back in its set which is receiving a strong pattern. Monitor the a.g.c. lines to both the tuner and the i.f. strip and adjust the input signal until the tuner is just not taking a.g.c. (i.e. the crossover point). Then apply your bias unit and adjust it for the same condition. You have now set the i.f. a.g.c. to the crossover point and can revert to the hook-up and look at the trace. Before we go on however a note on a.g.c. may help those who are rusty on this subject.

## AGC for the Rusty

The purpose of a.g.c. is to sample a part of the signal which does not vary with picture content – usually the back porch or the sync tip – and produce from it a control voltage which can be used to make the output constant. In order that sets will work anywhere, an a.g.c. range of 70dB

is required, i.e. the output should remain constant with inputs varying from 10 $\mu$ V to 30mV. The average tuner will manage about 20dB of this so the remaining 50dB of control needs to be applied in the i.f. strip. Because tuners generate the most noise, the i.f. strip is “put in to bat first”.

Starting from the weakest 10 $\mu$ V signal, everything – i.f. strip and tuner – is working at maximum gain. As the signal is increased, the a.g.c. voltage appears and turns down the i.f. gain to compensate. This goes on until about 3mV is arriving at the aerial. The a.g.c. is then applied to the tuner as well, reducing its gain as the signal increases further. The i.f. strip is now said to be working at “minimum gain” and is in fact running at 50dB below its maximum capability – nice and stable, nice and cool.

## Optimum Alignment Condition

This is the state usually chosen for optimum alignment of the i.f. strip. Any variable-beta or variable-mu stage in the i.f. strip will have its input capacitance arranged in such a way that the bandwidth narrows as the signal diminishes.

## Crossover Point

With transistor tuners you usually get mixer noise below 1mV and crossmodulation (vision buzz) above 10mV. This makes 3mV the decibel midway point at which to set the “crossover”. It is also the accepted field strength boundary of primary service areas (70dB on 1 $\mu$ V).

## AGC Polarity

A.G.C. is applied negatively to valves and pnp transistors, but positively – towards l.t. – with npn transistors. The forward a.g.c. technique used with transistors gives more control. If npn i.f.s are mixed with pnp tuners an a.g.c. inverting stage is needed unless the tuner is hung upside-down, like a sloth, from the l.t. rail.

## Alignmanship!

With a little practice most sets can be completely aligned from the tuner test point, provided they are fault-free. Sometimes it's necessary to take the process stage by stage

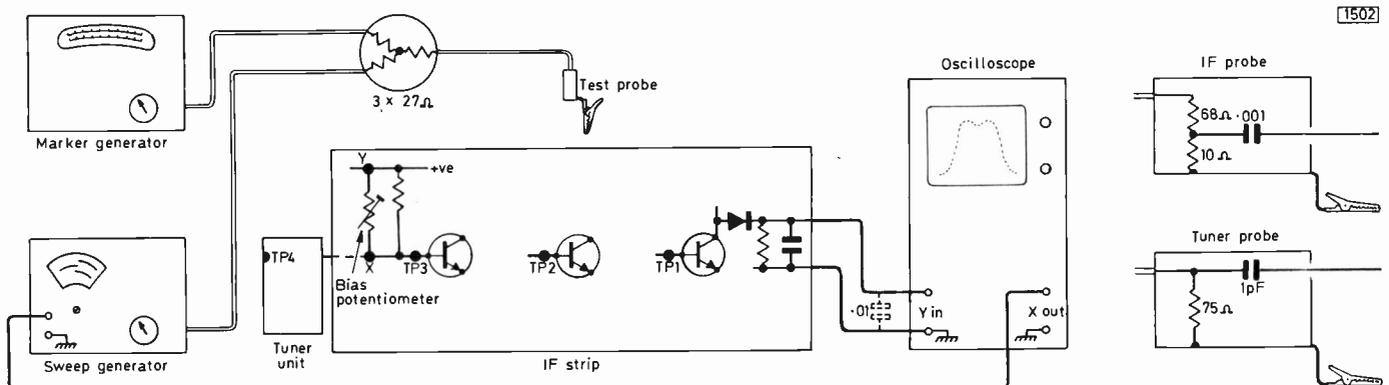


Fig. 1: The basic alignment hook-up.

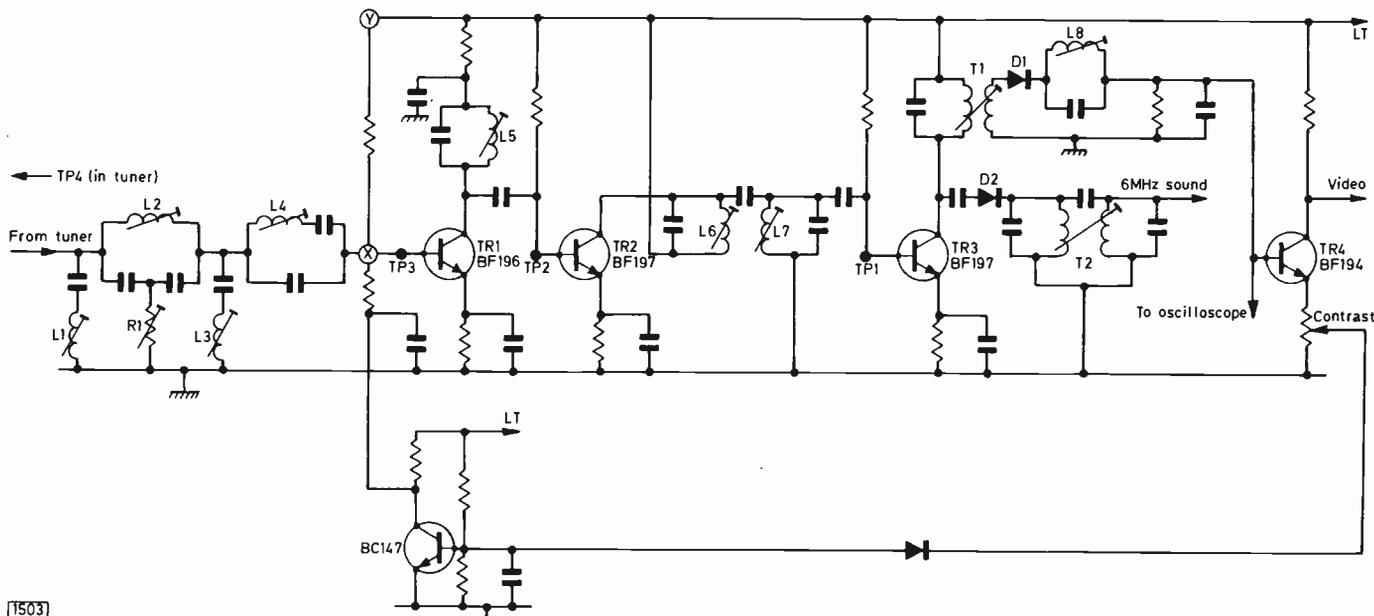


Fig. 2: Typical transistor i.f. strip arrangement, to illustrate how to go about alignment.

as part of a fault-finding procedure, so we'll run through our fictional i.f. strip in this manner as a working example. As previously the display probe is connected across the vision detector all the time (base of Tr4 to chassis, see Fig. 2). The sweep is applied to TP1 (base of Tr3) via the  $\div 8$  probe mentioned last month so as to give a low input impedance. Its chassis earth is important. Use short leads and solder to the cool part of the chassis. The setmaker will have found this for you and either planted an obvious test point there or taken the emitter decoupler to it. Signals entering the set at earlier stages are killed off by grounding TP2 of the previous stage. You will need to turn up the sweep output to around 200mV to get any size of trace.

### Detector Alignment

On the alignment diagrams (Fig. 3) we show markers at 39.5MHz and 34.65MHz. The detector transformer T1 is adjusted to balance these around the flat peak. If there is a sound trap (we show one at L8) this should first of all be

adjusted for minimum at 33.5MHz as it will affect the 34.65MHz side of the curve. Instead of balancing the markers you could equally well apply a midband marker at 37MHz and trim T1 to peak this at the top of the trace. At this stage the 39.5MHz and 34.65MHz markers should be high on the curve, typically 1½-2dB down from peak. Remember that we try to end up with them both – but especially the 39.5MHz one – at 6dB down from peak, i.e. halfway down the trace. We hope to see them drop progressively stage by stage. They must not be allowed to fall too abruptly at any one stage, as it is extremely difficult to jack them back up again later. If you did succeed in doing that you would play havoc with the group delay of the strip, which is something we have avoided mentioning so far and will return to in a later part.

### Bandpass Stage

Having aligned the final i.f. stage, transfer the  $\div 8$  probe to TP2 and move the short which was there to TP3. The

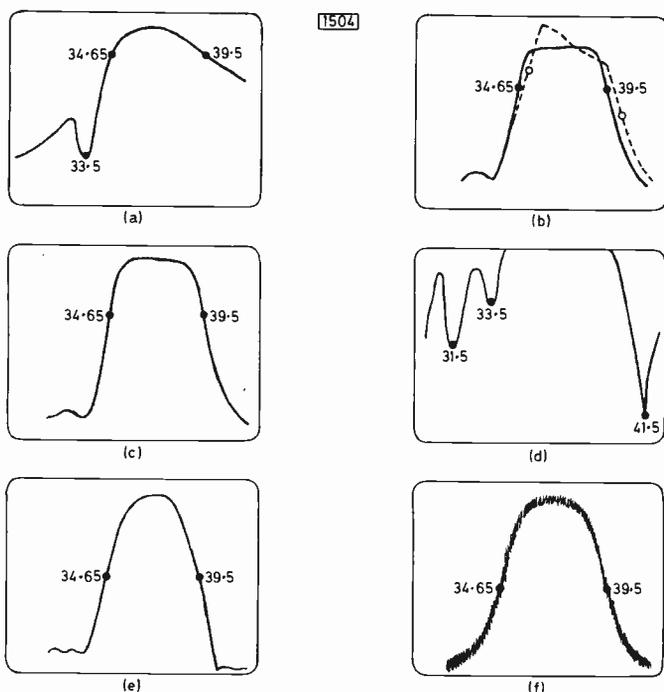


Fig. 3: Response curves obtained at the various stages in aligning the i.f. strip shown in Fig. 2. (a) The last i.f. stage, with the input applied to TP1. Rounded top with the markers high, typically 1-2dB from the peak. (b) The middle i.f. stage, with the input to TP2. One adjustment will rock the top of the curve, the other will move the markers along the trace – as shown in the broken line response curve. When levelled up they settle 1-1.5dB down compared to (a). (c) The first i.f. stage biased back to the point where the a.g.c. would normally be switched to the tuner. This response is not much different to (b), but the top is more rounded and the markers lower. (d) Setting the traps, with the input at the tuner test point (TP4) and the sweep generator turned up high to enable the traps to be set accurately. (e) The tuner/i.f. input bandpass coupling, damped by the traps, rounds off the alignment with the input again at TP4. The vision carrier should be left at -6dB down. (f) With the input still at TP4, remove the bias and reduce the gain of the wobulator. The maximum gain curve obtained shows a more rounded top, noise, and the markers lower down.

gain of this, the bandpass stage, will be so high that the sweep generator's output will need to be reduced by about 30dB. As you adjust L6 and L7 you will find that one of them will "rock" or move the markers up and down, whilst the other will tilt the top of the trace. With the same objective as before, i.e. of level markers, you should aim to keep the tilts or troughs at the top smaller than the order of  $\frac{1}{2}$ dB. You will be able to assess the order of bandpass coupling by the height of the markers and the shape of the top of the curve. A trough in the top with high markers indicates overcoupling, while a round top with low markers shows insufficient coupling. A contradiction of these parameters (round top high markers or vice versa) usually means trouble. Sharp corners can also lead to trouble later on, producing ringing on sharp picture edges. But back to the strip.

### First IF Stage

Remove the short from TP3 and move the  $\div 8$  probe there. Decouple the tuner output. Don't use a short here as there is often l.t. about. Apply the bias we have already discussed to point X and tune L5 for a similar result to the previous stage. Because of the bias now applied you may have to increase the signal from the sweep generator.

### Setting the Traps

Now move to the tuner test point, leaving the bias set but removing the decoupling. Inject the signal at the tuner test point with whatever special probe the mechanics there require. Turn up the sweep generator output so that the top of the trace is well off the top of the screen and the region around the baseline becomes magnified – see Fig. 3(d). Set the traps for the deepest dip. We show three, L1 and L3 are at 31.5MHz and 33.5MHz respectively and are on the left of the trace. You may be able to get them crossed, but the correct way round is for 31.5MHz to be the deeper of the two. 33.5MHz should ideally be 26dB down from the peak, plus whatever suckout there is in any detector trap (L8). With L8 up at the back giving another 10dB the total is 36dB down.

You may be wondering how we get away with the barefaced cheek of maintaining all along that 26dB of sound trapping is ideal and then showing a circuit with 36dB rejection. The explanation is that our circuit features a separate sound take-off circuit T2 with its own detector diode D2. At the point in the circuit where the sound parts company with the vision signal there is only the 26dB attenuation of L3 effective.

The last trap at the front end is the deep one, at 41.5MHz for adjacent sound and Crystal Palace. There are two adjustments. L2 fixes the position while R1 determines the depth. Adjust in that order, repeating if necessary, for the deepest trapping.

### Tuner/IF Bandpass

Until you have set these traps there is no point in looking at the top of the trace as the trap skirts will affect its shape. With the traps set, reduce the trace to full scan and do the final tuner/i.f. mating bandpass adjustment (tuner i.f. output coil and L4). This is not as spectacular as the second stage due to the extra damping. Try to achieve the classic response shape, with a nice round cornered top, 39.5MHz at 6dB down from the peak, and 34.65MHz at between 3dB and 8dB down. 35.04MHz (colour subcarrier) should be just down from the top left-hand corner, and 38.25MHz

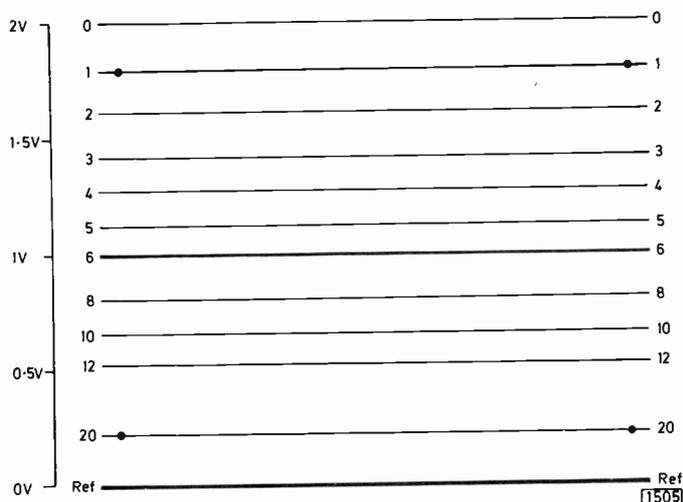


Fig. 4: A dB graticule for display units, plotted against a vertical scale of 0-2V (the typical output of a diode vision detector).

(beginning of the vestigial sideband roll-off) just on the right-hand corner.

### Full Gain Trace

Finally remove the bias and look at the full gain trace with a suitably attenuated sweep input. It should be narrower. If it "takes off" you have instability, probably due to the leads from the sweep generator. You can check on this by reverting to off-air operation and looking at the "snow" on the screen. Instability will give rough horizontal lines of noise, or a completely white screen if acute.

### RF Hook-up

The pedant should now check the curve obtained with bias against a similar one at u.h.f. drawn from a sweep input injected at the aerial. But having just persuaded you to tackle an i.f. sweep hook-up it is more than we dare suggest that you should try an r.f. one too. Unfortunately the tuner probe is the place where the greatest likelihood of introducing spurious tilts exists. In default of a u.h.f. sweep generator a rough check can be made against a set of known goodness by a comparison of the K ratings of the vertical interval test signal (see *Television* May 1976, pages 379-380).

### Damping

In some older valve sets using tightly-coupled i.f. bandpass transformers with separate cores for the primary and secondary windings it may be necessary to damp one winding while adjusting the other. Tune the primary first while damping the secondary with a resistor of say 4.7k $\Omega$ , then reverse the procedure. This is a must if normal sweep adjustments produce instability.

### Circuit Variations

With valve i.f. strips the trapping and bandpass shaping may be arranged somewhat differently to the transistor example we have given. You won't go far wrong however once you have discovered from the appropriate circuit or manual the frequencies to which the various traps and transformers must be tuned. In many chassis produced in recent years the i.f. stages are wideband, i.e. the only adjustments that can be made are to the bandpass filter network between the tuner and the i.f. strip.

# Servicing the Decca Gypsy

Barry F. Pamplin

THE Decca Gypsy mains/battery portable was introduced in 1971 and has appeared in several versions. The original version, Model MS1210, was a 12in. set using a rotary u.h.f. tuner. This was replaced by the MS1211 and MS1212 which differ only in presentation and are fitted with varicap tuners. There are also 15in. versions, Models MS1511 and MS1512. The same basic chassis is used in all these sets and remains – except for the tuning system – as when originally introduced. It features an all i.c. i.f. strip (MC1352 and MC1330) and sound channel (TBA750 and TAA611B). The 12in. tube is type A31-120W or equivalent, the 15in. one type A38-160W or equivalent.

Unlike some portables, this one really was designed with the service engineer in mind. The whole works is on two printed boards attached to the rear cover of the set. After removing the cover fixing screws the whole back hinges down giving unrestricted access to the boards.

## Circuit Description

The circuit is shown in Fig. 1. The tuner output passes via bandpass shaping circuits to the vision i.f. i.c. IC1. The output from pin 7 feeds the low-level synchronous detector IC2. The demodulated output at pin 4 of this chip feeds the video emitter-follower TR3 and, via the 6MHz ceramic filter FL1, the intercarrier sound i.c. IC3. The video signal is d.c. coupled from IC2 via TR3, the contrast control VR3 and the video output transistor TR4 to the cathode of the c.r.t., with beam limiting by means of D3. Pin 4 of IC2 also feeds the a.g.c. circuit in IC1 – via R16 to pin 6.

The signal developed across R21 in TR3's collector circuit is fed via C46 and the pulse shaping network C47/R34 to the base of the sync separator transistor TR5, R35 providing bias to ensure that the transistor saturates when a sync pulse arrives at its base. The sync pulses developed at its collector are fed via C81 to the flywheel line sync circuit and are integrated by R39/C49 for feeding to the field timebase.

The 6MHz signal from filter FL1 is amplified and demodulated by IC3 and then passes to the audio i.c. IC4.

## Unusual Field Timebase

The field timebase has some unusual features. TR6/TR7 form an astable multivibrator. The charging capacitor is C53 which charges via R48 and the height control VR6. The positive-going sawtooth it produces drives the driver transistor TR8 towards cut-off. A positive-going sawtooth appears at its emitter therefore to drive the output transistors TR9/TR10. Flyback is initiated when TR7 conducts, applying a negative-going pulse to the base of TR9 which cuts off. The main linearity network is C52/VR7/R52, with VR7 the linearity control.

The most unusual part of the circuit is the output stage. TR9 is driven progressively on by the positive-going sawtooth waveform applied to its base and conducts during the whole of the scan. The negative-going sawtooth at its collector drives TR10 towards cut-off, which occurs about half-way through the scan. When TR10 cuts off, TR9 continues to drive the scan coils via D6 and C57. When TR9 is cut off to give the flyback TR10 switches on again.

During the flyback, the scan coils form a tuned circuit with C53. The negative overshoot drives TR8 into saturation. TR8 then provides a clamp action, preventing further oscillation, and C53 begins to charge again.

## Line Timebase

The line timebase is conventional, starting with a discriminator circuit which provides a positive- or negative-going output to control the reactance transistor TR14. This in turn controls the tuning of the sinewave line oscillator TR15, L21 acting as the line hold control. The driver transistor TR16 is fed via R87 from the 25V boost rail and is transformer coupled to the pnp line output transistor TR17. The flyback is tuned by C94 and C95, the scan-correction capacitor C96 driving the scan coils via the width control L23 and the linearity control L24. D13 is the efficiency diode, with D14 acting as boost diode by charging C97 to 25V. This 25V line is used for the field timebase, the sync separator, the vision i.f. strip and the intercarrier sound i.c. as well as the line driver. D15 provides a 120V supply for the video output transistor – this is also the source of the varicap tuner's tuning supply – while D16 provides a supply for the c.r.t. first anode and focus electrode. An overwinding on the line output transformer feeds the e.h.t. rectifier D17, L26 and L27 providing fifth harmonic tuning to give good regulation.

## Power Supply Circuit

The power supply starts with a transformer feeding a bridge rectifier. The output developed across the reservoir capacitor C79 is then applied to the series regulator transistor TR11. This is driven by TR12 and the error sensing transistor TR13. VR10 should be adjusted so that the output across C80 is 11.25V. This supply feeds the audio i.c., the line oscillator and, via L22, the line output stage.

The battery input goes direct to the stabiliser circuit. Protection is provided by D9 which blows fuse F3 in the event of the battery being connected with its polarity reversed. This technique is widely used but in the author's view it would be better to use either a series diode so that incorrect battery polarity merely meant that the set would not work, or better still a bridge to automatically reverse the polarity – indeed with a bit of extra switching the existing bridge could be used. It is easy to get the battery leads reversed accidentally, and the trouble this causes in terms of having to open up the set, replace the fuse and so on is quite unnecessary. (For the uninitiated, the arrangement is simply a bridge with the battery input fed to the a.c. terminals: it doesn't matter which way round the battery is connected since a positive output will always emerge from the bridge at the same point.)

## The Stock Faults

So much then for circuit details. Now for the gen. First of all the stock faults.

Perhaps the most common trouble is a great big hum bar.

This is usually due to the bridge rectifier D8. In earlier sets an encapsulated unit was used and one of the diodes would go open-circuit. The answer to this problem is to fit four separate diodes – we use BY127s – and to mount them sticking up in the air so that their full length leads act as a heatsink. They don't look tidy but they do keep working.

The other common cause of hum troubles is hair-line cracks around the connections to the main smoothing block C79/C80.

### IC Troubles

Stock fault number two is i.c. troubles, especially IC1 and IC2. In theory i.c.s used in low-level circuits should be reliable. In practice however there are two problems. The first is simply dud batches of i.c.s, and the second incorrect setting of the supply voltages. Inherently dud i.c.s usually show up in the first few hours of operation. Supply voltage settings usually get changed by twiddlers. The voltages applied to IC1 and IC2 come, as we have seen, from the line output stage's boost circuit, the amplitude of the boost voltage depending in turn on the stabiliser's output voltage. If the 11.25V line is set too high all sorts of trouble will occur.

### Checking the ICs

The effect of defective i.c.s is to kill the vision and sometimes the sound. To determine whether IC1 or IC2 is faulty the key voltage is 4V at pin 4 of IC2. If there is no voltage here IC2 is dud. Another clue is that a rushing noise in the loudspeaker coupled with no trace of video usually indicates that IC1 is defective. The final test is to measure the voltages on each pin of the i.c.s – the correct values are listed in Table 1.

### Dry-Joints

Stock fault number three is dry-joints. These can occur anywhere but the favourite sites are C79/C80, TR9 and around the numerous links. The links are made from thin strips and unless the shoulder is firmly down on the top of the board there is a betting certainty that the joint underneath is defective.

### Less Common Troubles

These three stock faults cover 75 per cent of the sets which have been repaired in the author's workshop. What's left?

First the line timebase. On early sets the line oscillator coil winding was not glued to its former and moved around until one of the leads fractured. The various diodes fed by the line output transformer can go short-circuit with the loss of one or another of the supplies, or leak causing reduced width and bridge rectifier failure due to the excessive current. The AU113 line output transistor fails for no apparent reason.

Troubles in the sound channel are rare. We have had i.c. failure here but not often. In a few cases the tantalum coupling capacitor C69 has been found open-circuit. If there is no sound, check the switch in the earphone jack before looking elsewhere.

Some early chassis produced a picture with very low contrast. If this is the trouble take a look at the resistors in the collector and emitter leads of the video output transistor. Change the load resistor R26 to 4.7k $\Omega$  if the original 3.3k $\Omega$  value is used. Change R28 to 100 $\Omega$  and C41 to 470pF if other values are found.

Table 1: IC Voltages

Pin	IC1	IC2	IC3	IC4
1	3.7	7.9	1.35	11.25
2	3.7	9	11.5	0
3	0	9	2.75	7
4	0	4	2.75	0.65
5	0.45	17	0	0.5
6	3.9	19.25	2.8	0
7	17.3	4.3	2.8	0
8	17.3	0	4.25	0
9	7.15	–	4.25	0
10	2.6	–	8	0
11	11.5	–	7.35	0
12	7.85	–	11.25	5.9
13	0	–	1.1	0
14	5.8	–	1.1	11.5
15	–	–	5.4	–
16	–	–	6	–

The above voltages were measured with signal (test card F) input and the volume control at minimum, using a 20k $\Omega$ /V meter (Avo Model 8). The voltage across C80 should be 11.25V, the voltage across C39 20.25V and the voltage across C42 120V.

Another problem on early versions of the chassis was field buzz getting into the audio circuits. The solution is to fit a 220 $\mu$ F capacitor in parallel with C67. Mount it on the underside of the panel, with the negative lead to L20's can clip and the positive lead to C67's positive connection.

The stabiliser circuit is generally reliable. However we did have a case where the AD143 was responsible for a slight hum bar moving through the raster, with audible hum. More often it goes short-circuit however, blowing fuse F4.

### Adjustments

Apart from the setting of the regulator control VR10 (see earlier) the other control which we frequently find misadjusted is the a.g.c. preset VR2. The recommended procedure for setting this is to obtain 4V peak-to-peak video at test point PLJ/LK3 (the metal link in the far right-hand corner of the i.f. panel when viewing the set from the rear with the back hinged down). Since this involves the use of a 'scope it is suggested that for routine setting up the control is set to get just sufficient contrast. If it is set for a soot and whitewash picture there are likely to be problems with IC1.

### Modifications

One or two variations. In 15in. sets the AU113 line output transistor was subsequently changed to type AU111. An alternative is type BC206/1. In some sets the line oscillator transistor TR15 is type BC107B, with R84 changed to 62 $\Omega$ . If you wish to use a BC107B as a replacement a 68 $\Omega$  resistor can be used in position R84.

### After Servicing

Two final points after servicing the set. Make sure that all screws, especially those securing the mains transformer, are tight. And check that the lead coupling the tuner to the i.f. panel is well clear of the video output transistor's heatsink. ■

COMPLETE CIRCUIT OVERPAGE ➡

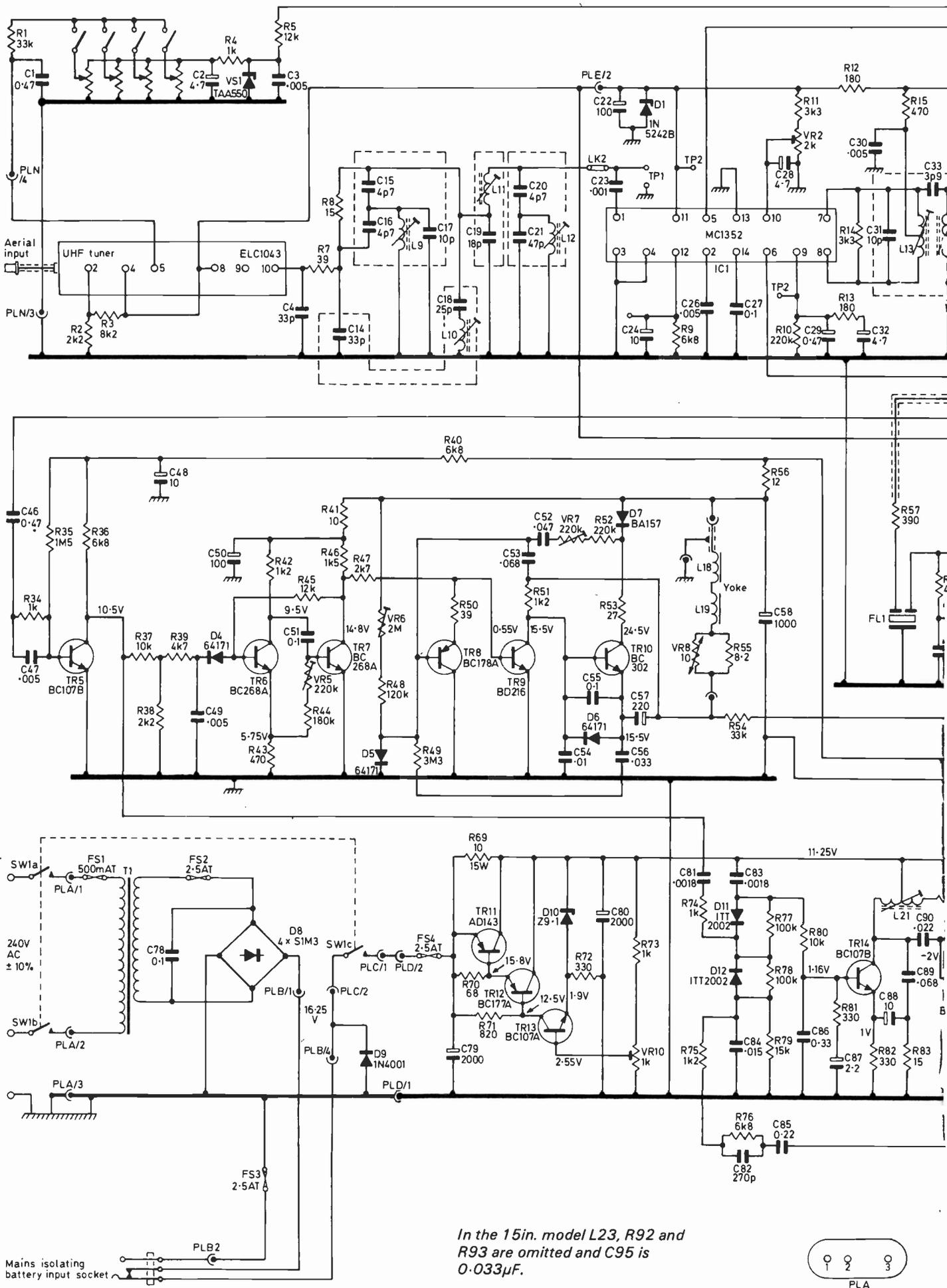
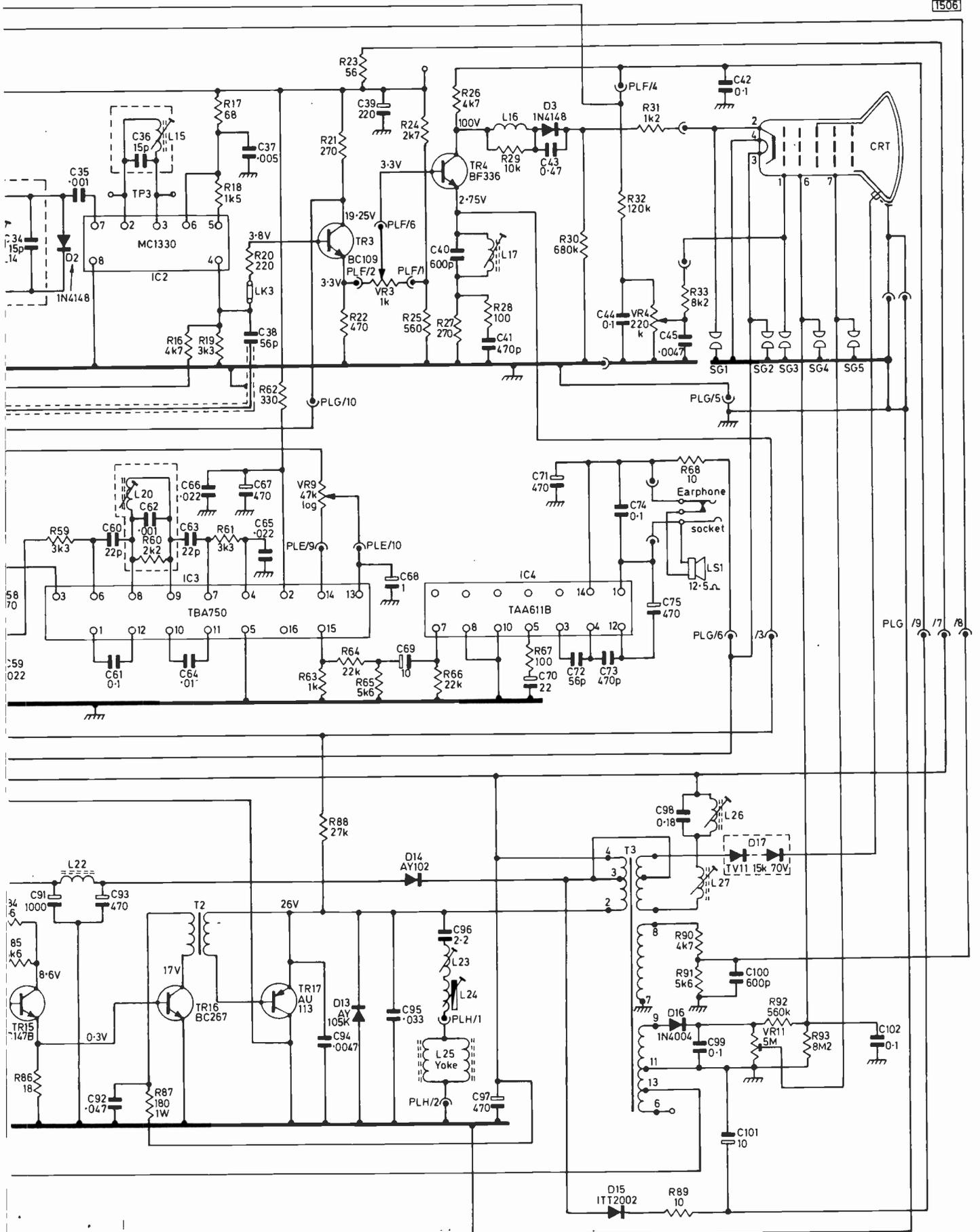
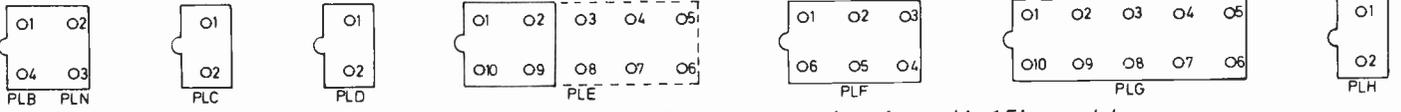


Fig. 1: Circuit diagram of the Decca Gypsy monochrome portable. Earlier sets were fitted with a rotary tuner.



Plugs viewed from underside

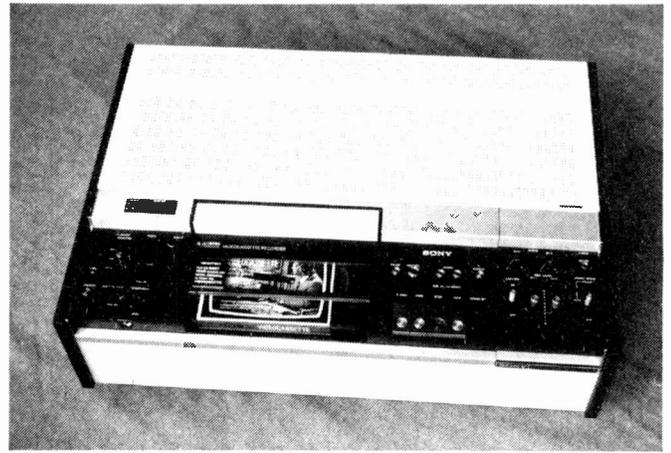


while some sets have six channel selector buttons. An AU111 line output transistor is used in 15in. models.

# The SONY VO1810 VCR

Part 2

M. P. Riley



SERVO systems for videotape recorders can follow either of two basic design patterns. If very high stability of playback information is required then two separate servos are employed, one to control the speed of the capstan and the other the speed of the head drum. This enables the vertical period off tape to be phased so that it coincides with the studio vertical sync, thus allowing the video recorder to be used as a vision source which is synchronous with the studio field pulses but nonsynchronous with the line pulse information.

A much simpler servo system is used on the less expensive recorders. This controls the speed and phase of the head drum only. A synchronous motor driven by the mains is used to determine the speed of the capstan, and the head drum servo has the task of phasing the VTR head with respect to the capstan.

In their VO1810 VCR Sony use the later of these two systems, and though the playback stability could be much improved the results produced are more than satisfactory for the applications intended for the machine.

When considering the operation of any videotape servo system it is important to stress exactly what the servo is trying to achieve before discussing the various electronic functions and operations of the system. Any tape servo system must have two signals, (1) a reference that is known to be correct, (2) a feedback signal which is to be compared with the reference. In both the record and playback modes of this VCR the vertical sync is used as the servo reference — in the form of separated vertical sync pulses during the recording and vertical sync pulses from the control track during playback. In both the record and playback modes the speed and phase of the head drum is compared with this vertical reference signal.

## Summary of Servo Operation

The servo's vertical drive reference signal in the record mode is obtained by separating the field sync period from the video signal which is being recorded on the tape. This 50Hz signal is amplified, shaped and then recorded as a separate signal on the tape's control track. It is also used (see Fig. 1) as the reference information for the head drum servo system, a second pulse derived from the head drum itself providing the feedback signal. Phase comparison of these two signals produces a d.c. correction voltage which is amplified and applied to an electronic brake which either slows down or speeds up the head drum rotation. When the servo is locked the feedback pulse is coincident with the reference pulse.

The timing of the feedback signal to the servo is of great

importance. For stable conditions it must coincide with the beginning of the scan which video head (a) makes of the tape.

During playback the servo has the task of reproducing the exact tape transport conditions that were present during recording. A vertical drive reference signal has been recorded on the tape's control track, and this signal is used as the servo reference during playback (see Fig. 2). The feedback signal from the head drum is phase compared with this signal and the resulting error voltage amplified and used to control the speed of the head drum itself.

## Record mode

The record mode is simpler so we'll take this first. The following description is based on the block diagram published in the first part of this article — see pages 34-35 of the November issue.

A separated vertical sync signal obtained from the video input to the machine is available at the output of sync separator Q1-Q6 on board G1. This VD (vertical drive) signal is coupled directly to the input of IC3002C on the servo section of board B1. The VD signal triggers this monostable multivibrator (MMV).

The vertical drive signal is clipped before being applied to this MMV. The clipped signal is also coupled to the control

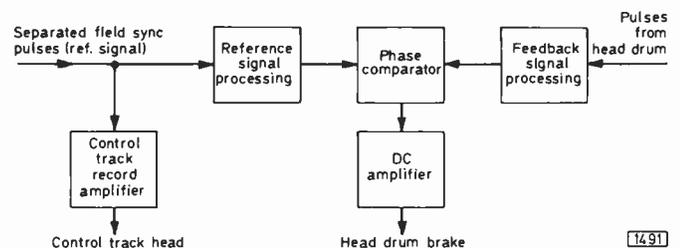


Fig. 1: Block diagram of the basic head servo system in the record mode.

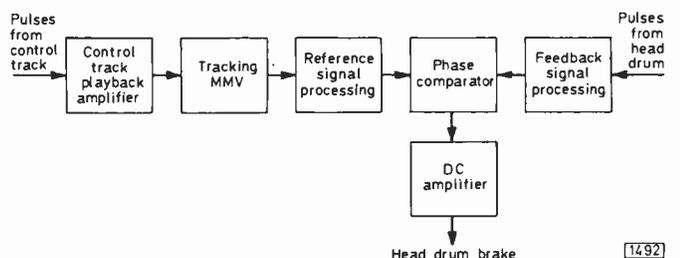


Fig. 2: Block diagram of the basic head servo system in the playback mode.

track record amplifier Q3001. This amplifier is muted during the lacing and unlacing of the videocassette. The main function of the control track is to indicate that a field sync period is being recorded, so the presence of the VD signal on the control track is of paramount importance to the operation of the machine.

Distortion of the recorded VD pulse is not so important because all that is required is that an *accurately timed* pulse is laid down on the tape. As an economy, h.f. bias is not applied to the control track head (this applies even in high cost broadcast VTRs). Hence the output of the control (CTL) track record amplifier is fed directly to the record/playback head. When this signal is replayed a considerable amount of distortion is present, but because the playback control track signal is applied to a switching amplifier which only conducts on the positive half cycle this distortion makes little difference.

### Head Drum Servo

MMV IC3002C produces from the vertical drive pulse at its input a squarewave which is fed to the Miller integrator Q3012. The integrator converts this squarewave into a sawtooth ramp whose slope is proportional to the mark-space ratio of the squarewave. Q3013 (sampling hold) is the stage where the reference and feedback signals are phase compared, the ramp signal from Q3012 being the reference and the head drum pulse the feedback signal.

Production of the feedback pulse takes place as follows. The "30/25" (depending on the mains frequency) PG (pulse generator) coil A receives an induced voltage from a small pole piece mounted on the head drum every time video head (a) commences scanning the tape. This pulse is coupled to the servo electronics where it is amplified by Q3009. A negative-going output from this pulse amplifier is used to trigger two multivibrators, IC3002A and Q3018/19.

The latter of these two is also triggered by the output of pulse amplifier Q3005 which produces a similar negative-going pulse every time video head (b) commences its scan of the tape. Hence the output of the MMV Q3018/19 will consist of a positive-going pulse which will be present every time either head starts to scan the tape. When the servo is locked, these pulses will coincide with the vertical sync period of the record/replay waveform. They are used to inhibit the DOC on board K1.

The second output from pulse amplifier Q3009 is fed to MMV IC3002A which introduces a short delay in the waveform. The amount of delay determines the playback switching point between the two video heads before the field sync period (normally 6.5 lines).

One output from this MMV is fed directly to the next MMV IC3002B, a second is coupled to the video switching pulse generator Q1420/21 (B1 board, r.f. section) which initiates the change over between the f.m. feeds of the two video heads. The additional delay inserted by IC3002B is required to position the feedback pulse from the head drum accurately in the correct part of the reference ramp.

Compensation to reduce the effect of head drum jitter is also included at this point by altering the mark-space ratio of the MMV. A separate phase-locked loop is used for this purpose, consisting of an integrator network followed by transistors Q3020/21/22. Description of this second servo loop is given later.

Now that the feedback signal from the head drum has been correctly delayed and corrected for variations in head drum speed it is coupled to Q3014 where it is amplified before being phase compared with the reference ramp voltage. In fact this feedback signal opens a gate that passes

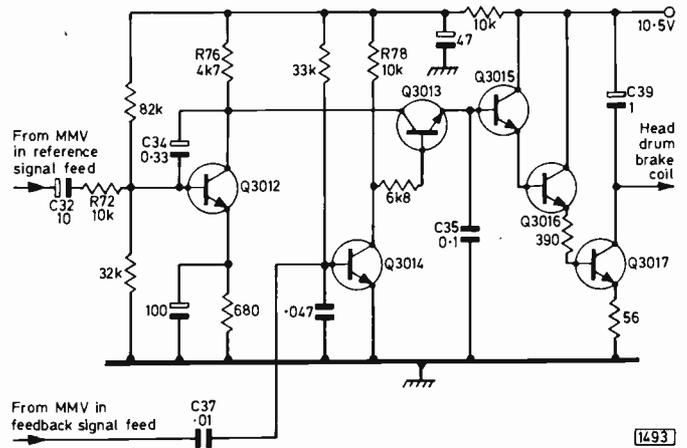


Fig. 3: The head drum brake control circuit. Q3012 integrates the reference signal to produce a ramp waveform for the phase comparator gate stage Q3013 which is switched on by the feed-back pulses at its base from Q3014 to sample the ramp. The control voltage is developed across C35 and is then amplified before being used to control the head drum brake.

the corresponding voltage of the reference ramp. The gated voltage is stored in a large capacitor which smooths the signal to produce a d.c. correcting voltage. The complete circuit of this stage is shown in Fig. 3.

Q3012 forms the Miller integrator, the reference squarewave from IC3002C being coupled via C32 and R72 to the base of this transistor. Heavy negative feedback provided by C34 is responsible for the integration of the input signal and the resulting ramp output is taken from the collector of the transistor. The feedback signal from IC3002B is coupled to the base of Q3014 for amplification and is then applied to the base of the gate Q3013. This transistor conducts only during the positive gate pulse period, and when it conducts the low resistance between its emitter and collector enables the reference ramp potential to be coupled to the storage capacitor C35. When Q3013 is cut off C35 holds its charge, thus producing the d.c. control voltage.

If the feedback pulse arrives early the ramp gating is advanced and the voltage stored by C35 rises; on the other hand if the feedback pulse arrives late the control voltage falls. Q3015/16 form a Darlington pair with a high input impedance to prevent the storage capacitor being loaded. Q3017 is a current amplifier which supplies the brake coil on the motor with the correcting current.

### Phase-Locked Loop

Errors caused by rapid variations in head or tape speed are too quick for mechanical correction by the head drum servo and if left uncorrected would appear as horizontal jitter on the playback picture. To minimise this error electronic compensation is used in the form of a phase-locked loop which compares the feedback pulse from IC3002B with the reference vertical drive signal present at the input to IC3002C. Any errors produced by short term tape transport variations, i.e. head to tape pressure or head speed, are detected and the correcting voltage used to alter the mark-space ratio of MMV IC3002B. The method of phase comparison is very similar to the system used in the main servo, so a second description is unnecessary.

During the playback mode the control track signal is used instead of the reference vertical drive signal, and in this condition the correction will be for variations in tape speed rather than head speed.

Integration of the control voltage ensures that the error

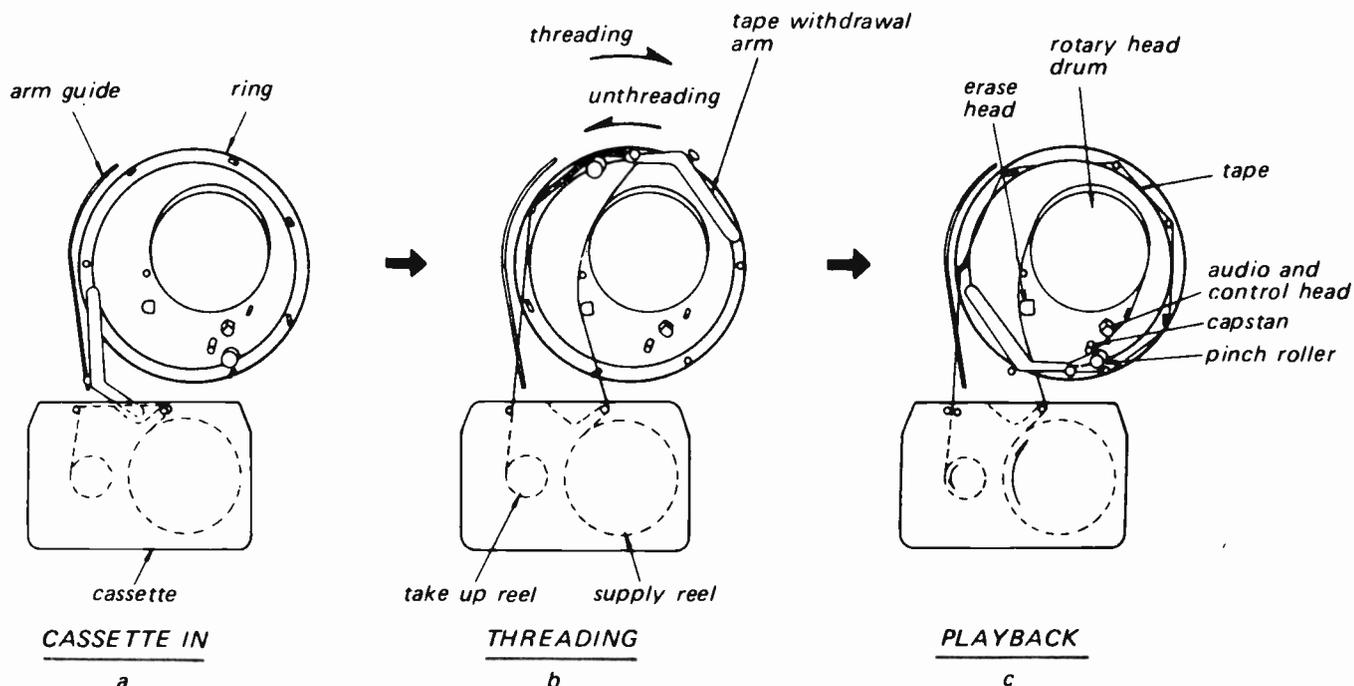


Fig. 4: How the tape is automatically threaded around the rotating video head drum by the tape withdrawal arm.

voltage produced is stored for a long time interval and therefore it's the *average* error that is corrected.

### Playback Mode

We have seen that in the playback mode the servo reference is the prerecorded control track signal, and it might be assumed that all that's required is simply to switch the reference input to the servo system from one source to the other. Unfortunately it's not as simple as that, because if the machine is to be compatible with others of the same type it's necessary to compensate for small variations in the spacing between the video and control track heads from one machine to the other: this requires a manual control. Apart from this, it is quite possible that heat and other physical variables have stretched the tape slightly so that the spacing between the video and control track signals has changed on the tape rather than on the machine! To compensate for these problems provision is made to alter the timing of the control track reference pulse so that it can arrive earlier or later than its correct position. The rest of the servo electronics is the same as in the record mode, apart from the reference signal to the phase-locked loop previously described.

The output from the control track head is amplified and clipped by Q3002/3/4 to produce a clean negative-going 25Hz pulse which is then applied to the delay MMV IC3001B. IC3001C acts as a second delay stage, but in this case the mark-space ratio is adjustable so that the correct tracking can be obtained. A tracking on/off switch is provided so that tapes recorded on the machine can be played back with the switch in the off position, but if a tape recorded on another machine is used the tracking facility can if required be switched in. Should the control track be missing during playback the inhibit circuit Q3026 becomes operational, muting the video playback electronics completely to leave a blank raster on the screen of the receiver.

Time-constant switches are provided on the following i.c. multivibrators: IC3001A and B and IC3002A and C. These are included to alter the delays for 60Hz N.T.S.C. operation.

### The Tape Path

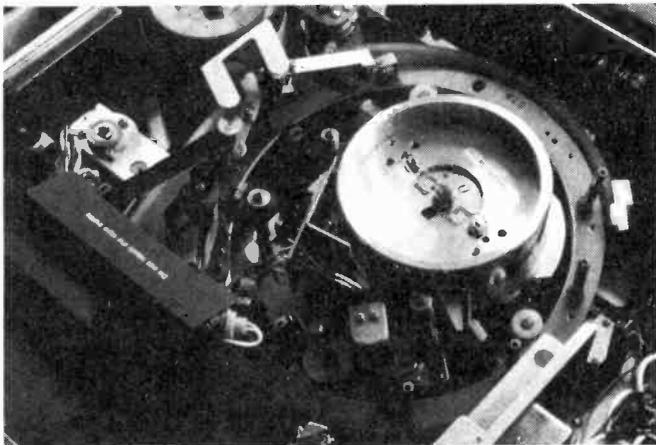
All videocassette recorders have to lace and unlace the tape around the head and other parts of the transport system automatically, and as the width of the tape increases so do the tape handling problems. Two inch broadcast cassette machines have to be seen to be believed! The Sony VO1810 uses  $\frac{3}{4}$  inch tape and to watch the machine lace and unlace the tape makes many a service engineer stare in disbelief. The electronics involved in this process are even more mind boggling and would take the best part of six pages to describe. So the description which follows deals with the mechanical aspects and is much simplified. In the author's opinion it would be a very brave man who sat down and attempted to describe fully the operations that take place when the tape is threaded in the machine. Even Sony don't do it!

The mechanical operating modes of the VCR can be subdivided into two main sections: (a) Those that take place with the tape laced in the machine, i.e. playback and record. (b) Those that take place with the tape stored in the cassette, i.e. forward and reverse wind.

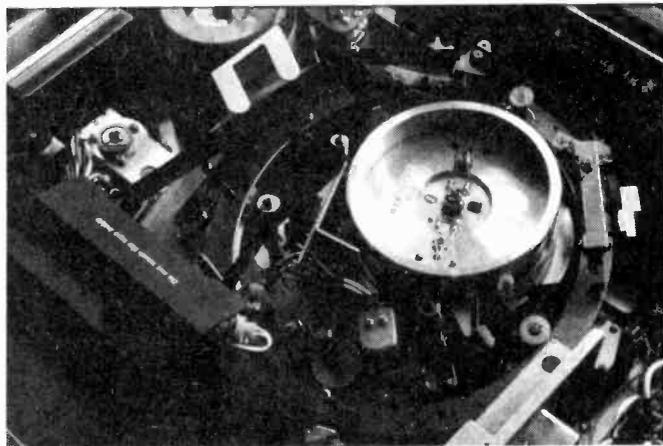
A photograph of the cassette was shown on page 32 of the November issue, and as you can see it is very similar in design and appearance to the normal audio cassette.

The tape remains inside the cassette, as shown in the photograph, during the wind and rewind modes. If this operation took place with the tape laced there would be a very great danger of the tape spilling when travelling at high speed, due to the large amount of tape outside the cassette. So every time the wind/rewind buttons are depressed the machine stops, unlaces the tape, and rewinds the tape inside the cassette. When the tape is rewound and the stop and forward buttons are depressed the machine stops, laces the tape, and then goes into the playback mode. Should the operator want to find a particular part of a prerecorded programme, and have to shuttle through the tape between wind and forward therefore, the process of lacing and unlacing the tape between each wind becomes rather a frustrating business!

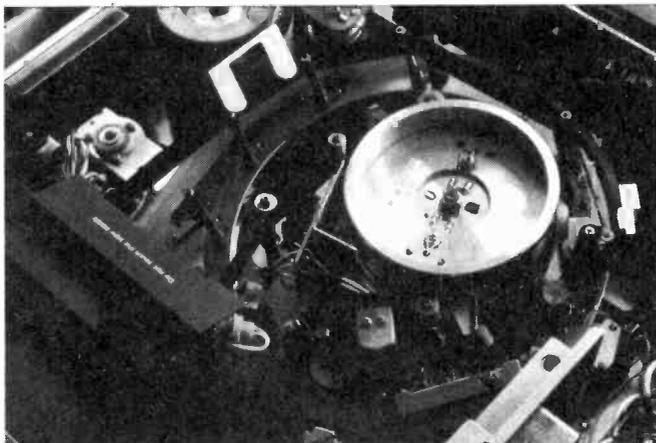
During all the other modes of operation the tape is laced



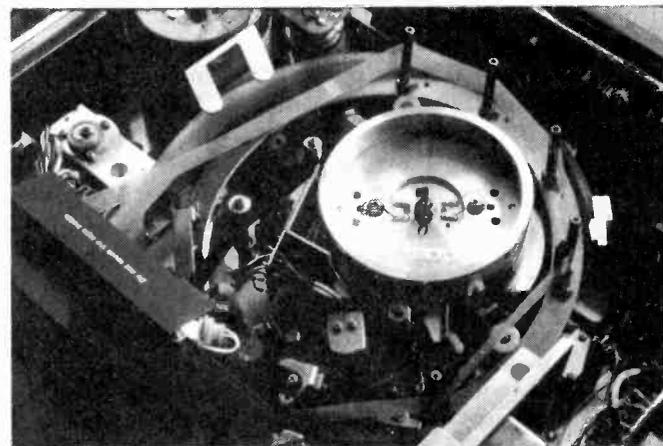
**A** Photographs showing the interior of the machine as the tape starts to leave the cassette.



**B**



**C** Photographs showing the concluding stages of the tape lacing action.



**D**

around the head drum. This operation takes place as follows. When the cassette is lowered into the machine a tape withdrawal arm is positioned behind the tape inside the cassette. See Fig. 4(a). The other end of this arm is mounted on a large ring which rotates in a clockwise direction as the tape is laced. When this ring starts to rotate, tape is pulled from the cassette, passes the erase head, and wraps around the video head drum. This situation is shown in Fig 4(b). Guide pins on the ring ensure that the tape follows the correct path. These can be seen more clearly in photographs A and B which show the interior of the machine as the tape starts to leave the cassette.

As the lacing process continues the ring completes one revolution of the head drum, pulling more tape from the cassette past the audio and control track heads and finally past the capstan. During this operation the brake on the feed spool in the cassette is released and back tension is applied to the take-up spool so that as the tape is laced in the machine it's kept taut. Fig. 4(c) shows diagrammatically the complete tape path when the lacing process is finished, while photographs C and D show the concluding stages of tape lace inside the machine. Note that the pinch roller is mounted on the outer ring with the tape withdrawal arm, and when the ring stops rotating the pinch roller is positioned opposite the capstan.

During the unthreading operation the reverse procedure takes place, the only difference being that the brake on the supply reel is engaged and as the tape is unlaced it's rewound on the take-up reel inside the cassette.

An auto rewind facility is employed every time the

machine is put into the stop mode and the tape placed inside the cassette. This is necessary because the unlacing process effectively advances the tape, i.e. if the machine was made to lace the tape and then unlace the tape without going into play or record, the length of tape required to lace the machine would have been transferred from the feed spool to the take-up spool. To compensate for this effect the tape is automatically rewound for one second so that when relacing occurs the original section of the tape is around the drum.

At each end of the tape there is a transparent leader which enables a light source to shine through it on to a phototransistor. When this happens the machine automatically stops, unlaces the tape back into the cassette and then rewinds the tape back to the beginning. After this operation a repeat sequence can be used in which following the tape rewinding the machine relaces the tape and then goes back into the play mode: an ideal situation for lectures and demonstrations.

As the reader can see from the diagrams and photographs the mechanics of this VCR are highly complex. The section of the manual dealing with the mechanical adjustments is twice as long as the complete electronic line up procedure! If the complexity of the mechanics in VCRs advances as quickly as the electronics then the situation is going to be reached where the service engineer is going to need a degree in mechanical as well as electrical engineering!

The author would like to express his thanks to the technical staff of Tom Molland Ltd., Plymouth, for their help in the production of this article. ■

# MILLER'S MISCELLANY

*Chas. E. Miller*

## *The New ITT Chassis*

I had the chance recently to work on one of the latest ITT colour sets. What an impressive chassis (CVC20) it is, appearing but little larger than some monochrome models. The tube assists in the illusion, with its modestly sized scan coils and convergence magnets similar to the shift controls on black-and-white models. It's impossible to escape the conclusion that the conventional delta-gun shadowmask tube, with its complicated convergence controls, will be as obsolete as the horn gramophone in a few years' time.

## *The other side of the coin*

The set I was asked to check was suffering from low width. It was so new that no service information had reached these parts, so I had to work by ear. I would like to be able to report that I discovered and rectified the fault by a brilliant diagnostic process, but as this might cause those who know me to fall about and injure themselves I had better tell the truth. The width control is a preset potentiometer mounted on a small subpanel at the top of the line can. Rotating the control had absolutely no effect on the picture, so I guessed that the fault might lie in this subpanel. Upon removing it I found that it had three transistors and a handful of small components. I decided to check the transistors by the base to collector and emitter resistance method, and as luck would have it the first one I tried – that nearest to the control – proved to be open-circuit. A replacement restored the width, and the control's action, to normal. The ironical point was that immediately above the subpanel was fastened a label with the comment "Checked".

## *Value for Money?*

Did you notice that at the time of the recent hoo-hah over higher colour TV licence fees the BBC screened black-and-white feature films at most of the peak viewing times. It would appear that someone needs a little training in elementary salesmanship!

Having said that, even a £26 colour licence would be good value for money if a reasonable sense of values is applied. One daily and one Sunday newspaper taken regularly cost over £30 per annum; add the Radio and TV Times and the figure soars to over £40. I frequently use this argument against those who give the cost of the licence as their reason for not buying a colour set. (We had better say nothing about those who spend £200+ a year on contracting lung cancer!)

## *Too Reliable?*

Some sets imported from the Far East have been so

outstandingly reliable that engineers have just not had the opportunity to acquire experience on them. An example of this occurred to me recently when a colleague and I went to look at a set which had been completely free from trouble since its installation some years ago. It was perfectly obvious that a fuse had blown, but to our acute embarrassment we just couldn't locate it! Search as we might we could find no sign of a fuse holder. Fortunately the lady of the house was too busy to observe our discomfiture. When the blown fuse was at last discovered – by folding part of the upright chassis forward – it was so badly blackened as to almost shout "dead short!" In the event it was one of four silicon diodes in a bridge h.t. rectifier that had shorted. The manufacturers had provided a semiconductor kit which naturally did not contain this essential item, so a 1N5404 was used. To date it has performed successfully.

## *The sets that never were – 1*

In 1950 the Golden Age of television in this country was dawning. The BBC had just opened its second transmitting station at Sutton Coldfield, bringing pictures to the Midlands, and it would not be long before other transmitters followed. The setmakers were gearing up for a bonanza, and there were many of them to share it! It's possible to list, without undue effort, over 25 major firms active in this field at the time, the vast majority of them wholly or partly independent. Indeed the only closely associated companies were Marconiphone/HMV and Philips/Mullard (sets were being produced under the latter trademark in those days). Of the rest all but a handful produced highly individual chassis. The few remaining ones mostly employed what was the first "standard" receiver, made by the giant Plessey concern. This company made sets for the radio and TV industry for many years, but none ever appeared under its own name. They can thus be fairly called "the sets that never were". They appeared chiefly wearing the insignia of Regentone (Lloyds Packing Warehouses) and Defiant (the Co-op), but were also to be found in the cabinets of Philco, Argosy, Decca, Columbia, RGD, the odd Marconiphone, and in later days even Grundig models. In addition they were highly favoured by Rediffusion.

Perhaps the best known of the very early models was that known as the Regentone "Port Hole", a 12in. set (Model TR20) housed in an enormous console cabinet with a circular screen aperture. Because of the aspect ratio of the transmitted picture it was necessary to mask off only a small amount at the top and bottom of the screen. The set was a good example of what might be called "primitive" design, soon to be outmoded by more modern chassis. It used 20 valves, driven by a large and heavy power pack in the bottom of the cabinet. The mains transformer

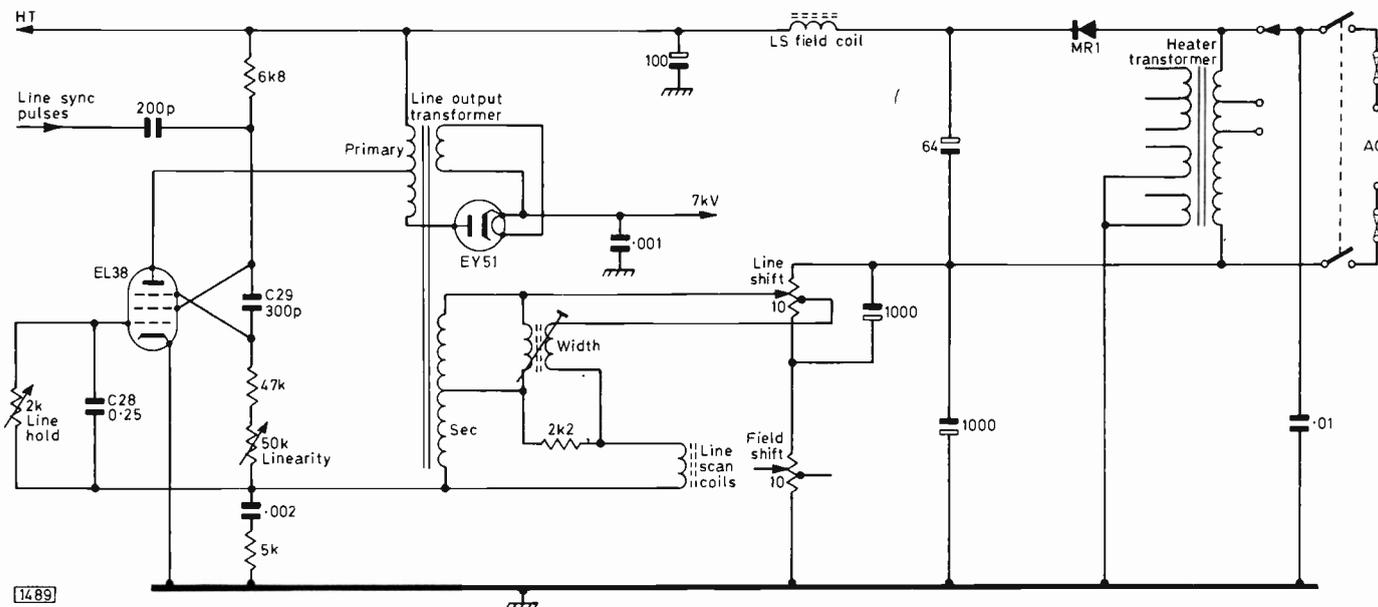


Fig. 1: The single valve plus e.h.t. rectifier line timebase used in the Plessey single-channel TV chassis. The EL38 doubled as a transistron oscillator in addition to being the output valve. The line and field shift controls were connected between the negative mains lead and chassis – hence the set's entire h.t. current flowed through them. The field shift arrangement was identical to the line shift circuit. The scan coils were connected between the centre taps and the sliders of the shift potentiometers, enabling the scans to be shifted in either direction. The same basic idea came back with the advent of colour receivers many years later. A triode c.r.t. was used, so there was no need for a first anode supply.

incorporated an e.h.t. overwind. I will never forget carrying one of these sets up a long flight of stairs to a flat above some shops. Half-way up we discovered that a previous engineer had omitted to replace any of the bolts securing the power pack. . . . the hard way!

In order to be able to sell these sets in both the London and Birmingham areas, two sets of coils were fitted in the r.f. and oscillator cans. These had to be selected by soldering leads to the appropriate tags. Maybe it was just as well that only two stations were operating at that time, or things could have become really complicated.

The chassis which replaced this model was a very different kettle of fish. It will be remembered, in the most part with affection, by all engineers who were in the trade at the time. It was produced in various slightly different forms to suit setmakers requirements but the basic design remained unchanged for a number of years. It had 15 valves, eight of them grouped on a small r.f./i.f. sub-chassis. Although nominally a single-channel set the tuning could be altered for other transmitters if the need arose. The field timebase consisted of a 6SN7 double triode in a simple and reliable multivibrator circuit, driving a low-power triode (6L18) as the output valve. Linearity control was by means of a 5kΩ variable resistor in the latter's cathode circuit.

The most unusual feature was undoubtedly the line timebase, which employed just one valve (an EL38) as a combined oscillator and output stage (see Fig. 1). Basically the valve was connected as a transistron oscillator, as can be seen from the 300pF capacitor C29 between its suppressor and screen grids. C28 in conjunction with the line hold control generated the basic sweep waveform. In practice this formed a very stable oscillator circuit that seldom went out of lock. The valve's anode drove the primary winding of the line output transformer, an overwinding supplying the EY51 e.h.t. rectifier which lived inside the output transformer. The scan coils were driven by the secondary winding on the line output transformer, the width control transformer being connected across a portion of the secondary winding to provide a variable load,

ensuring that the e.h.t. did not vary with adjustment of the width control. The latter operation was achieved by means of a long iron dust core, which on occasion had been known to be replaced by a six inch nail in an effort to get a little more width! The result of this unwise exercise was a very hot nail and little else! In earlier production sets the scan coils were coupled to the transformer by a 100μF electrolytic capacitor, and your guess is as good as mine as to how this component stood a steady 10,125Hz. The line and field shift controls operated on the same lines that were later to become familiar in hybrid colour receivers.

A substantial mains transformer was used but live chassis techniques were still involved as the h.t. rectifier was fed from the mains primary. The use of 6.3V heater valves in parallel made for extreme reliability – switching on surges were negligible, and there were no droppers to fail.

Various tubes, 9 or 12in., could be accommodated, but I imagine that the most popular was the CRM121. This was a 2.0V heater triode, cathode modulated. It had a distressing tendency to go heater-cathode short, with consequent nasty effects upon picture quality. Since no isolating transformers were then available we used to make up phase reversing unity gain amplifiers on the ubiquitous tobacco tins and go over to grid modulation.

The only serious complaint which could be levelled at the design was the use of a panel of wire-wound slider controls for the various preset functions. They seldom seemed to last long after being adjusted a few times. Eventually rotary controls replaced them.

Apart from this the most common fault was the failure of the selenium h.t. rectifier and/or its 64μF reservoir capacitor. It was not unusual to find a set soldering on with its h.t. line reduced to about 160V from the nominal 260V!

As stated earlier these sets could if necessary be tuned to any of the five BBC channels; but since in practice this meant changing various coils and capacitors some other method had to be found to cope with the ever-widening areas served by television. It might be thought that this well-proven design would have been modified to accept

continuous tuning, but this was not to be. Instead, another completely different chassis was introduced. But more of this next time.

### A Coincidence

Shortly after starting to write this column, and after having commented on the latest ITT colour set, I met for the first time one of the old CVC2 hand-wired models. I don't know how I've missed seeing this chassis till now: maybe not too many of them were made, or perhaps they were outstandingly reliable. They must certainly have been a most expensive set to build, with virtually all the components and transistors mounted on parallel ranks of tagstrips.

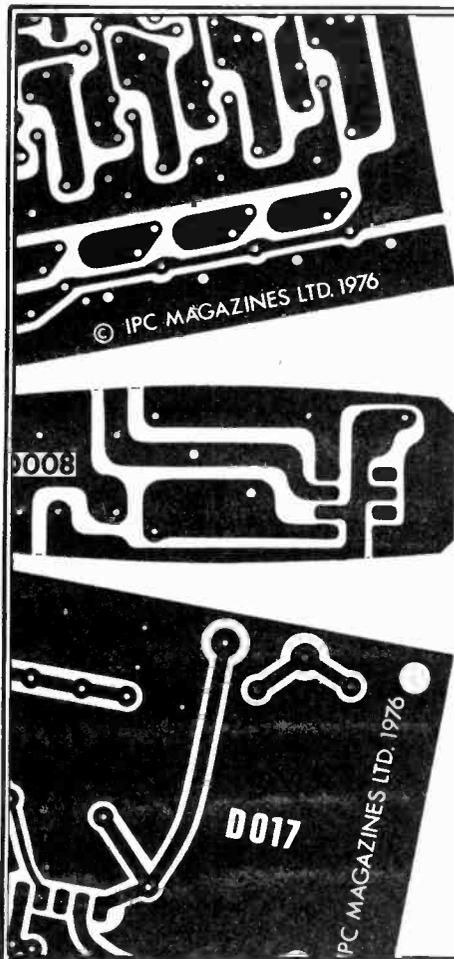
This particular example of the breed had had a chequered career of late, passing from one auction sale to another bearing the completely mendacious description "in working order". By a combination of discreet questioning and good fortune I was able to trace its recent history. Because of a baffling decoder fault it was left idle for a long time on the shelves of a certain dealer. ITT quoted a price of some £48 for a replacement panel (or so I am told), and this finally sealed its fate. The c.r.t. was removed and an old one fitted in its place. This had apparently been run for some time with 13V on its heater, and the emission was virtually nonexistent when it was changed back to 6.3V. There were two PY500s in the line can, an ECC82 where the PCF802 should have been, and the latter type occupied the place of the PCL86! The three colour-difference amplifiers, which should have been PCL84s, had been replaced by a PCF80, an EF184 and a 30L15! But the masterstroke was the fitting of a GY501 e.h.t. rectifier with two of its pins

cropped in the socket for the PL508 field output valve! In this condition it was sold by auction for £36. Its new owner promptly resold it at another sale for no less than £42, but his luck then expired. The prospective purchaser realised that he had been "done" and made unpleasant noises concerning the Consumer Protection Act. Thus it was that the set finally came into my possession for a nominal sum.

Having equipped the set with a set of good used valves I discovered just how bad the tube was. When this too had been replaced I realised that I had a decoder fault on my hands. Never previously having had cause to examine the circuit closely I was surprised to find that there was no bistable, the PAL switch – a diode bridge – being driven directly by the 7.8kHz ident amplifier. It was evident that a lot of "tattooing" had been done to the panel, and it took me as long to put this straight as to discover the original fault – two defective diodes in the PAL switch (one was open-circuit, the other shorted). The set now performs reasonably well on strong signals, but it is obvious that colour synchronisation is only touch-and-go. This leads me to wonder if the alleged quote of £48 may have included modifications to render the circuit somewhat more conventional. It has crossed my mind to build in a bistable myself, just for the hell of it, and if any reader has any experience of this I would like to hear of it.

Another fault which showed up was complete loss of control over the brightness level after about a minute from switching on. This was found to be due to someone having left the heatsink off the luminance amplifier transistor.

All in all I consider this chassis to have been a brave attempt to build a hand-wired colour set, as in ITT's erstwhile sales slogan of the time, but seen in retrospect it can only emphasise the superiority of the printed panel.



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# UNDERWATER VIDEO

## *Development of new TV cameras for underwater use*

MARINE UNIT TECHNOLOGY in conjunction with British Petroleum have developed a new underwater television camera. Although the prime reason for the development was for BP's use in their offshore oil and gas programme, the camera and its associated monitor and control equipment are currently being used to assist in the underwater survey of the Tudor warship "Mary Rose" which sank in 1545 and is now buried in 10 feet of mud under 40 feet of water in the Solent. This exercise is proving useful to all concerned.

To announce the new camera, a group of Naval Historians, Museum Curators and the Press were invited to a "live" demonstration over the site of the wreck. On the way to the site a videotape of part of the previous day's dive was shown. The camera used employed a standard vidicon tube but despite extra lighting at the wreck the pictures weren't too good.

The camera used at the site however used a tube with a silicon intensified target (SIT) and the pictures were excellent even without anything except natural light. This type of tube features a target consisting of a silicon photodiode array, with an image intensifier mounted in front of the faceplate.

The new cameras are based on the existing MUT/BP units, but incorporate significant improvements. The most significant advance is probably in the optical system. The

angular coverage of the objective lens has been increased to 130°. This represents an extraordinarily large field of view for a television camera, especially for underwater work – most cameras for this application require extensive corrective optics and consequently have a narrow field of view.

The camera has an electronic zoom, developed by MUT, which allows the image magnification to be boosted from 1 to 1.4 (linear) or 2 (linear). This operation is controlled from the surface, leaving the diver free except for pointing the camera as directed.

The new unit also incorporates a new integrated circuit sync pulse generator which controls the functions of the camera. It generates six different pulse chains for the various timing functions.

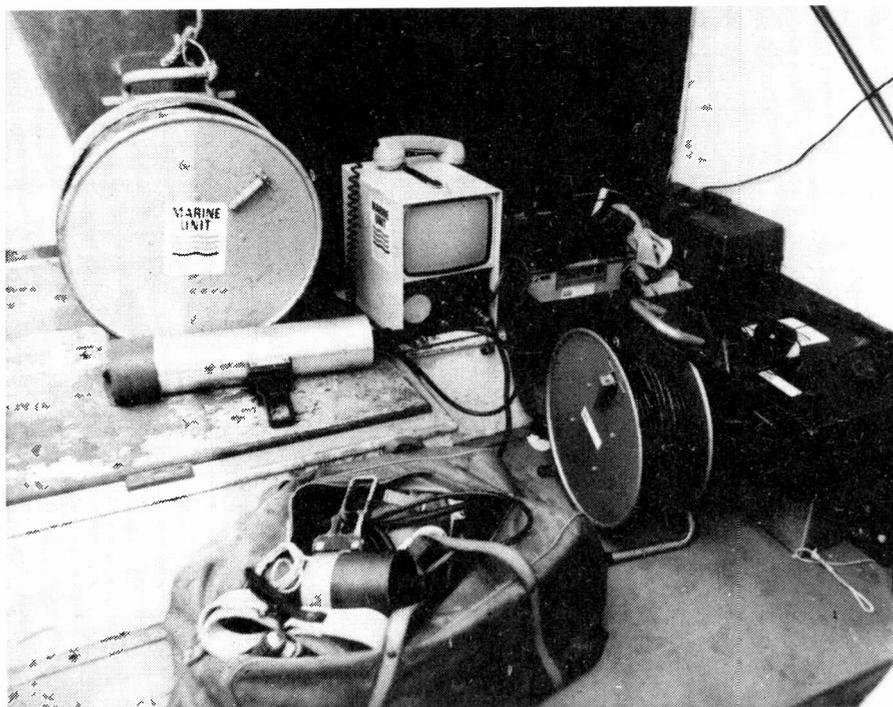
The camera can either be held by the diver, in which case instructions are relayed by a communications link terminating with a small bone-conduction microphone behind the diver's ear, ensuring that the resulting field of view is satisfactory, or it can be suspended beneath the survey vessel and operated remotely.

The control unit on the surface consists of a television monitor, microphone and loudspeaker. The standard unit has been especially ruggedised to make it suitable for the North Sea environment.

Of the options available, one has a standard vidicon tube (for use in shallow water), a second has a silicon diode tube which gives improved pictures at medium depths, whilst the third uses a silicon intensified target tube (SIT) – type 4804, from RCA – for depths of 100ft or more.

The stage two cameras will be used by BP in their West Sole and Forties fields. The experience gained at the wreck of the "Mary Rose" will be invaluable in this activity. It has already been invaluable to the party surveying the "Mary Rose" itself, since it has enabled a wide audience, most of whom could never have made the dive, to see the wreck in situ.

The cost of the standard vidicon based system currently being sold is around £6,500. The silicon diode and SIT versions will be on the market in the near future. For further information contact Marine Unit Technology Ltd., 3 Friars Lane, Richmond, Surrey. Phone 01-940 3682. ■



*Photograph of the items comprising the system. The camera in the foreground, on the tool bag, is the vidicon type. The camera in the centre left, in front of the cable drum, is the silicon type.*

# SUPER ARCH MASK

In shadowmask c.r.t.s the mask itself absorbs between 75% and 85% of the electron beam energy. This inevitably leads to thermal expansion of the mask and frame assembly, with a consequent radial outward movement of the apertures. This of course results in misregistration between the beams and the phosphor dots on the tube screen, giving rise to colour field impurity and degraded white uniformity (see Fig. 1).

In 1966 RCA introduced "Perma-Chrome" as a solution to this problem. This system moves the mask assembly slightly towards the screen as it expands, with the result that the mask apertures remain in the correct positions relative to the beam paths, maintaining good register between the beams and the phosphor dots (Fig. 2). Movement of the mask towards the screen is achieved by using bimetal elements in the frame's support system. These expand as the frame temperature increases. This system has been accepted as an industry standard, and although minor design variations have been made by some tube manufacturers the basic concept remains the same.

## 110° Deflection Tubes

With the introduction of 110° deflection and the use of higher anode voltages an additional mask expansion problem which is not corrected by Perma-Chrome became evident. This is a transient problem in which the mask temperature increases more rapidly than the frame temperature during the initial few minutes of tube operation at high input power to the screen. Since the mask is

restrained at the edges by the slower heating frame, it tends to dome or increase its curvature and thus reduces the mask-to-screen spacing as shown in Fig. 3.

Two methods are used simultaneously to reduce the effects of this problem. The first keeps the temperature of the mask as low as possible. In addition to the customary blackening of the mask, RCA took the further step of blackening the back of the phosphor screen to make it a more effective heatsink. This blackening allows the face assembly to absorb more of the heat from the mask and therefore maintains a lower mask temperature.

A second solution was the development of a particular register pattern which is imposed by the screen printing lens. Due to the low deflection angle, register near the centre of the screen is not disturbed by mask doming. At the same time mask movement at the extreme edges is very limited because of its attachment to the cold frame. Misregistration is at maximum therefore in the region between the centre and the edges of the mask (see Fig. 4). A screen printing lens was developed to adjust the beam landing in these areas to give the maximum possible tolerance for this mask expansion.

## In-line Gun Tubes

With in-line gun tubes the mask expansion problem is more pronounced because of the reduced horizontal spacing between the phosphor lines. As Fig. 5(a) shows, the typical width of a phosphor stripe in an in-line gun tube is 0.28mm, which compares with a typical dot diameter of

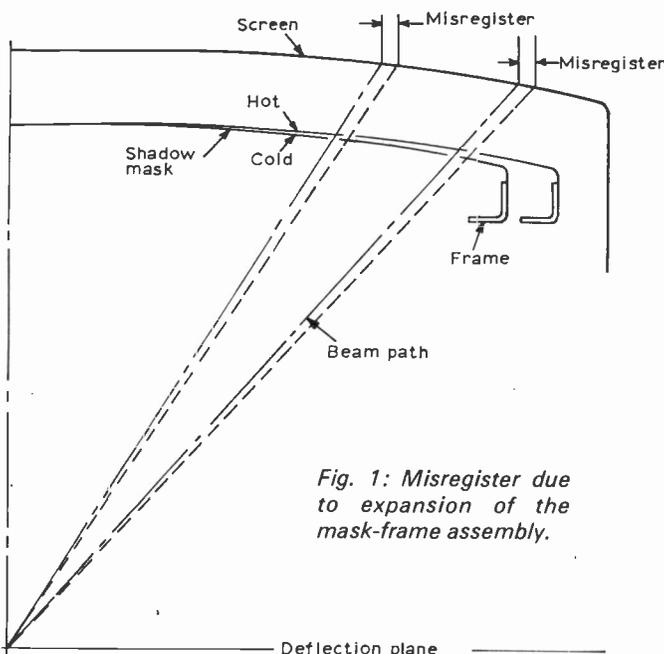


Fig. 1: Misregister due to expansion of the mask-frame assembly.

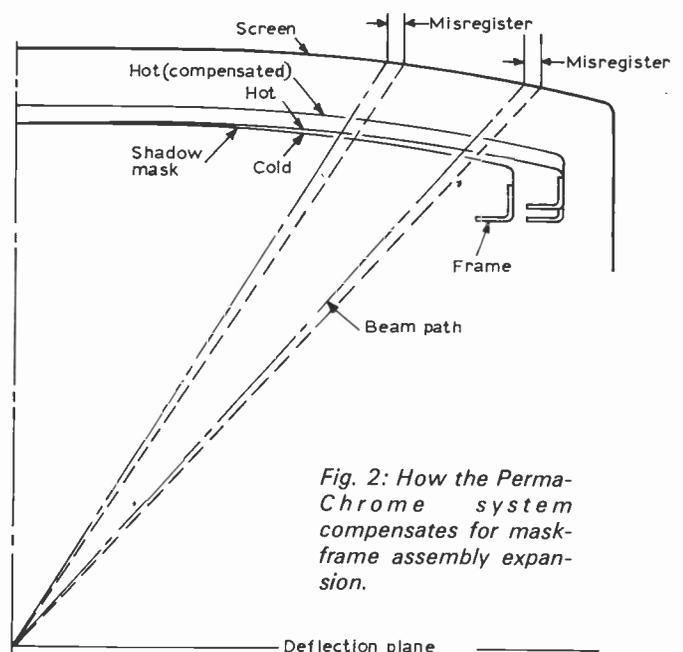


Fig. 2: How the Perma-Chrome system compensates for mask-frame assembly expansion.

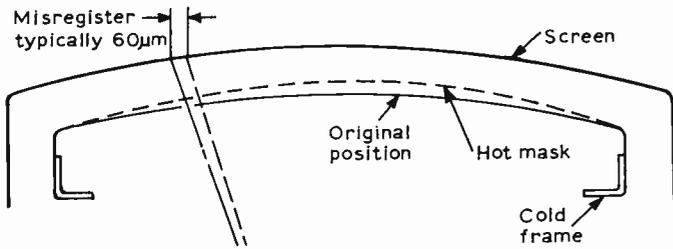


Fig. 3: Shadowmask doming during the initial minutes of tube operation.

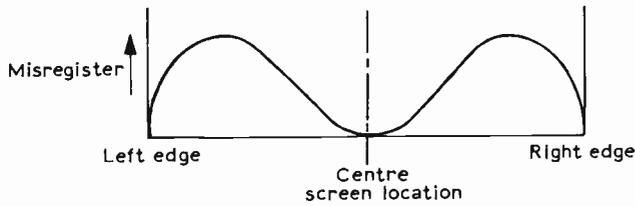


Fig. 4: Register sensitivity as a function of position on the screen.

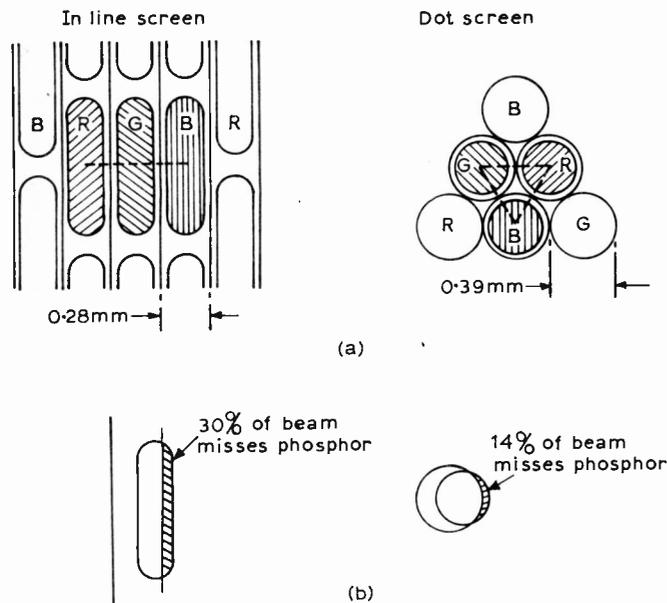


Fig. 5: (a) Beam landings in perfect register. (b) Beam landings with 100µm misregister.

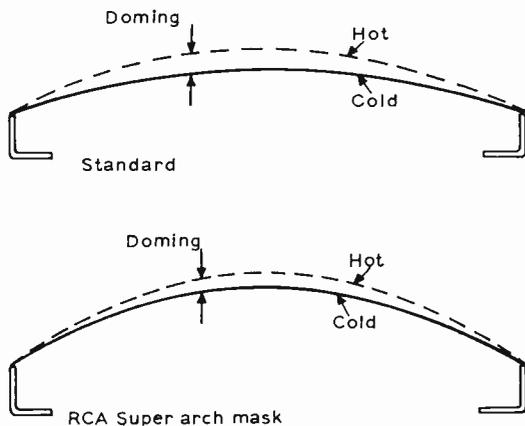


Fig. 6: Comparing doming with standard mask (top) and RCA Super Arch Mask (bottom).

0.39mm in a dot-screen tube. Thus a given misregistration will result in a higher percentage of the beam missing the correct phosphor in an in-line gun tube than in a dot-screen tube. As shown in Fig. 5(b), a misregister of 100µm causes 30% of the beam to miss the correct phosphor in an in-line gun tube, compared to only 14% in the dot-screen tube.

A simple way of increasing the tolerance to allow for mask expansion is to increase the spacing between the phosphor elements. This approach was rejected because it increases the visibility of the screen structure.

### RCA Super Arch Mask

The basic problem is to minimise the change in spacing between the curved mask and the phosphor screen as the mask expands. The degree of the curvature of the mask structure determines its rise for a given linear expansion. For example, if the mask was flat, for a given expansion it would rise (dome) appreciably more than the same mask with a greater curvature. The new RCA Super Arch Mask has a greater curvature which minimises the change in spacing between the mask and the screen during mask expansion. This is illustrated in Fig. 6.

The mask curvature cannot be changed arbitrarily since it is determined basically by the curvature of the tube's faceplate and the tube geometry required to ensure correct "nesting" of the phosphor trios as shown in Fig. 7. The mask curvature varies from that of the faceplate in such a manner that the spacing  $q$  obeys the equation:  $q = La/3s$ , where  $q$  is the space between the mask and the faceplate,  $L$  is the distance from the screen to the deflection plane,  $a$  is the spacing between slots in the mask and  $s$  is the beam spacing at the deflection plane.

By letting  $k = L/3s$  (constants for a given tube), it leads to  $q = ka$ . Thus under normal conditions  $q$  is established by the given tube parameters and it is not obvious that the curvature of the shadowmask can be modified. If, however, parameter  $a$  is allowed to vary between the centre and the edge of the screen, with a larger value at the edge than at the centre,  $q$  will also change in a similar manner. Thus if  $a$  increases from the centre to the edge,  $q$  will increase proportionally resulting in a mask with a greater curvature. As mentioned previously, this leads to less change in mask doming for a given mask temperature change.

In addition to the advantage gained by the greater curvature, the Super Arch Mask has a secondary benefit in that the variable  $a$  value towards the edge of the screen provides a greater tolerance for mask expansion in that critical area.

A larger  $a$  value for the entire screen was rejected because of the resulting increased visibility of the screen structure. In the Super Arch Mask this problem is overcome by having no change in screen structure in the centre where maximum picture detail is desirable.

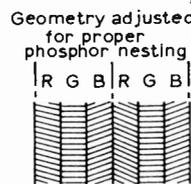
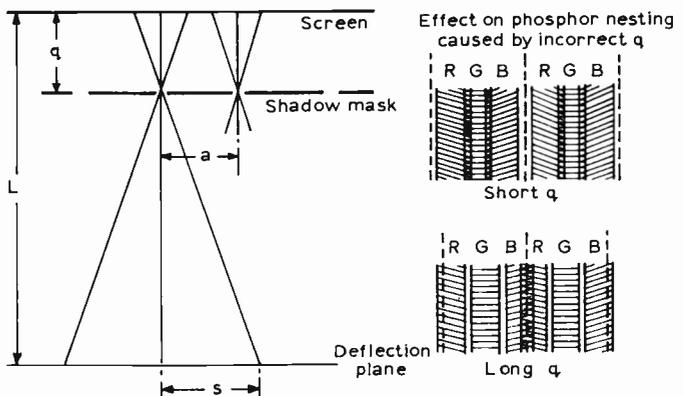


Fig. 7: Screen geometry showing "nesting" of phosphors with correct and incorrect values of  $q$ .



# SERVICING TELEVISION RECEIVERS

## PHILIPS 320 CHASSIS

— continued —

L. LAWRY-JOHNS

### The Line Timebase

There is little doubt that the BU105 transistor is not a wholly reliable device. It should be changed for the more reliable BU205. Before condemning the line output transistor however there are one or two quick checks to be made.

Remove the e.h.t. cap from the side of the tube. The e.h.t. rectifier which is of the single stick type (TV20) can give trouble and overload the line output stage. If removal of the cap restores timebase working the stick is faulty.

A check at the base of the line output transistor should show a negative swing of a little under 1V. If this is present, the TBA720Q line oscillator i.c. is working as is the BF337 driver transistor.

If the negative swing is not present, it could be that the i.c. line oscillator is reluctant to start. If this is the case it may

not be necessary to replace the i.c.: Philips suggest that adding a 68k $\Omega$  resistor in parallel with R2407 (wired on the print side of the board) may help to get things going every time in cases where intermittent operation is experienced.

They also make the point that great care should be taken when making voltage checks around this i.c. Only check at the points which are obviously supply points, never around the area of pins 12 and 13 where application of the meter will cause radiation from the leads — this can damage the output transistor.

The fact that the line output stage is not working need not be due to the oscillator of course. It may be due to the BF337 driver transistor being defective. This doesn't take long to check in the usual way, since the circuit values are high enough to permit checks in situ with a tester or ohmmeter. The emitter is chassis connected and the base voltage is derived from the i.c. This can be recorded on a meter if there is doubt. If there is no swing and no short in the transistor go back to pin 11 of the i.c. to ensure that voltage is arriving here and that C2424 is not short-circuit.

Note that the i.c. may not be a TBA720Q. It could be a TBA720AQ and it should be realised that there are differences and that they cannot be interchanged without making changes to the circuit. For example R2416 and C2420 are not fitted when the AQ type is used.

Another point relevant to the life of the line output transistor is the length of its conduction period. This should be between 25 and 32 $\mu$ s and is determined by the value of R2409. If it's longer than 32 $\mu$ s the value of this resistor should be reduced (from 3.9k $\Omega$  to say 2.7k $\Omega$ ). This only arises when the earlier (TBA720Q) i.c. is changed and the line drive is measured with a scope at the collector of the BF337.

From a practical point of view, the reliability of the components used ensures that very little trouble will be experienced apart from faulty transistors, the e.h.t. rectifier and this pencil's housing which tends to decompose after a period leading to unmistakable discharge.

### Field Timebase

So far, and as far as we are concerned, the field timebase has proved reliable and the choice of BD131 and BD132 field output transistors was a wise one. To digress for a moment, we have had a long succession of Indesit T12LGB portables brought into us with the complaint of field collapse due to failure of the output transistors. It is clearly not good practice to replace these with the same type as this would only invite further trouble. Therefore we now fit a BD131 and BD132 with a suitable heatsink, and we've had no further complaints on this score. Now back to the Philips chassis.

The output pair are driven by a BC107 which has proved

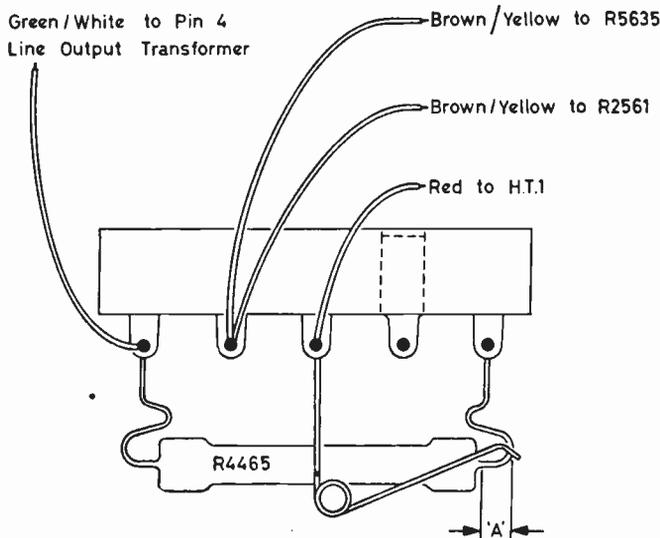


Fig. 2: Assembly of the thermal fuse resistor which is in series with the h.t. supply to the line output stage. In the event of the stage drawing excess current the temperature of R4465 rises sufficiently to melt the solder securing the end of the spring to the resistor's lead-out wire, thus disconnecting the h.t. supply to the stage. If the fuse is found to be open-circuit, clear the fault in the stage then reset by soldering the end of the spring to the outside of the bend in the resistor's lead-out wire as shown above, using 60/40 solder. The distance 'A' is important and should be 3mm. In earlier models the assembly was wired differently — the spring was soldered to the other end of the resistor. In these sets 'A' should be 2mm in 17in. models and 5mm in the larger screen receivers.

Fig. 3: Layout of the power supply unit. Add 5000 to each component reference number to correspond with the circuit diagram (Fig. 1) on pages 84-5 last month. Mains fuse blowing is a common fault on this chassis. Several causes were mentioned last month. Fitting the later type of thyristor helps – and make sure the fuse is rated at 1.6A. Another point worth checking is that there is a good soldered joint at the earthing screw X1 on the tube base panel. For optimum reliability, make sure that the h.t. voltage has been reduced to 158V.

**Voltages:** The readings on the circuit (Fig. 1 last month) were measured using a 20k $\Omega$ /V meter. Figures in brackets are with signal, the volume control at minimum and the other controls set for normal operation. Figures not in brackets were measured with no signal and the user controls at minimum.

a reliable transistor in this position. The BC107 is fed from a BC147 emitter-follower and preceding this is the field oscillator.

The oscillator is an s.c.s. of the same type (BR101) as that used in the power unit to trigger the thyristor. It discharges the timing capacitor C2530 and also, via D2504, the field charging capacitors C2531/C2538/C2540.

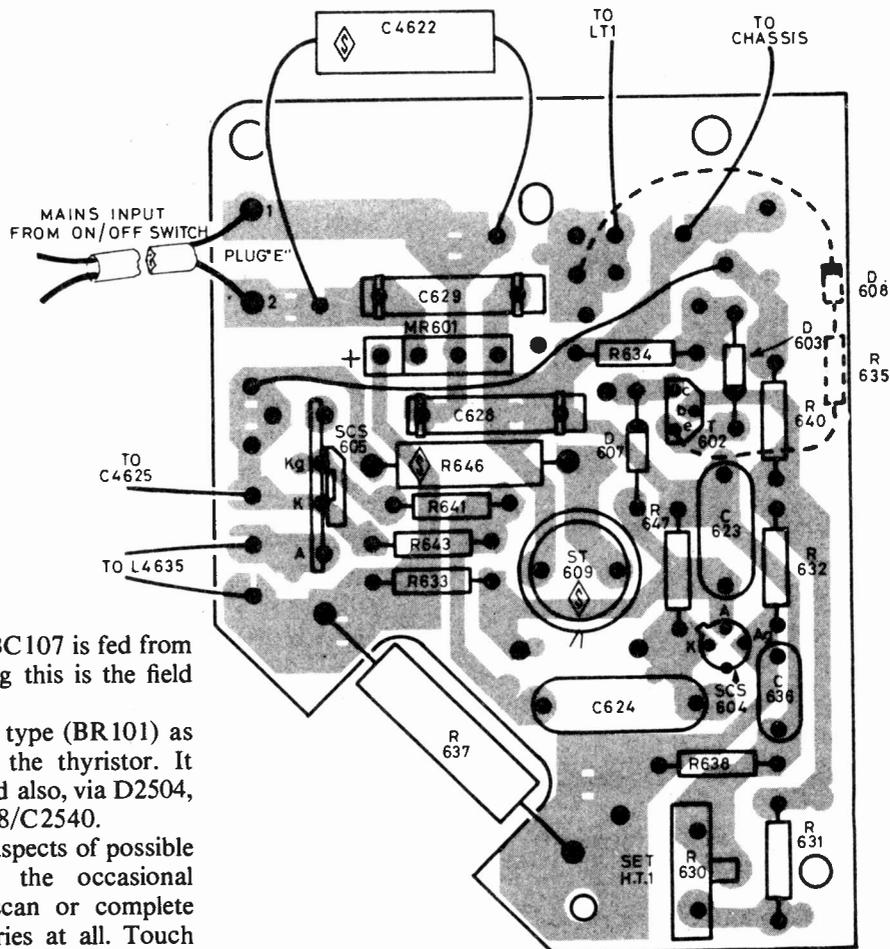
We cannot comment on the practical aspects of possible fault conditions because apart from the occasional transistor failure resulting in reduced scan or complete collapse we have encountered no mysteries at all. Touch wood.

## Video Circuits

We have had a spot of bother with the BF337 video output transistor and the TBA550Q video processing chip however. The BF337 is in fact one of the more reliable video transistors. But it does occasionally fail, and the fault symptoms can vary. Usually a very weak picture is presented but with good lock. A few quick tests will reveal the cause of the trouble, with very little room for doubt. A word of caution however. The fact that there is a small voltage across the emitter resistor R2249 is no guarantee that the BF337 is passing current. The resistor is linked to the supply line via R2240 etc. and in consequence there is a voltage across R2249 even when the transistor is open-circuit. The clue is that the voltage recorded is lower than the correct 5V which should be present if the base voltage is around the correct figure of 5.7V. With these two voltages correct there should be 90V at the collector with no signal input. Any wide variance will necessitate a closer look at the transistor, checking cold with an ohmmeter in the set (the associated resistor values are reasonably high, enabling a good idea to be gained of the state of things). Remove it for a closer check or replacement if there is any doubt.

The symptom could of course be no picture at all and a blank raster to boot. But there is little doubt here because if this is the case the voltage at the c.r.t. cathode and transistor's collector would be higher than the 90V (no signal) already specified.

Problems start when the picture is very weak and there is little variation of the voltage at TP12 (high end of the contrast control, or pin 12 of the i.c.) with strong aerial signal and good sound. Now an i.c. such as the TBA550Q carries out many functions. Therefore the fault symptoms



can vary according to which internal bit is giving trouble.

We have quoted the most frequently encountered fault, which is that the video signal is impaired but the sync and sound remain good. This does not always happen. The sound could also be weak or, as in one case recently encountered, the vision signal and the sound were good but the sync was hopeless because the line sync discriminator section had become faulty, producing severe tearing of the picture as the sync control voltage at pins 1 and 2 of the i.c. did silly things. There is no hard and fast rule about this type of chip, and funny things that are not in the book can happen.

## IF Strip

We do not propose to moan and groan too much over the i.f. strip. Faults do occur, but they mainly concern the transistors and a meter check will almost always lead the diligent digger straight to the faulty stage. Take voltage readings at the emitters first, then at the bases and collectors, backing this up with ohmmeter checks where suspicions are aroused. If the voltages are about right and there is some noise on the screen and from the loudspeaker the trouble is elsewhere and a quick check on the tuning voltage supply (not tuner voltage) can be most rewarding. Intermittent variations of gain can be due to dry-joints.

## Tuning Voltage

Programme selection is by varying the voltage applied to pin F on the tuner. The tuning potentiometers on the programme selector assembly can be preset to the desired station only if the 28.5V supply is present at TP8. A 22k $\Omega$  resistor (R2111) drops the HT1 line to what is required and

this is stabilised by the TAA550 small i.c. and smoothed by C2113. The exact voltage applied to the selector is set by R2114. It was found that the original value of C2113 (6.8 $\mu$ F) imposed too much of a strain on the i.c.: in all cases the capacitor should be changed to 1 $\mu$ F (disc).

If the voltage is not present at all, check the 22k $\Omega$  feed resistor and if this is correct check the capacitor for shorts and then suspect the TAA550. If one of these is not to hand a 30V zener can be used for test purposes. If there is tuning drift check these same components by replacement. If the voltage is steady at 28.5V at TP8 check at TP10 as C2104 could be messing about (it hasn't done so with us, but you never know).

The tuner doesn't give much trouble but when it does (applied voltages being right) it doesn't lend itself to easy repair. Having lost our spirit of adventure (senile decay) we prefer to put in another tuner if there is any doubt since this can be done in a matter of minutes with a hot iron and some desoldering braid.

Before suspecting the tuner check back to the TBA550Q (oh yes, this also provides the a.g.c. voltages) to ensure that pin 4 is at 2.2V (no signal) and pin 6 at 1.8V. When the set is working and with an aerial signal these voltages can go up to 6.2V and 3.4V respectively.

## The Sound Channel

The detected signal from the vision i.f. gain unit (U2900) is taken from pin 8 and passed through the sound i.f. pick off coil U2350 before being passed to the video TBA550Q. That's why faults in the latter chip do not normally result in loss of sound. The TBA750Q sound chip is a coat of many colours however as can be seen by the circuit diagram.

Sound faults must be tackled logically and, using a little common sense, troubles can usually be resolved quite quickly. If the picture is good but the sound is playing about one has to cast a baleful eye on the TBA750Q i.c. and the pair of BD131 output transistors and their circuitry. The usual trouble is either no sound at all or weak sound which may be distorted (or normal volume with some distortion but this is less likely). Let's start with no sound.

If there is no trace of sound at all there isn't much point in applying a hum test to the volume control to ascertain which part of the circuit is at fault, but still do it in case you're getting deaf (as well as senile). If there is no response, quickly check the loudspeaker. This is a 50 $\Omega$  item (yes 50 $\Omega$ ). If this clicks nicely when a meter switched to the low-resistance range is applied, as well as giving the correct approximately 50 $\Omega$  reading, attention should be directed to the output pair of BD131 transistors, ensuring first that they are supplied from LT1 via R2337. There should be about 31V at the collector of T2303, with 18V at its emitter (TP7). The most significant reading however is at the emitter of T2302 since this gives an indication of how much current is passing through the output pair. 2V is normal.

If this voltage is absent one is faced with the possibility that there is an open-circuit in the output pair or that they are not being turned on. It is a matter of choice at this point which action is taken next. The BD131 transistors could be cold tested to find out whether one of them is open-circuit or has a short from its base to emitter, or one could use a dodge which we use to prove the whole stage and at the same time lay the blame.

This is to turn on T2302 by connecting a 4.7k $\Omega$  resistor from the supply line to its base, i.e. from pin 2 to pin 15 of the chip if this is convenient. At a stroke (sorry Ted) this could prove the output pair to be in order, restore a certain amount of sound (albeit with background hiss) and prove

the i.c. to be at fault if indeed it is. The point is that an open-circuit or partial open-circuit in the chip does occur from time to time in the audio section and has the effect of robbing the lower BD131 of its base turn on bias. So this dodge will often be of help in many ways, particularly if the right chip is not to hand. This equally applies to the G8 colour chassis, so it's quite useful if you are out in the depths of the Yukon without your whats-its-names.

There are times of course when one (or both) of the BD131 transistors is open-circuit or shorted, but this is pretty obvious after a couple of checks. The same can be said when the i.c. is defective in such a way that no amount of external giggery pokery will help matters. One will sometimes find that there is plenty of hum from the volume control to indicate that the fault is further back, and again the i.c. could well be at fault or pin 2 could be robbed of its supply.

Distorted sound is another kettle of fish and the source and cure will depend on the type of distortion. One's ear (or ears if you have two) quickly identifies most types of distortion but it is difficult to describe them in words. You could make appropriate sounds like brrr and grrr and sssss but it's not really helpful. Things like a rubbing speech coil in the speaker are pretty well known, but you try to describe it. So you have to work out your own destiny and learn as you go.

If the speaker is in fact rubbing this will be more obvious at low volume levels and sometimes a little soft packing in the right place will clear it until the new speaker can be obtained (one does not normally carry 50 $\Omega$  speakers in stock).

If audio injection at the volume control produces a pure and sweet output from the speaker it is on the cards that the distortion is only due to the quadrature coil U2360 being mistuned. This is quickly proved of course and one quickly gets used to this type of detector misalignment on this and a great many other receivers. The idea is to tune in the picture for the finest detail (just off the patterning point) and adjust the core of the coil for the clearest sound. Turning the core the wrong way will result in a nasty buzz.

There are many other kinds of distortion of course but these are pretty common to most receivers and the writer is not very good at describing them.

One item often overlooked is the coupling electrolytic capacitor in series with the loudspeaker. We haven't been able to fault it in these models but in some it can leak or go open-circuit. The latter of course results in no sound, which is where we came in.

## Some Maker's Notes

**Field Output Transistors:** The T2507 BD131 is insulated from the heatsink by means of a silver coloured pad. This must be refitted when the transistor is changed. The pad is adhesive on one side and this side should be in contact with the transistor. Do not apply silicone grease. Silicone grease should be applied to the thermal contact surface of the other transistor (T2508, BD132) however before it is clamped as there is no insulating pad.

**Sound Output Stage:** The design may vary slightly, R2334 being replaced with a wire link and some minor component changes being made.

**Black Level Drift:** The video circuit should be modified as follows. Change R2239 from 560 $\Omega$  to 820 $\Omega$  and R2240 from 1.5k $\Omega$  to 220 $\Omega$ . At the same time change R2243 from 56k $\Omega$  to 68k $\Omega$  and R2253 from 22k $\Omega$  to 12k $\Omega$ .

Most other variations have been mentioned during the course of our comments.

# LONG-DISTANCE TELEVISION

ROGER BUNNEY

OCTOBER 1976 was a quiet month in West Europe so far as distant TV reception goes. Following the months of hot dry weather the monsoons arrived with a vengeance, with heavy and prolonged rain. If nothing else this washed out any chance of a good Tropospheric opening.

The Orionids meteor shower which peaked on October 21st proved interesting, with a number of useful signal bursts throughout the day – mainly in Band I: I saw very few pings in Band III, at least during the period when I was viewing. Meteor shower (MS) reception has been the main activity this month, although during the 10th and 11th there were afternoon Sporadic E openings from Spain (RTVE) and Italy (RAI). Other signals noted on these two days were from Eastern Europe.

## Month's Activities

Due to pressure of space I will briefly summarise the signal loggings here at Romsey. The first four days of October produced excellent morning MS, including a ch. E5 ORF (Austria) signal in Band III on the 2nd. I noted TVP (Poland) using the PM5544 test card on the 5th, but with an identification of sorts in the lower rectangle – unfortunately this was too weak to be deciphered. On later days the card was seen without identification. The Tropospherics improved slightly on the 10th, and both this day and the 11th brought Southerly SpE. The latter half of the month – at least up to the time of writing (26th) – has produced mainly unspectacular MS, though with the change to GMT at the end of October there was greatly enhanced early morning MS – due to more stations being “on the air”.

I have also been active with another ATS reception project, but as yet without success. I was informed that the ATS-6 satellite would be transmitting demonstration TV signals during its drift back to the west of Peru. Apparently 25 hours of transmissions weekly were promised until October 31st. Little other information was available but several successful ATS enthusiasts were contacted in the hope that someone would see something. As yet nothing has been seen here despite continual watch on 860MHz over two weekends, and no reports of ATS reception have come in. Since my crude dish was elsewhere I pressed into service my inverted washing line and a modified backfire (using MBM group C/D elements). I hope to include a photograph next month to show the excellent temporary mast that an inverted rotary line can provide.

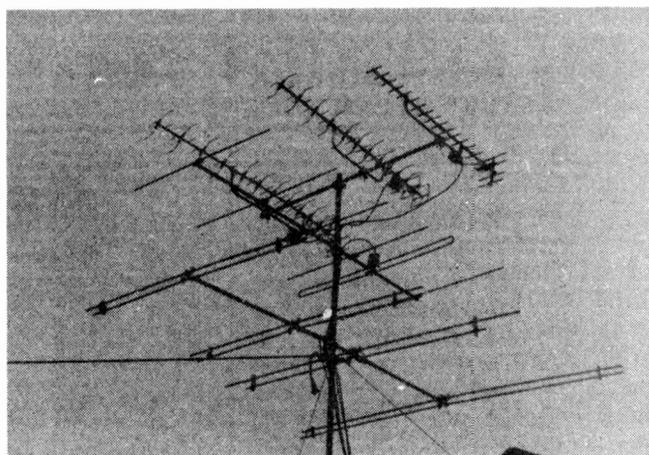
## Interference Problems

Regular readers of this column – at least those who know that I've changed locations several times – will have read of the various interference problems that I seem to attract. In

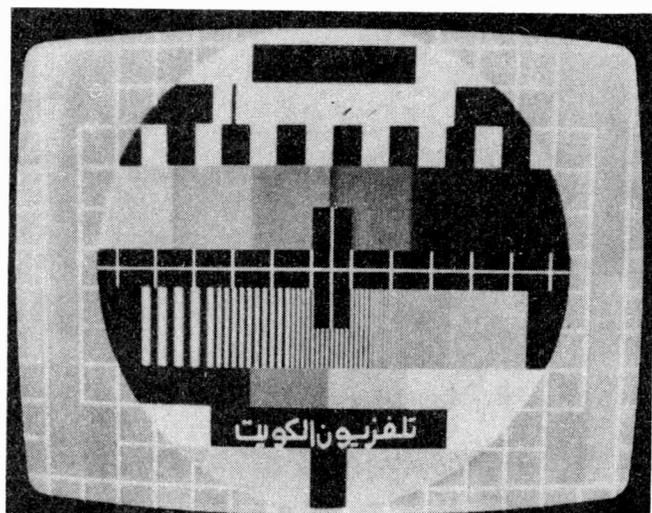
recent years I've chronicled the problems of unseen fork-lift trucks at a nearby industrial premises. Fortunately these have now been suppressed as indeed have any new units brought into operation. Like some devilish “encore” however a new problem which is sorely trying my patience has arisen. On September 24th at 0815 all of Band I was strangely affected by a somewhat musical whine. This appeared in various parts of the band, each segment having a different pitch to that of its neighbour. In fact the problem covered the 48-105MHz spectrum at quite high levels. The following day the same “noise” commenced again, confirming regular use of ill suppressed equipment. To cut a prolonged monologue short, the offending equipment was eventually found to be a computer terminal at the same site where the fork-lifts live! The noise seems to emanate from the display units, and can be locked in on the receivers as running in excess of 20kHz line frequency. The manufacturers have been contacted and investigation is promised. In the meantime reception continues but is somewhat restricted as the aerials are being pointed to the ENE which is the minimum pick-up angle for the interference. The level of the interference to my receivers is some 20 $\mu$ V, which is sufficient to ruin all but the strongest DX-TV signals.

## News from Overseas

*Sweden:* We have heard from Sveriges Radio about a recent report of a projected satellite TV service for direct (i.e. home) reception there. SR tell us that there are no plans for a special satellite TV broadcasting service for Northern Sweden. The report apparently originated from the intention of the Nordic countries to study the possibilities of



David Roche's aerials at Worksop, Notts. Note the “Tru-match” director system on the Band I array – see details in the October 1976 column.



This exotic PM5544 test pattern was received in the Abu Dhabi area.

12GHz broadcasting at the ITU World Administrative Radio Conference in early 1977.

**Norway:** NRK have recently brought into service a new transmitter at Vega Island, off the NW coast. Due to the severe weather in this area the mast (77m) with its 31m aerial assembly has been designed to operate with a 60cm covering of ice. A tunnel has been provided for engineers adjacent to the mast to avoid injury from falling ice.

**Belgium:** We have seen a report that Belgian TV at v.h.f. is to change from system C (positive-going video, a.m. sound) to system B (negative-going video, f.m. sound), possibly in February/March 1977. Another programme chain is indicated, with Genk operating on ch. E46 at 1000kW e.r.p., possibly starting at the end of 1977.

**France:** It is expected that the TF-1 Lille Bouvigny u.h.f. transmitter will be operating/testing in the near future on ch. E27. Installation is at an advanced stage. Rumours suggest that the transmitter may already be operating on a test basis as the Antenna-2 output from Lille has been seen duplicated on ch. E27 as well as on the usual ch. E21.

**West Germany:** Another loss for the Sporadic E enthusiasts. The NDR ch. E2 100kW Steinkimmen transmitter is to close. The date is not known but the information suggests "soon"!

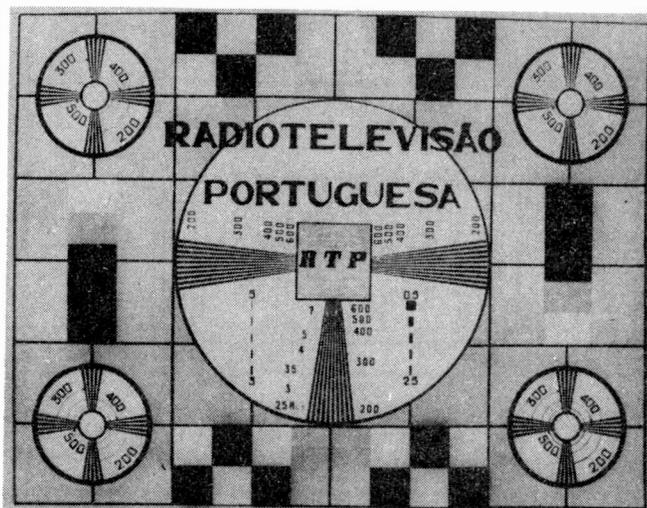
**Czechoslovakia:** Video magazine reports that the new CST-1 Dubnik transmitter near Presov will come into operation in early December, covering East Slovakia. Several new CST-2 transmitters are planned.

**Poland:** New u.h.f. transmitters are in operation at Nakrzymaniusze (Suwalki), Karkonosze (ch. R35, covering Sroclaw, Zielona Gora), Jemiolow (ch. R35, covering part Zielona Gora and Gorzow provinces).

**USSR:** A new transmission system has been announced, giving stereoscopic colour television. If anyone has further information on this project please let us know! The Moscow Central TSS-2 programme is being radiated in Lithuania on a permanent basis following several years of experiment. New TV centres are to be built in Vilnius and Kaunas to increase local programming.

**Caribbean:** RCA (Canada) is to construct a new studio complex at Port-au-Prince to bring television to Haiti. RCA is to supply much of the equipment for the project, including a microwave link to the main transmitter some 50 miles from Port-au-Prince on the Ile de la Gonave. A 3kW (not e.r.p.) transmitter will cover the coast line. It is expected that the system will come into operation during late summer 1977.

**China:** A new microwave network linking Peking with 20



The test card being used by RTP at u.h.f. – it was also used for earlier v.h.f. transmissions.

provinces and other autonomous regions has been brought into operation. This allows transmission of network TV in colour between the large population areas along the East China seaboard and the NW Plateau, and from the Changpai Mountains in the north to the River Chu in the south. The equipment was designed and manufactured locally.

### An Unusual Reception!

Our friend Des Walsh (Co. Tipperary, Eire) has sent details of an unusual phenomenon and wonders if anyone can explain the cause. At the time Des was viewing his "local" ch. B8 Presely on 405 lines, with strong signals. Between 8 and 9 p.m. a reflection was seen on the picture, but to the left of the main image (usually a reflected weaker signal would be to the right). The left-hand image built up slowly in strength over 30 minutes until it was quite visible and clean with no smudging; it then gradually faded. No aerial or receiver fault was present. Although one can explain a delayed signal to the right, I find the left-hand signal rather more of a puzzle. Can anyone assist?

### New EBU Listings

**Spain (RTVE):** RTVE-2 Torrente ch. E22 60kW horizontal (00W29 39N26).

**Poland (TVP):** TVP-2 Lublin ch. R23 1000kW horizontal; TVP-2 Rzeszow ch. R29 1000kW horizontal.

### News in Brief

A new identification for the Fubk test card in West Germany. The ident "Saarlandische Rundfunk" has changed to 'Saarl-Rdfk H' . . . . It seems that the Istanbul University transmitter is still operating at 500W. Apparently a test pattern was seen in Holland during the Summer SpE season. There is a Moon and Star to the left of frame, together with a Turkish flag. A central circle contains the letters R and D. This logging was on ch. E4 at 0900 CET on May 27th last. . . . The first 12GHz TV transmitter is operating from the 23rd floor of the West Berlin Post Office building. Measurements are being carried out at Habichtswald and these will be published in three months' time. . . . The Hoher Meissner transmitter's e.r.p. is to be reduced. At the moment it radiates HR programmes on chs. E7, E32 and E35, with 100kW, 470kW and 500kW respectively. . . . A rough translation of the NOS (Holland)

caption seen recently on test patterns – “Het Testbeeld van de Zender Smilde 1 (Kanaal 6) zal in verband met werkzaamheden aan de Zender Heden niet worden uitgezonden” is that due to work at the Smilde 1 channel 6 transmitter the test pattern will not be transmitted.

### *From our Correspondents . . .*

Again a very full post bag! Mike Allmark (Leeds) has sent us a shot of the test card used by the RTP (Portugal) TV service at u.h.f. Veteran DXers will recognise this as the mono card used by RTP in the early 60s. Allan Latham in Abu Dhabi tells us that the Dubai ch. E2 outlet is assumed to be of very low power since it's poorly received at his residence. There is a possibility that it may close, since two u.h.f. outlets are already in operation. The RETMA card has not been seen by Allan since he went there – the PM5544 reigns supreme! Clive Athowe has written from his Norwich hilltop lookout to say that MTV-1 (Hungary) is now using a pulse and bar pattern instead of a sawtooth prior to programme commencement. The sequence is now pulse and bar, EBU pattern, PM5544, programme. I've noted CST-1 using vertical bar patterns lately both in the early morning and late evening just after programme close. If you see a late evening programme close with a waving flag this is likely to CST-1 on ch. R1, 2.

### *The Year of ATS-6*

The year 1976 was a good one for Sporadic E and will long be remembered for the incredible periods of Middle Eastern reception in many parts of Western Europe. For others 1976 was the year that introduced a new era in TV reception – that of direct reception from a broadcasting satellite. The ATS-6 satellite was positioned in Equatorial orbit at 35° east longitude (over Lake Victoria) for the SITE experiment. Its height was 36,000km. Following an initial test period, programmes to the Indian sub-continent commenced on August 1st 1975. The output of the 860MHz transmitter was raised from 80W to 160kW e.r.p. (relative to isotropic) via the 30ft diameter high-gain dish aerial, and was beamed on to the Indian sub-continent centred on Nagpur. In addition, 4GHz signals were radiated on a downlink for the main v.h.f. stations to receive, down-convert and re-radiate over the normal v.h.f. channels.

During the preliminary test period over 60% of the Indian villages taking part in the experiment were found to be receiving good signals. Others experienced problems due to erratic electricity supplies etc. Eventually reception was acceptable at over 90% of the sites. Reception was via 10ft parabolic dishes which had an integral low-noise head amplifier and a converter to provide a signal at 70MHz for the receiver itself.

There were doubts as to whether it would be possible to receive anything in Western Europe since the signals would be some 25dB down on the main beam. Dublin University first succeeded however, with signals calculated at around 1.6µV/m field strength, using a 20ft dish. Photographs showed the excellent quality on the monitor screens. Strangely, a wideband u.h.f. amplifier was employed. Given the time to construct a narrowband low-noise amplifier even better reception should have been achieved.

The first news of a DX-TV enthusiast receiving the signals came on Christmas Eve, in a letter from Steve Birkill (Sheffield). He had successfully resolved signals using a 5ft diameter dish and a narrowband head amplifier. This fed an i.f. strip, with f.m. video demodulation by means of an



*An off-screen picture taken by a DX-TV enthusiast in Holland on the final day of the ATS-6 satellite transmissions, showing one of the SITE jeeps used to visit the community receivers. The date shown (1/8/75) was the project's starting date.*

NE561c phase-locked loop i.c. Photographs of initial reception showed some noise, but improvements were made and towards the end of the experimental transmissions reception was excellent.

Steve's success naturally inspired others to try. The problem was eased by the discovery that the right-hand, circularly polarised transmissions from the satellite could best be resolved using a straight plane polarised dipole 5° off vertical. Ian Beckett subsequently succeeded, using a folded dipole facing into a 5ft dish. Improvement was then made by using a Jaybeam Parabeam Group C/D dipole/reflector assembly in place of the dipole. Others adopted this approach and generally anyone who went to the trouble of making a dish was rewarded with signals of sorts.

The results achieved depended on the accuracy of aerial construction, geographical location and the type of demodulation used. It was found that signals could be locked using a conventional receiver with a.m. vision detection, the quality depending on the receiver make and the demodulator design. Many found that a good signal could be resolved in this way but with reversed video, and that by tuning away from the reverse-video locked position the video tended to change to normal but with a considerable increase in noise.

Head amplification is essential, the use of the lowest noise amplifier possible paying dividends in the quality of the signal resolved. A dish assembly is advisable because of its high gain – a 5ft dish will give a gain of 25dB, particularly if a folded dipole is used. With a home constructed dish a folded dipole has the advantage of easier alignment, particularly if the dish surface has irregularities (I found it difficult to achieve a smooth surface using ¼in. mesh!). It seems unlikely that we shall have the opportunity to receive satellite transmissions again at such low frequencies, the 12GHz band having been allocated for this application. The USSR Stations T satellite, designed to bring television programmes to the Russian far north, will operate at 714MHz however. It's just over the horizon in the UK – but you never know!

As it draws to a close, I feel that 1976 has been a most remarkable year. For those who participated in the new field of satellite reception it was an experience, excitement and an achievement. Our thanks are due to those enthusiasts who proved that it was possible.

# VIDEO EFFECTS UNIT

## Black/White Video Signal Slicer

E. A. Parr, B.Sc., C.Eng., M.I.E.E.

THIS unit is a good example of a project that started off as one thing and ended up as something rather different. It was originally designed for an application in which a computer was to be used to identify objects via a TV camera. To do this it is necessary to code the TV picture into a binary form (in this case black or white) which the computer can understand. The simplest way of doing this is to use a simple signal level switch, calling the input above a preset level white and that below it black. The computer is then presented with a matrix of black and white dots which it can analyse and (fingers crossed) recognise.

The circuit to be described was built to do the level switching, the resultant binary output to the computer also being reassembled back into video form so that one could monitor the black/white picture the computer was seeing. To my surprise the resulting picture was very dramatic, looking rather like a pen and ink drawing.

After experimenting with the unit it was found that the logic outputs could be used with the video effects generator (see *Television*, April/May 1976) to give a form of keying.

Shortly afterwards the computer project was dropped

and I found myself left with an interesting toy! Such is the lot of an engineer.

### Circuit Description

As mentioned above, the circuit is basically a level switch which looks at a video signal. All above a preset level is deemed "white" and all below it "black". The resulting binary signals then have sync pulses added in order to give a composite video output.

The circuit is shown on Fig. 1. The incoming video first goes to SW1. This switch allows the video to pass without modification (for setting up and focusing) or to be terminated and passed to the circuit.

TR1 is a buffer stage feeding a d.c. clamp comprising C2, D1, D2 and R4. This clamps the video so that the bottom of the sync pulse sits at about 4.2V regardless of video content.

The clamped video is fed via TR2 to pin 4 of IC1, a type 710 comparator. This compares the video level with the

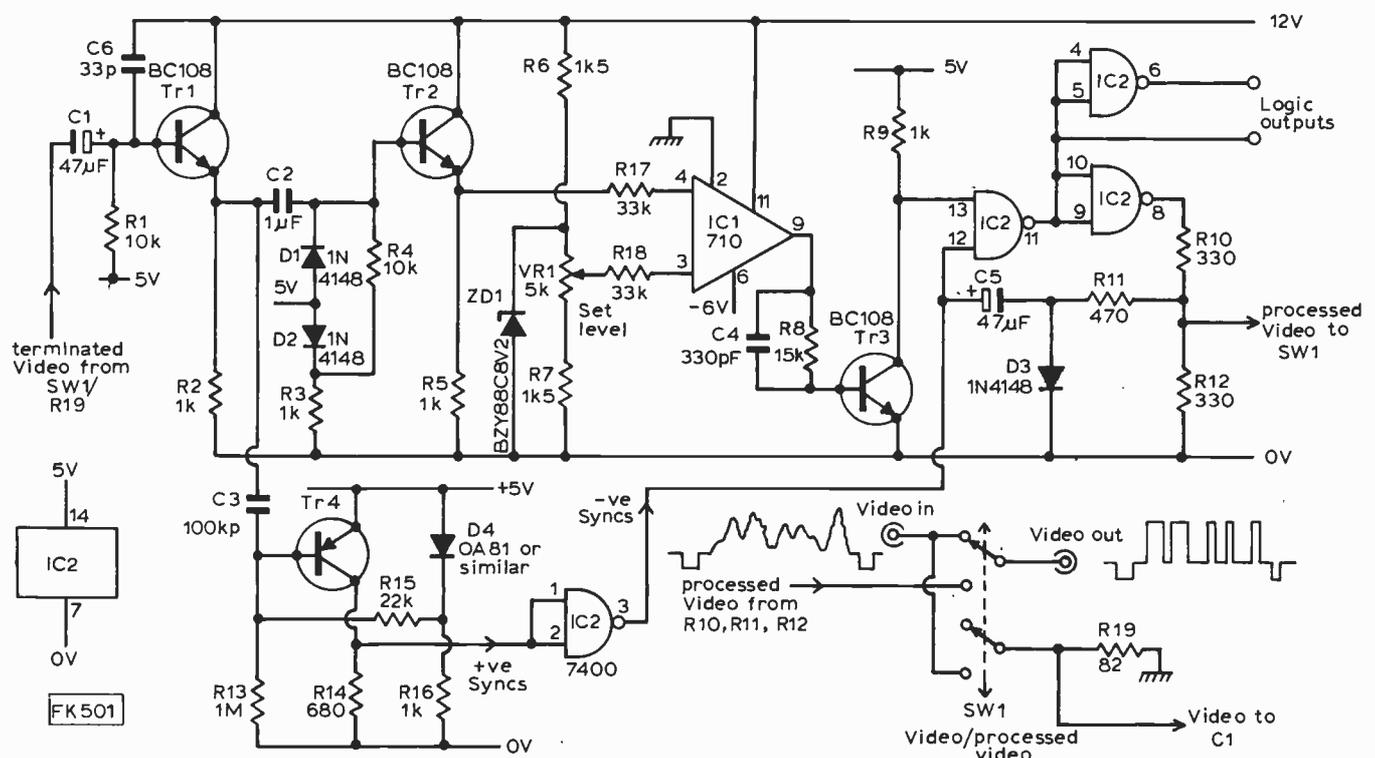


Fig. 1: Circuit of the slicing, logic and sync sections of the unit. Tr4 is type 2N3702 or equivalent.

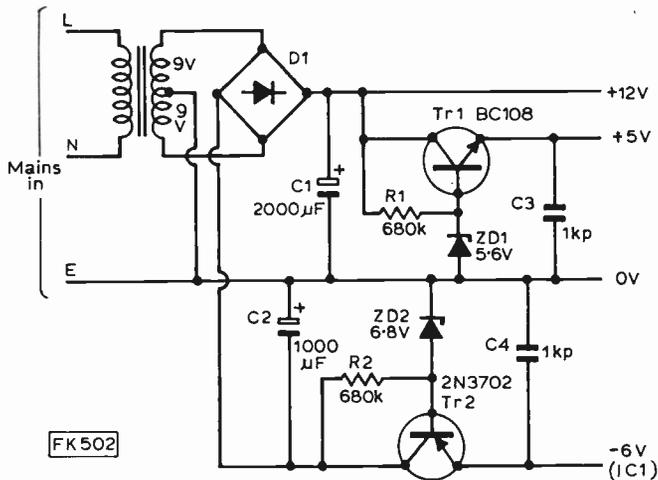


Fig. 2: The power supply circuit.

preset voltage level at VR1: its output falls to 0V if pin 4 is more positive than pin 3, and is about 3.5V if pin 4 is more negative than pin 3. VR1 sets the trigger point therefore, and with the values shown it can accept video signals up to 3V peak-to-peak. ZD1 stabilises the supply to VR1 as the 12V supply is unregulated. The output of IC1 is inverted by TR3 prior to mixing with the sync pulses.

TR4 forms a sync separator. This is identical to the sync separator used in the *Television* video effects unit. Negative-going mixed line and field syncs appear at pin 3 of IC2. The binary video and the syncs are mixed by C5 and R10-R12. This gives a 2V peak-to-peak video signal at 75Ω (i.e. 1V peak-to-peak into a 75Ω line).

Fig. 2 shows the circuit of the power supply. The 710 comparator i.c. is one of the most awkward devices to power, requiring a positive supply of around 10V and a negative supply of around 6V. The power supply provides an unregulated 12V line with two simple series regulators giving +5V and -6V.

### Construction

The unit was built on RS Components i.c. stripboard (available from Doram Electronics Ltd., PO Box TR8,

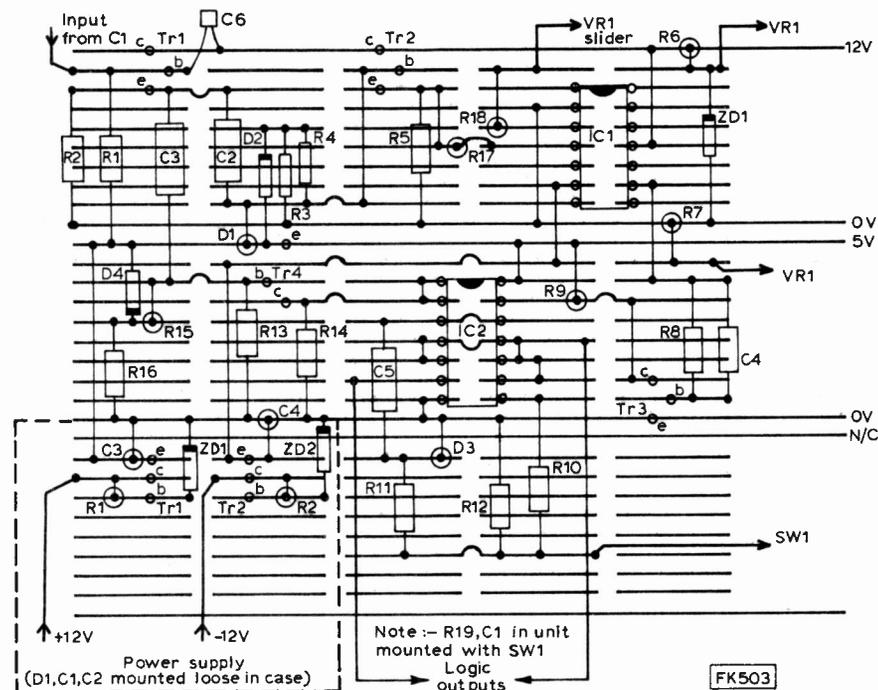


Fig. 3: Layout of the unit on stripboard.

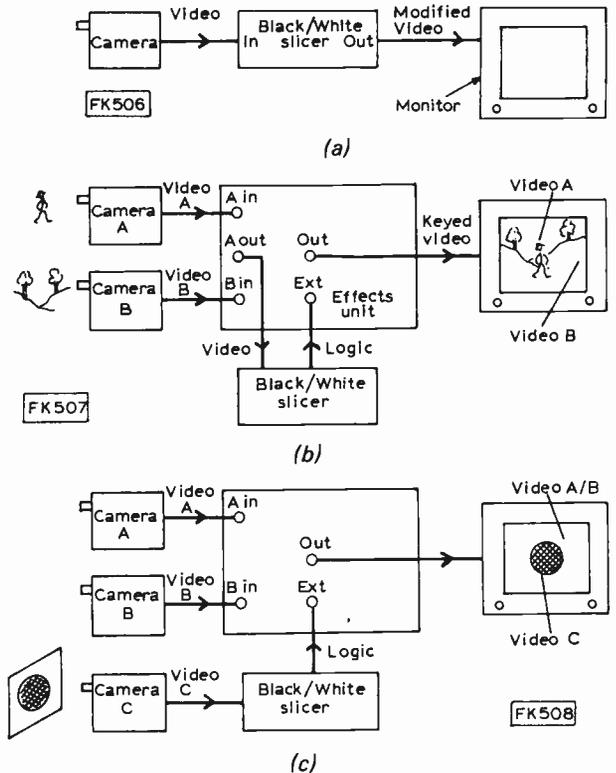


Fig. 4: Methods of using the unit. (a) As simple black/white slicer; (b) keying with effects unit and two cameras; (c) with a third camera to gate specific shapes into a picture.

Leeds LS12 2UF). The layout is shown in Fig. 3. Note that the two series regulators are also on the board.

### Use

Fig. 4 shows how the unit may be connected for various applications. It will work with any video signal from 1V to 3V peak-to-peak. Signals much above 3V peak-to-peak get IC1 a little worried. Regardless of input level, the output is always 1V peak-to-peak into 75Ω. The simple black-and-white case is shown first, in Fig. 4(a): VR1 is adjusted to

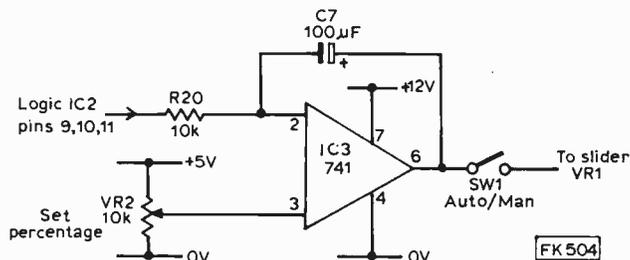


Fig. 5: Use of an additional i.c. to give automatic level setting. VR2 sets the black/white ratio: clockwise rotation gives more white, anticlockwise rotation more black, with 50:50 black/white when the potentiometer is set at the centre of its range.

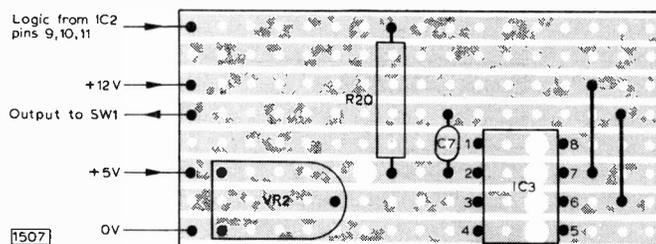


Fig. 6: Layout of the automatic level setting circuit on Vero-board. The 741 i.c. is available in various packages. This layout is for the widely available 8-pin d.i.l. pack.

give the best effect. The background should be kept evenly illuminated as shadows tend to come out as odd looking blobs.

### Keying and Gating

Keying is shown in Fig. 4(b). Here the logic outputs are used and the effects unit is set with the switch in the external position. The logic pulses now control the switching of the signals in the effects unit. Lighting is very important if keying is to be tried. An evenly illuminated (or matt black) background is essential. Similarly there should be no side shadows on the object doing the keying. Dramatic ghostly effects occur if the keying is not complete (as often seen on "Top of the Pops").

Finally, Fig. 4(c) shows how the unit may be used with a third camera to gate specific shapes into a picture. The shape is drawn with matt black and white paint, and the video from the third camera gives the necessary gating information to the effects unit. With this arrangement gating can be done with shapes not normally available on the effects unit.

### Automatic Level Setting

With the addition of one further i.c. the unit can be made to set its own trigger point. The logic output at pins 9, 10 and 11 of IC2 is at 0 for white and 1 for black. Logic 1 corresponds to approximately 3.5V, and logic 0 to about 0.2V.

If we take the mean of the logic output over one complete picture it will vary between about 0.5V and 3.5V according to the amount of black and white in the picture. By comparing this mean voltage with a voltage corresponding to the desired black/white ratio we can produce an error voltage which can control the trigger level voltage.

The circuit to perform this operation is shown in Fig. 5. IC3 is a 741 operational amplifier. R20 is connected to pins 9, 10 and 11 of IC2 (the logic output). VR2 sets the desired black/white ratio. The 741 is connected as an integrator by means of C7, and its output is the integral of the error

between the setting of VR2 and the black/white ratio from IC2. The output from IC3 is then taken straight as the trigger level voltage to R18. This is switched to allow automatic or manual control.

Operation is as follows. Suppose VR2 is set for equal black/white and the trigger voltage is correct. The scene now changes and there is too much black. The output of IC2 will be predominantly at 1 and the output from IC3 will start to fall. This falling trigger level increases the amount of white. When the output from IC3 is such that the black/white ratio is correct there will be no error and the output from IC3 will be constant. Similarly if there is too much white the output from IC3 will rise until the correct ratio is restored. VR2 can be set for any desired ratio. On the prototype it is a preset but it could be a front panel control if desired.

The response of the circuit is set by C7 at about one second. This could be made quicker if desired (down to correcting line-by-line), but a slow response means that the circuit does not react to flashing lights, etc.

### Afterthoughts

Just after the unit was built I encountered the LM319. This performs the same function as the 710 but requires only one supply rail. I have not tried the device, but it should give the same results as the 710 with the advantage of a lower power supply cost.

Although the project for computer identification of objects has been dropped, I am still interested in the subject and would be very pleased to hear from anyone who has done any work in this field. ■

## LETTER

### SURFACE ACOUSTIC WAVE IF FILTERS - PLESSEY'S ANSWER

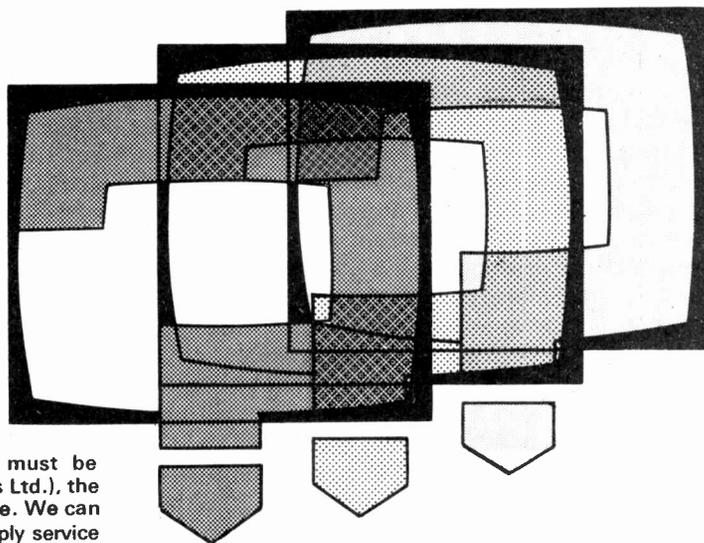
Following your article on Surface Acoustic Wave Filters (*Television* October 1976) there is one point I would like to take you up on.

It was said that SAW i.f. devices were not yet being used in production chassis and are, at present, not economically competitive. This is untrue. Several large television set manufacturers have now proved them to be economically viable in both pre-production and production quantities, and when all the costs associated with a bandpass filter/trap arrangement using discrete components are taken into account considerable savings are achieved.

For the past year three large European manufacturers have been producing sets using SW170 SAWFs, and at least three UK manufacturers now have chassis with SW150s designed in - one of these chassis is already in production and the other two are planned to start production shortly.

Our sales figures for different areas for the last three months prove that Plessey Semiconductors have well and truly passed the stage where SAWFs are being supplied on a sample basis - USA 500,000 devices; Europe 200,000 devices; UK 50,000 devices. With these levels already achieved it is obvious that a second source is necessary and indeed should be available early in 1977. It should not be all that long before *Servicing Television Receivers* will be featuring chassis that use SAWFs! **A. G. Hudd, Marketing Manager, Consumer, Plessey Semiconductors.**

# Your PROBLEMS solved



Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 163 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

## HMV 2701

Before the raster disappeared the picture would fade and become defocused every couple of seconds. On examination, the fusible resistor R1 on the power supply board was found to be open-circuit. This is in series with the h.t. supply to the e.h.t. generator transistor VT7. On turning the hold control the line oscillator could be heard to be working. VT7 was replaced therefore, along with VT6 which controls its h.t. supply, but still no raster. These two transistors and their heatsinks are hot and there is no 8kV pulse from the e.h.t. transformer. Do you think the tripler is faulty?

Disconnect the tripler input lead (plug/socket 12) from the e.h.t. transformer. If this restores the 8kV pulse the tripler is faulty. If not, suspect the e.h.t. transformer of having shorting turns. (Thorn 2000 chassis.)

## PYE TV99

This set worked perfectly on both mains and battery, but the vision then suddenly disappeared. The raster is o.k., but the sound is noisy, as if off tune.

Bias is applied to the detector circuit from the 25V "+4" line which is derived from the line output stage. Check that this voltage is present and correct. If so, check the voltages throughout the i.f. strip and in the video channel. Check the tuner a.g.c. voltage at M6. This should be 7.4V. If satisfactory the tuner could be faulty. If incorrect check the BC148 tuner a.g.c. delay transistor TS408. Also check that the i.f. a.g.c. voltage at M5 is correct at 4.7V. If incorrect suspect the BC147 a.g.c. transistor TS412. (Philips T4 chassis.)

## PHILIPS N1500 VCR

I have tried two of these machines on several sets and in each case have noticed a loss of line sync at the bottom of the picture – on test card this occurs in the bottom castellation area. Is this normal, and if so can the loss of line sync be moved into the field flyback period?

This horizontal band is known as the "heads gap" period and is the interval between one head leaving the tape and the other head joining it. While the gap can be moved down by slow and careful adjustment of R223 we do not recommend this since there is a danger of upsetting the field sync pulses. It would be better to slightly increase the setting of the receiver's height control.

## DECCA CS2633

The problem is colour balance. At times the colour is perfect from switch on, but at other times there is a predominance of green with whites appearing yellow and there are no greys or blacks.

Turn the colour control fully down to check that the monochrome picture is also affected. Concentrate on the RGB stages between the MC1327 demodulator i.c. and the c.r.t. cathodes. To assist in identifying which channel is at fault, switch off the guns by pulling the c.r.t. leads from the decoder panel. When you have decided which channel is at fault check the two transistors and the two miniature presets (drive and balance) in the circuit. The 10k $\Omega$  load resistors are also suspect. (Decca 30 series chassis.)

## BUSH TV105

The picture appears broken up when the set is switched on from cold. Slight adjustment of the line hold control corrects this, but when the set has warmed up the picture starts to roll. This can be stopped by adjusting the field hold control, but after a few more minutes the rolling starts again along with pulling to the right. The video, sync and line and field generator valves have been replaced without improving matters.

If you look on the upper left side panel you will find two large resistors. Normally the second one, which should be coloured orange, orange, orange (33k $\Omega$ ) will be found discoloured, indicating overheating. Change this resistor, which is used to stabilise the video output pentode's cathode bias voltage at 3.3V. No other action should be necessary.

## KB CK500

The problem with this set seems to be corona discharge – a jagged vertical band on the left-hand side of the screen. The picture itself is otherwise o.k. The colour to the right of the band is correct but to the left it is as if one of the primary colours is missing – lacking in red – while the band itself is red. The line output stage has been very carefully checked and new valves fitted but everything seems to be in order.

This fault should disappear when the colour is turned off, eliminating corona discharge as a cause. There seems to be something wrong with the PAL switch and we suggest you replace the 47pF bistable cross-coupling capacitors C220 and C225 (top of the decoder board) with 68pF types. (ITT CVC5 chassis.)

## ULTRA 6713

Once or twice every hour, or maybe longer, the raster goes intermittently green for 1-10 seconds. This appears on top of the normal colour picture. Sound and picture are normal at all other times. Reducing the brilliance control setting still leaves the green raster, as does reducing the colour control setting. The fault also occurs on monochrome. Vibration, or the length of time the set is on, have no effect on the fault and I've tried looking for dry-joints in the green drive circuit without finding anything here amiss. I suspect the colour demodulator/matrixing i.c. but the trouble is so intermittent that I can't pin it down.

There are three leads from the c.r.t. base to the signal panel. Interchange the red and green ones and if necessary set up the grey scale. Watch in monochrome (colour turned off). If the fault still comes up in green, monitor the green first anode voltage. No change here or a drop in the voltage indicates a faulty c.r.t. If the fault now comes up in red however, suspect the green (now driving the red gun) output transistor VT119, the green drive potentiometer R216 or, as you suggest, the demodulator i.c. (IC3). The fault can be further pinpointed if necessary by interchanging leads to pins 1 and 2 (red and green outputs) of IC3 (watch in monochrome). (Thorn 8500 chassis.)

## BUSH TV128U

The set works normally on 405 lines but when switched to 625 lines the picture and sound fade out after some minutes, with a hissing noise as though off signal. On repressing the u.h.f. tuner button both picture and sound reappear for half an hour or more. Both valves in the u.h.f. tuner have been replaced.

There is almost certainly a dry-joint in the tuner. Resolder all suspects or disturb each with a plastic tool to see which is causing the effect.

## HMV 2715

The trouble is intermittent loss of colour. Switching the set on and off restores the colour, sometimes for only a minute or so but at other times for hours.

The symptoms suggest failure of the reference oscillator section of the decoder. A lazy reference oscillator transistor VT304 (BF194) is often responsible. Otherwise check the voltages on transistors VT301 through to VT307 under the fault condition, and the PAL switch diodes W309/W310 which also generate the colour turn-on bias. (Thorn 3500 chassis.)

## DEFIANT 901

The fault on this set consists of foldover at the left-hand vertical edge of the screen. On change of picture format this foldover often moves to the centre of the screen, causing the picture to break up. The fault is present on both systems. By changing station or adjusting the hold controls the break up can be corrected but the foldover persists.

The trouble is due to inaccurate line phasing. This should direct attention to the reference pulse feedback from the line output transformer to the flywheel line sync discriminator circuit. Check the resistor (3R2 or R32 depending on circuit drawing) in this feed line: it should be 47k $\Omega$ . If this is in order you will have to check the associated components, including the discriminator diodes and the PCF80 line oscillator and its associated components. (Bush TV141 series.)

## STELLA ST2133A

The sound is very distorted on 625 lines though it's o.k. on 405. The quality improves after the set has been operating for some time but never becomes as distinct as on 405. Background hum is also present at this stage on 625. The two sound i.f. valves and the audio amplifier/output valve have all been changed and the voltages in these stages are correct.

The trouble is due to misalignment of the f.m. sound discriminator circuit. Set the ratio detector balance control R228 to midway and very carefully adjust the cores, which are sealed with red wax. They are very coarse threaded and any real pressure will "lose" them. Only slight adjustment is required. These components are on the extreme top left of the panel. Do not adjust any of the other cores. (Philips 170 series chassis.)

## KB KV017

Normally the picture and sound are good. Now and again however the contrast automatically increases, resulting in a very black and unstable picture accompanied by hum. After a minute or so the set returns to normal. The manual contrast control operates correctly. The set is used on 625 lines only.

First check the a.g.c. clamp diode D9, type M1, by substitution; then check the coupling capacitor C44 (120pF) between the two vision i.f. valves; finally check the first of these valves (V5, EF183). Too high a setting of the contrast control on this model can cause intermittent a.g.c. lock-out. (ITT VC4 chassis.)

## ULTRA 6713

There is intermittent sound on this set. When the sound goes off, gentle pressure on the lower part of the board restores it. Resoldering the joints in the region of R165 has not improved matters. Where do you consider the dry-joint is likely to be?

We have known dry-joints inside the sound detector can on this chassis. Investigate this, and the joints between the can and the printed circuit board. Patience is often required in tracking down this type of fault. Check that the sound plug and socket on the i.f. board is making good contact. (Thorn 3500 chassis.)

## ITT CK702

Is it possible to remove the colour fringing effect which moves across fine bar and mesh patterns?

This cross-colour effect is inherent in the transmission system and is experienced on all colour sets. We cannot suggest any modification which would improve the condition.

## MARCONIPHONE 4816

The sound on this portable set goes off about 8-10 seconds after the set has been switched on. Turning the volume up or down after the sound has gone off gives sound-on-vision. For the first 8-10 seconds however the set works correctly.

First make sure that the 25V rail – measure it across C35 – does not alter. Then check that 12V reaches pin 11 of the intercarrier sound i.c. Check that the insulation resistance of the two 0.1 $\mu$ F decoupling capacitors C55 and C57 associated with this i.c. is good. Then if necessary replace the i.c. (Thorn 1590 chassis.)

## MURPHY CV1916S

The problem is vision-on-sound on all channels. On initially switching the set on this can be tuned out leaving a good picture, but after about half an hour it gradually reappears until the only way in which it can be eliminated is to retune to a position which gives slight patterning on the picture. I have tried adjusting the coils associated with the intercarrier sound i.c. on the A809 i.f. panel.

The i.c. provides amplification and limiting only, demodulation being carried out by a slope detector circuit at its output. Unfortunately the slope detector is rather prone to this trouble. We suggest you replace 2C70 (33 $\mu$ F) which decouples the supply to the TAA350 i.c., and the OA90 slope detector diode 2D7. Ideally this should be followed by alignment of the intercarrier circuits as specified in the manual, using a sweep generator. It's remotely possible that the i.c. is faulty. (Rank A823 chassis.)



Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

A Pye colour receiver fitted with the 691 chassis would work normally for several hours and then suddenly develop the symptom of changes in brightness level at irregular intervals. Sometimes the brightness would drop by almost 50%, and then hold at that level for several minutes before jumping back to normal level. During such a drop in brightness, the brightness control was advanced and it was found that this restored the correct brightness level with no apparent alteration to the grey-scale tracking or colour balance. It was noted however that in this condition very faint and widely-spaced diagonal lines could be seen on the display.

A tube fault or trouble in the luminance output stage or associated circuits was considered to be a good possibility. The receiver is a hybrid type, with a PL802 luminance

output pentode. This was changed but the fault remained exactly as before. Before considering the tube it was decided to make a few voltage measurements in and around the luminance output stage. The luminance signal is applied to the control grid of the PL802 from the contrast control slider, the coupling being via a 0.22 $\mu$ F capacitor (C39). To eliminate the possibility of this capacitor having poor insulation and thus affecting the PL802 biasing, a replacement was fitted. This made no difference however.

A high-resistance meter connected to the PL802's anode circuit – at the junction of the peaking coil and the load resistor, with the other connection to chassis – revealed that the voltage rose slightly when the brightness level fell. But no fault could be found in the anode circuit components.

The cathode circuit was next investigated. The valve's cathode is returned to chassis via a BC147 transistor which provides flyback blanking. During the forward line scan it is biased on by a supply obtained from the h.t. line. In view of the faint diagonal (field flyback) lines present during the fault condition it was decided that this transistor must be at fault. But replacement, again, failed to provide a cure.

What was the most likely cause of the trouble and which part of the circuit needed more detailed investigation before this could be exposed? See next month's Television for the answer and for a further item in the Test Case series.

### SOLUTION TO TEST CASE 168

(Page 106 last month)

Because the red raster appeared to be affected by hum or pick up of some other spurious signal, the technician investigating last month's problem on a Grundig Model 717GB decided first to check the potentials on the three tube control grids. Noting a lack of voltage on the red one, and also that the display was modified when the meter was connected to this grid, a continuity check was made back to the red grid feed from the clamping circuit.

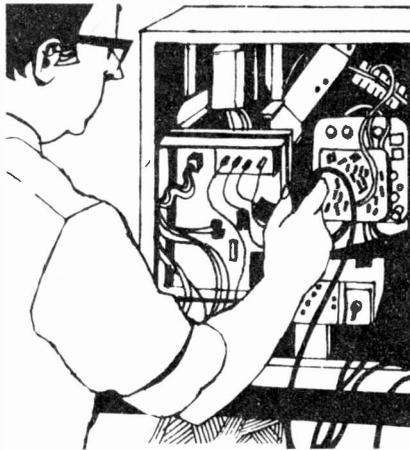
The trouble was found to be caused by an intermittent connection to the 1k $\Omega$  flashover protection resistor in series between the red grid lead to the tube and the colour-difference output stage. In this condition the grid was "floating" and responding to external influences which affected the red beam current. To be on the safe side the 1k $\Omega$  resistor was replaced and the soldering around the suspect area reprocessed. Since then the receiver has continued its excellent performance record.

A similar effect can result from poor connection between a tube grid pin and the corresponding tube base socket – a source which can be easily overlooked.

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TELEVISION JAN. 1977



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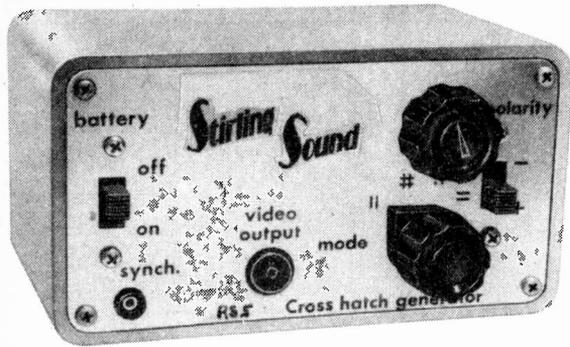
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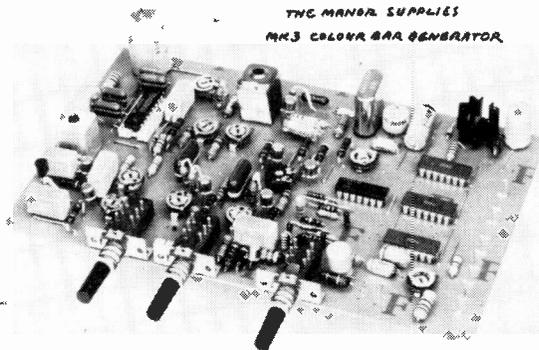
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BRC Colour 8500	75p
Phillips G8	50p
Phillips 210 (with link)	55p
Phillips 210	65p
RRI Mono 141	75p
RRI Mono 161	80p
GEC 27840	75p
GEC 2000	75p
Phillips G9	35p

**THYRISTORS**

2N4443	1.20
TV106	1.80
BR101	45p
BRY39	45p
BR100	35p

**Bridge Rectifiers**

BY164	50p
BY179	65p

**High Voltage**

TV20	1.90 each
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**DIODES**

AA113 14p	OA81 11p	BA100 14p	BA164 17p
AA116 14p	OA85 11p	BA102 24p	BAX13 5p
AA117 14p	OA90 6p	BA130 35p	BAX16 6p
AA119 8p	OA91 6p	BA145 16p	BAY38 10p
OA47 6p	OA95 6p	BA148 16p	IN4148 4p
OA79 6p	OA202 11p	BA154 12p	BY206 30p
		BA155 15p	

**RECTIFIERS**

BY100 21p	IN4001 4p	<b>TUNER</b>
BY126 15p	IN4002 5p	ELC1043/05
BY127 15p	IN4003 6p	4.50 each
BY133 22p	IN4004 7p	
BY182 2.00	IN4005 8p	<b>CRYSTAL</b>
BY238 40p	IN4006 9p	4.43 MHz
BYX10 14p	IN4007 10p	1.90 each

**INTEGRATED CIRCUITS**

MC1307P	1.50	MC1310P	2.50
TAA350	1.90	SN76003ND	1.70
TAA550	50p	SN76013N	1.80
TAA630S	4.00	SN76013N07	1.80
TBA120S	1.50	SN76013ND	1.60
TBA120SQ	1.50	SN76023N	1.85
TBA520Q	3.00	SN76023ND	1.60
TBA530Q	2.50	SN76033N	2.75
TBA540Q	3.00	SN76665N	2.50
TBA550Q	4.00	CA3065	2.50
TBA560CQ	4.00	MC1358P	2.50
TBA750Q	2.20	MC1327P	2.00
TBA800	1.60	MC1327PQ	2.50
TBA920Q	4.00	MC1330P	1.50
TBA990Q	4.00	MC1351P	1.20
SN76003N	2.75	MC1352P	1.60

**REPLACEMENT COMPONENTS**

BRC 3500 Cutouts	1.60 each
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**VALVES**

DY86/87 50p	PCF80 50p	PL36 90p
DY802 50p	PCF86 50p	PL84 50p
ECC82 50p	PCF801 60p	PL504 1.20
EF80 45p	PCF802 75p	PL508 1.20
EF183 46p	PCL82 75p	PL509 3.00
EF184 46p	PCL84 80p	PL519 3.00
EH90 90p	PCL85 75p	PY500A 1.90
PCC89 60p	PCL86 75p	PY800 65p
PCC189 60p	PFL200 85p	

**EHT TRIPLERS**

BRC950	2.40	Pye CT205	5.00
BRC1400	2.40	PYE731	7.50
BRC1500(17")	2.40	Decca2030	6.00
BRC1500(24")	2.75	GEC2028	6.50
BRC3500	6.00	GEC2110	7.00
BRC8000	2.60	ITTCVC5	6.00
BRC8500	5.00	RRI1111/174	9.00
BRC9000	7.00	RRI A823	7.00
Decca CS190	6.50	Korting 90°	6.50
Phillips L8	6.60	Tanberg	6.50

**TRANSISTORS**

AF179 55p	BC182L 10p	BD138 49p	BF257 48p
AC107 33p	BC182LB 10p	BD139 80p	BF258 65p
AC126 23p	BC183L 10p	BD144 2.10	BF271 15p
AC127 30p	BC183LB 10p	BD155 74p	BF273 15p
AC12701 50p	BC184L 10p	BD157 74p	BF274 15p
AC128 23p	BC186 24p	BD183 55p	BF336 34p
AC12801 50p	BC187 26p	BD235 74p	BF337 34p
AC141 24p	BC203 15p	BD237 74p	BF338 34p
AC141K 40p	BC204 15p	BD238 74p	BF458 59p
AC142 24p	BC205 15p	BDX32 2.50	BFX29 29p
AC142K 25p	BC206 15p	BF115 19p	BFX84 24p
AC153 23p	BC207 15p	BF118 25p	BFX85 25p
AC176 24p	BC208 11p	BF121 24p	BFX88 23p
AC17601 50p	BC209 15p	BF152 30p	BFX89 30p
AC187 23p	BC212L 11p	BF154 30p	BFY50 22p
AC187K 24p	BC213L 11p	BF157 30p	BFY51 22p
AC188 24p	BC214L 11p	BF158 24p	BFY52 22p
AC188K 40p	BC225 15p	BF163 24p	BU105/01 1.90
AC193K 29p	BC237 15p	BF167 24p	BU105/02 1.90
AC194K 31p	BC238 11p	BF173 24p	BU105/04 2.50
AD140 45p	BC251A 16p	BF177 29p	BU108 3.00
AD142 50p	BC301 32p	BF178 32p	BU126 2.90
AD143 50p	BC303 59p	BF179 32p	BU204 1.90
AD145 50p	BC307 11p	BF180 34p	BU205 1.90
AD149 1.00	BC308 9p	BF181 32p	BU206 1.90
AD161 45p	BC327 12p	BF182 43p	BU208 3.00
AD162 45p	BC328 12p	BF183 43p	MJE340 65p
AF114 50p	BC337 15p	BF184 25p	MJE520 80p
AF115 23p	BC547 12p	BF185 25p	MJE2955 1.10
AF116 23p	BD115 64p	BF194 14p	MJE3055 73p
AF117 19p	BD116 60p	BF195 14p	MPSU05 65p
AF118 48p	BD124 79p	BF196 14p	MPSU55 1.25
AF121 30p	BD131 44p	BF197 14p	R2008B 2.00
AF124 23p	BD132 49p	BF198 19p	R2009 2.00
AF125 23p	BD133 49p	BF199 24p	R2010B 2.00
AF126 23p	BD134 49p	BF200 34p	TIP31A 60p
AF127 23p	BD135 39p	BF240 19p	TIP32A 60p
AF139 34p	BD136 45p	BF241 21p	
AF178 53p	BD137 47p	BF256LC 44p	