TELEVISION

20p

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JANUARY 1974

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TV86	TV141
	TV145
TV91	TV148
TV92	TV161
TV93	TV165
TV94	TV166
TV95 or C	•TV171
TV96 or C	TV175
TV97	TV176
TV98C	TV178
TV99 or C	181S
TV100C	183
TV101C	183D
TV102C	183S
TV103 or D	183SS
TV105 or D or R	185S
TV106	186
TV107	186D
TV108	186S
TV109	186SS
TV112C	191S
TV113	191D
TV115 or C or R	1935
TV118	193D
TV123	
TV124	

From model TV123 to TV139 there have been two types of transformer fitted. One has pitch overwind, the other has plastic moulded overwind.
Please state which type required as they are not interchangeable.

BAIRD

600	628	662	674
602	630	663	675
604	632	664	676
606	640	665	677
608	642	666	681
610	644	667	682
612	646	668	683
622	648	669	685
624	652	671	687
625	653	672	688
626	661	673	

Please quote part No. normally found on tx. base plate; 4121, 4123, 4140 or 4142.

DECCA

DR20	DR34	DR71	DR505
DR21	DM35	DR95	DR606
DR23	DM36	DR100	666TV-SRG
DR24	DM39C	DR101	777TV-SRG
DR29	DR41	DR121	
DR30	DM45	DR122	MS1700
DM30	DR49C	DR123	MS2000
DR31	DM55	DR202	MS2001
DR32	DM56	DR303	MS2400
DR33	DR61	DR404	MS2401

SOBELL

T24	ST284 or ds	1010dst	1033
SC24	ST285 or ds	1012	1038
TPS173	ST286 or ds	1013	1039
TPS180	ST287 or ds	1014	1047
ST195 or ds	ST288 ds	1018	1048
ST196 or ds	ST290ds	1019	1057
ST197ds	ST291ds	1020	1058
SC270	5T297ds	1021	1063
T278	1000ds	1022	1064
ST282	1002ds	1023	1065
ST283	1005ds	1032	1066

MURPHY

V310	V430	V520	V879 or C•	V789	V2015SS
V310A	V430C	V530	V923•	V153	V2016S
V310AD	V430D	V530C	V929 or L•	V159	V2017S
V310AL	V430K	V530D	V973C•	V173	V2310
V310CA	V440	V539	V979•	V179	V2311C
V320	V440D	V540	V653X	V1910	V2414D
V330 or D	V440K	V540D	V659	V1913	V2415D
V330F or L	V470	V649D	V683	V1914	V2415S
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V410C	V490	V843•	V735	V2014S	V2416D
V410K	V500	V849•	V783	V2015D	V2316S
V420	V510	V873•	V787	V2015S	V2417S
V420K	V519				

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PHILIPS

23TG111a	G19T210	G23T210
23TG113a	G19T211	G23T211
23TG121a	G19T212	G23T212
23TG122a	G19T213	G24T230
23TG131a	G19T214	G24T232
23TG142a	G19T215	G24T236
23TG152a	G20T230	G24T238
23TG153a	G20T232	G24T300
23TG156a	G20T236	G24T301
23TG164a	G20T238	G24T302
23TG170a	G20T300	G24T306
23TG171a	G20T301	G24T307
23TG173a	G20T302	G24T308
23TG175a	G20T306	
23TG176a	G20T307	
23FG632	G20T308	

GEC

2000	2015	2022	2043	2064
2001	2017	2023	2044	2065
2010	2018	2032	2047	2066
2012	2019	2033	2048	2082
2013	2020	2038	2063	2083
2014	2021	2039		

PYE

11u Series
12u
13u — State Pt. No.
14u — required
15u — AL21003 or
20u — 772494

V700 or A or D
V710 or A or D — State Pt. No.
V720 — required—
V830A or D or — 772444 or
LBA — 771935

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1500 24" 5 stick	RT5	£3.90
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1590, 1591	RT17	£1.30

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PYE	691, 692, 693, 697	£6.10
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CTV174D
CTV182S
CTV184S
CTV187CS
CTV194S
CTV197C
CTV199S
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DECCA
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CTV25 " "
Overwind Coil "
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CT109
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CT121 &/T
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CT73
CT78
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CT153
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CV2213	CV2611
CV2214	CV2614

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TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

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ISSUE 279

JANUARY 1974

THE PRICE OF A GUARANTEE

When you have purchased something classified as "durable goods" and carrying some form of manufacturer's guarantee, has it ever occurred to you that perhaps that guarantee is a condition of the purchase? Or had you thought that you, the purchaser, should feel free to opt out of the guarantee if you thought the need to claim under it was so remote?

What we have in the past considered to be our right to protection from manufacturing failure now appears to have been a compulsorily purchased "insurance policy" giving limited liability as soon as the customer signs a printed card and returns it to the manufacturer.

The recent revision of the laws of trading, virtually nullifying manufacturers' guarantees, has caused a considerable stir in the television whole-equipment and spare-parts industry. Setmakers seem to be at variance with each other and undecided as to how the former guarantee rights can best be replaced to suit the new laws. Some say they will cancel all forms of manufacturer's guarantee and offer the customer a cash discount *in lieu:* others that customers can have an optional guarantee which can within reasonable limits be over a period of time of his choice, but that the customer must then purchase the guarantee in addition to the goods.

In our opinion this is tantamount to an insurance policy and is presumably an additional protection to the current laws of guarantee under the Supply of Goods (Implied Terms) Act.

If you choose to "buy" your guarantee how, do you suppose, is it possible to place a fair value on it? Would you necessarily expect to exercise your rights under it? A reasonable person would expect to have faith in the manufacturer's reputation and honesty and assume that either his quality control department is effective or that he will give an automatic replacement guarantee without question in the event of faulty manufacture or a breach of the trading laws. Any other form of guarantee must be of dubious value therefore. The trouble is that the law does not allow for unreasonable deterioration of condition over a period due to either faulty manufacture or design, a loop-hole that needs plugging.

This basically is why some manufacturers have cancelled their guarantees, offering price reductions instead. A neat manoeuvre this to keep out of possibly disputable situations, but in the long term the customer will still find that the price will rise while he loses a little of the protection he once had.

M. A. COLWELL—*Editor*

THIS MONTH

THE NEXT ISSUE DATED FEBRUARY WILL BE PUBLISHED JANUARY 21

TELETOPICS

TV SERVICING: CRUNCH COMING

First some facts. During the last five years the number of people concerned with radio and television servicing has declined by 25 per cent. Next, a survey of jobs and salaries carried out recently by the Society of Electronic and Radio Technicians found that those employed in servicing domestic radio and television equipment are lower paid—by 20-30 per cent—than those employed in similar jobs, e.g. in industrial and electronic maintenance work and in this type of work in HM Services. On top of this bear in mind the colour TV sales boom of the present time, expected to continue for at least another year. What will happen then when the transistors in all those lovely new colour sets start blowing, the capacitors leaking and the resistors burning out? Some sort of crunch is most certainly coming and there doesn't seem to be all that much effort being made to bring this home either to the trade or the public.

Not that it is a problem with an easy answer. The radio and television trade has always been highly competitive. How else could that extraordinary bargain, the colour receiver at around £200-250, be available to the public? When you think of things like houses and cars, which steadily rise in price, it is amazing that a sophisticated piece of equipment like a colour set can sell, thirty-five years later and considering the appalling inflation in between, at less than twice the price of a monochrome TV set before the war! The public has been well served, far too well served probably in this respect. What will happen when it becomes necessary to charge realistically for domestic electronic maintenance, after years of consumer feather bedding? The "throw away" philosophy may apply to small transistor radios: it doesn't to a thing like a colour TV set.

We may sound alarmist, but let us consider some more facts. New sets are not at the moment giving all that much trouble (if you forget the sillies like dry-joints) but the difficulty in obtaining adequate quantities of components to keep the production lines going means that some components being used are not ideally rated from the point of view of long-term reliability. As we know, this sort of thing takes time to show up. And even the best chassis have their weaknesses which become apparent only when hot spots in a chassis, spikey waveforms and hefty gulps of current have had a chance to do their worst. Then, the shortage of service engineers is not unique to this country: one of the largest W. German colour setmakers has been advertising in the trade press recently for servicing engineers to join them from the UK. A further consideration for the future is the growing amount of electronic equipment likely to become a standard feature of the domestic scene: videoplayers, small TV cameras, viewphones, electronic calculators, more elaborate audio equipment (if possible!) and automatic control systems. Who's going to look after them?

H. Potterton, joint managing director of Currys, has suggested a levy on the entire trade's turnover to be used to attract and train service engineers for the future. That one looks a non-starter in an industry notoriously unable to agree on anything whatsoever. Appropriate remuneration and acceptable work conditions are obviously essential if the problem is to be overcome, and the trade is going to have to find a way of providing them. It is ironical that one major setmaker is at present urging that service personnel should take a greater interest in and have a greater say in the overall policy of retail organisations. If it were possible however it could be a major part of the answer, since it could make the whole industry more conscious of the servicing aspect.

RCA's move to enter the consumer service field by setting up a colour service network in the UK is another indication that the problem is not being entirely overlooked.

In whatever way the problem is eventually solved however one thing is clear: the customer will eventually have to pay a realistic charge for the skilled maintenance he expects. The trade has in recent times concentrated on selling what it can lay its hands on in a seller's market. In the immediate future there are two problems: getting the servicing side of the trade organised, and educating the public as to the likely cost.

NEW TRANSMITTERS

Transmissions from the main stations at **Huntshaw Cross** (North Devon) have now started. BBC-1 is on channel 55, IBA (Westward Television programmes) on channel 59 and BBC-2 on channel 62. The maximum e.r.p. is 100kW and the transmissions are horizontally polarised. A group C receiving aerial should be used. In addition the following relay stations are now in operation:

Betws-Y-Coed (North Wales) IBA channel 24, carrying HTV Wales programmes. Receiving aerial group A.

Conway (North Wales) IBA channel 43, carrying HTV Wales programmes. Receiving aerial group B.

Hastings (Sussex) IBA channel 28 carrying Southern programmes. Receiving aerial group A.

These relay transmissions are all vertically polarised.

The IBA comments that the cost of providing a u.h.f. service has risen from about 3p per potential viewer at the time when the service was started at Crystal Palace to the present average of about £1.80 as new stations are brought into operation, and that this figure will rise steeply over the next few years to over £20 per additional potential viewer as the service is extended to the more remote areas.

MOS ICs FOR TV

We hazarded the guess in this column last month that the application of complex m.o.s. integrated circuits for colour TV set use being worked on at ITT's Esslingen Central Applications Laboratory is as a replacement for the glass chrominance delay line. This has now been confirmed and other details of work in this field released. The Laboratory sees the use of m.o.s. i.c.s as the answer to the problem of jitter in videotape recording machines. It also considers that they will make feasible ITT's COM system which is able to transmit up to twelve audio channels in digitally coded form during the field blanking interval. This is similar in principle to the IBA's Oracle and the BBC's Ceefax, but is concerned with audio rather than video information. The received information is stored and then decoded as required and made available during the following field period. The i.c.s would be used to perform the necessary data storage and decoding operations.

DOMESTIC VIDEO PLAYBACK

Magnetic tape looked for a long time to be the most likely means of recording video programmes for home playback: one advantage is the flexibility of tape systems, with a recording facility being easy to add. Nevertheless tape is expensive and it will be cost that determines which system will capture the eventual mass market. The present signs are that disc systems of one sort or another may well have an appreciable advantage in this respect. The Telefunken/Decca TED system was the first to be demonstrated and is due for release on the German market any time: licence agreements have now been entered into with two Japanese concerns, Sanyo and King Record, to produce TED equipment. The great disadvantage, the ten-minute playing time, has yet to be overcome however and nothing has been heard for a considerable while of the long-awaited auto-change version of the player.

The second system to be announced was the Philips VLP (video long-play) system which uses a laser beam to scan metallised video discs. Philips now say that they expect to start marketing the system in both Europe and the US later this year (1974) though they do not anticipate being able to go into full-scale selling on the domestic market until about 1978

In the USA another videodisc system has been announced. Music Corporation of America (MCA) intends to launch its Disco-Vision player in 1975. This will use a laser beam to scan a 12in. Mylar disc giving twenty to forty minutes playing time per side. Technically it appears to be similar to the Philips system. MCA owns Universal Pictures which has an 11,000 title library of films available: this could be a trump card in marketing the system since it seems that whatever system of reproduction is eventually used it must be backed by an organisation able to provide an adequate library of material for home viewing. That at any rate is the idea being put about by the various concerns hoping to get established in this field first: surely, however, once one system can prove itself to be acceptable on technical and economic grounds anyone with a library of copyright material worth viewing, i.e. the various film and broadcasting companies and organisations, will want to join in making their programme material available?

All these announcements of future videodisc developments occur against the background of the news of the difficulties that Cartrivision have had in getting their videocassette system accepted by the US public since its introduction just over a year ago.

NEW SETS

Rank Radio International have now introduced on the market two monochrome sets under the **Dansette** brand name. Model DM6901 is fitted with a 20in. tube and Model DM7104 with a 24in. tube. Recommended prices are £76.50 for the former and £85.95 for the latter, including VAT. Distribution is via wholesalers. The sets are fitted with the A774 chassis which is also used in the Bush/Murphy TV181S/V2016 series (see *Servicing Television Receivers* April/May 1973). A 12in. battery/mains portable, the DM6504, is to be added to the range shortly.

JVC have introduced an 18in. colour model, the 7440GB, at about £250 including tax. Features include the use of a black matrix shadowmask tube (the areas between the phosphor dots are coated black to avoid reflection from the aluminised backing) and a "scene control circuit" which is claimed to give sharp pictures at all brightness levels.

TELENG VIEWPHONE

The accompanying photograph shows the Teleng viewphone in use, hooked up to their two-way cable TV system. The noteworthy feature of this system is that it uses one cable only, i.e. both the transmitted and received signals travel along the same cable. This is done by using the band 54-300MHz for "downstream" signals and 5-30MHz for "upstream" signals, with a guard band of 24MHz between. Teleng is the first company in Europe to have installed and demonstrated two-way vision transmission over a single coaxial cable: the test network which links its two factories in South Ockendon has now been in operation for over fifteen months.

Teleng viewphone in operation with their single-cable two-way TV system.

RENOVATING the RENTALS

19 PHILIPS G6 CHASSIS

CALEB BRADLEY B Sc

DECODER—2

Decoder Setting Up

In this decoder there are clearly a great number of presets which should only be "twiddled" using an oscilloscope and with a clear idea of their functions. The following simple setting-up procedure for the reference oscillator a.p.c. loop will often be adequate and can be used as a starting point for fault diagnosis.

Connect V7008 pin 2 to chassis. With no signal input trim L7651/2 for maximum reference oscillator output, shown by maximum positive voltage (170V approximately) on C7109. Connect the aerial and disable the colour killer by earthing the left-hand side of v.d.r. R7196—see decoder layout Fig. 10. Connect R7618 slider to chassis to disable the a.p.c. loop. Trim L7638 (reactance control) for near-lock (stationary colour on screen). Remove the shorts on V7008, R7618 and R7196. Trim L7624/5/6 for maximum negative voltage (approximately −4V using a high-impedance voltmeter) at V7003 pin 2. Then connect V7003 pin 8 to chassis and adjust R7618 (discriminator balance, inside the can) for 0V across C7102. Remove the short on V7003 and retrim L7638 for exactly 0V if necessary.

Ident Tuning

Having established that the a.p.c. loop is operating correctly there should be stationary colour on the screen, though the R−Y switch may not be correctly phased (green faces). Trim L7634 for maximum a.c. at T7015 collector (can)—an Avo meter on an a.c. voltage range with 0·1μF in series with one probe can be used for this.

A C C Adjustment

Assuming that a colour picture is obtainable set the contrast control normally and the saturation control to maximum. Advance R7179 clockwise (viewed from underneath) until adequate maximum saturation is obtained—if R7179 is advanced "over the top" the colour killer and monochrome relay remove all colour. Adjust R7206 for reasonably consistent colour at different contrast settings.

Colour-Drive Faults

The colour-difference amplifier/clamp stages give various troubles which do not involve loss of all colour content or loss of reference oscillator lock. If one tube gun goes fully on or off suspect first the relevant first anode feed resistor (R1267/8/9 in the convergence box) and then the relevant clamp and its 10MΩ load resistor—especially the latter (R7232/41/49) if the grey-scale drifts badly with warm-up. An intermittent open-circuit joint between a tube grid and the decoder commonly causes the picture to flash "all green" (or red or blue) as the set warms. Grey-scale drifting may also be caused by the following: C1028/9 (0·047μF), R1077 (47kΩ), R1080 (47kΩ) or R1279/80/81 (2MΩ).

Wrong Colours

Ident faults are immediately obvious since the colour killer, not operating from the ident signal in this chassis, does not mask them. Check for a faulty T7015, shorted or mistuned L7634, or C7093 can become intermittent. If the PAL bistable stops, every other line of colour is wrong giving a severe Hanover-like effect. Check the two transistors (T7013/4), X7322, whether the line pulse is being lost in a dry-joint en route, and beware of open-circuit chokes L7576/8 (L7578 was incorrectly shown as L7528 in Fig. 9 last month).

Loss of R−Y or B−Y only points to trouble in one preamplifier or demodulator and d.c. checks will find the trouble. Merely reduced gain in either channel has at various times been traced to C7035, C7038, C7039 or C7041.

No Colour

In cases of no colour the first action must be to tune in a transmission known to be in colour and to disable the colour killer by earthing the left-hand side of R7196. Three main results are possible.

(1) Still no colour. Either chroma amplifier may be faulty (try new valves, make d.c. checks) or the oscillator may be stopped. The crystal (plug-in type) may be intermittent, or suspect R7271, R7281 or R7282 which may have been damaged by a valve short.

(2) Stationary colour on screen. Check why the chroma a.g.c./colour killer arrangement is not working properly and especially the setting of R7179.

(3) Unlocked colour (horizontal coloured bands). Endeavour to set up the a.p.c. loop as previously described. If lock cannot be obtained make d.c. voltage checks around V7001, V7008 and V7009: after this an oscilloscope becomes virtually essential to check whether adequate burst is reaching the demodulators. R7261 (100kΩ) the burst amplifier screen grid feed resistor is a common culprit, so is C7025 (first chroma amplifier circuit) which goes short-circuit and burns out R7140. Faults often occur inside the demodulator can, such as the tiny R7618 disintegrating or diodes going open-circuit. Such faults can become so time consuming to repair that it is often cheaper to replace the whole assembly.

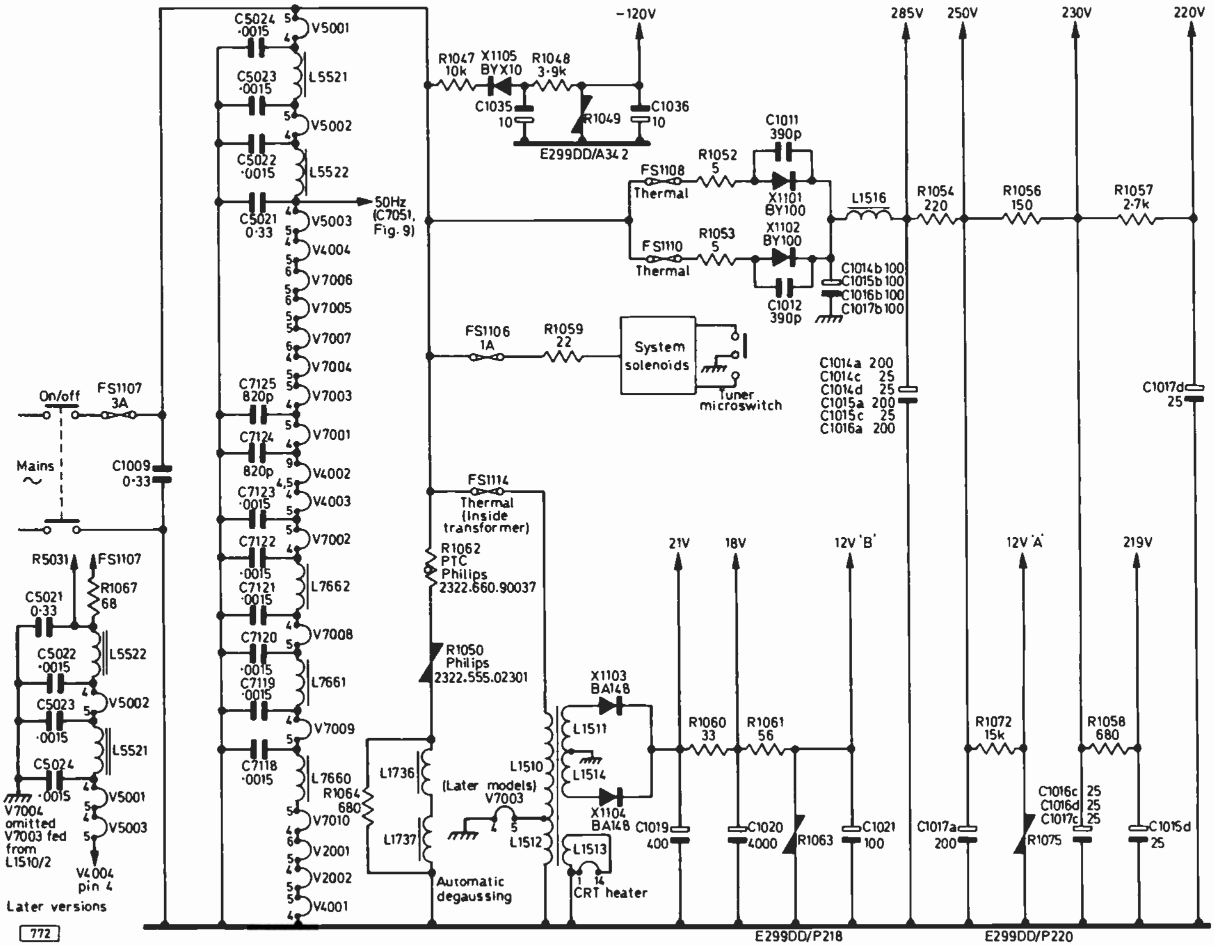


Fig. 12: The heater chain, automatic degaussing and power supply circuits, including modifications. See Fig. 13 opposite for physical layout.

(The coils are identified as part number 3122.108. 67500.)

Power Supplies

The many h.t. rails used throughout the set are identified in Fig. 12 which shows the astonishing number of smoothing capacitors used. On the l.t. side the v.d.r. R1063 which stabilises the 12V "B" supply to the tuner goes short-circuit giving the appearance of a faulty tuner. On the h.t. side there can of course be shorts in many places, the common silly one being C1024 across the horizontal shift control shorting through its sleeve to chassis. Anything like this blows a fuse, the silliest one of all being a short-circuited C1009!

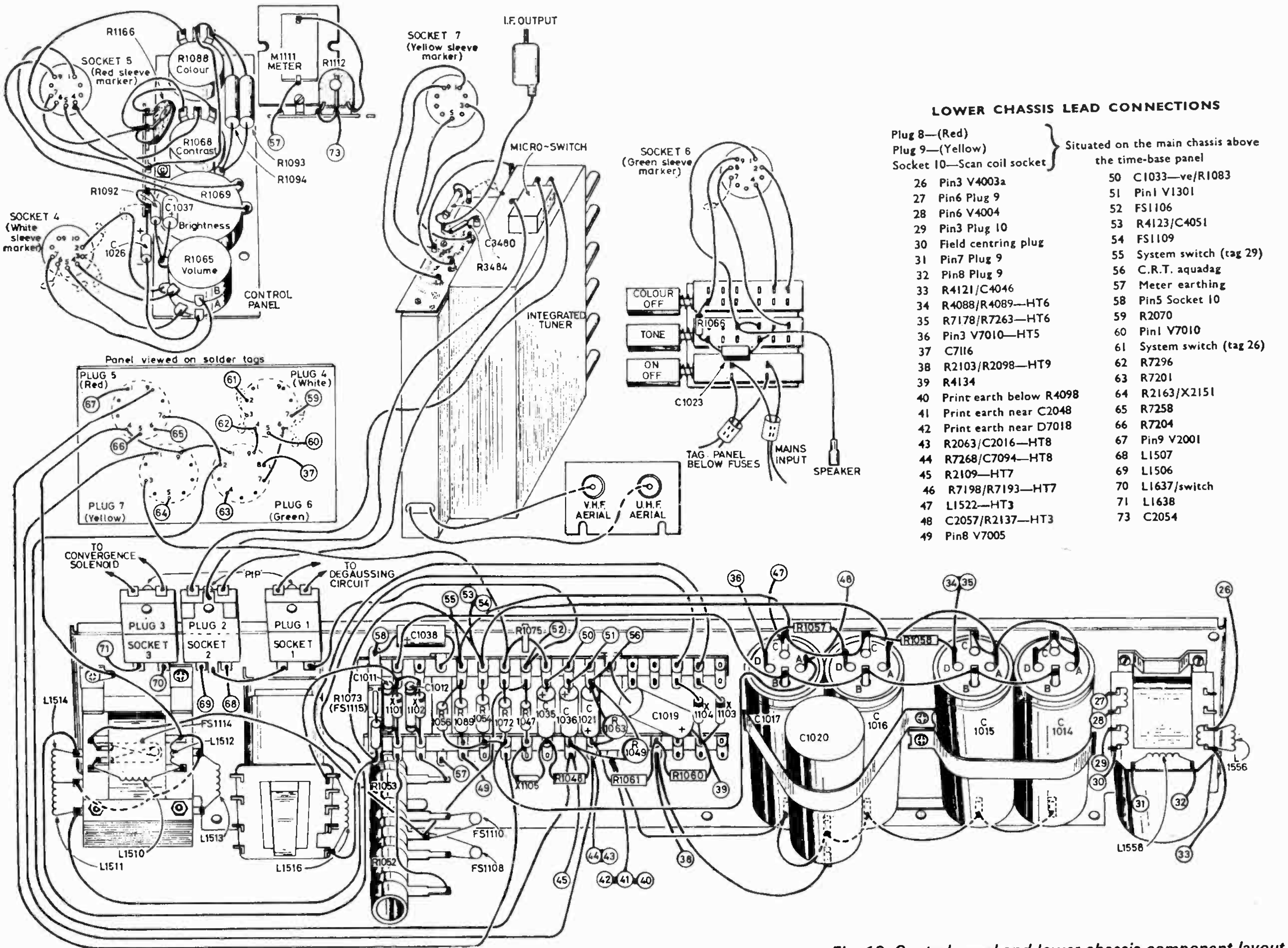
Audio Troubles

The main audio trouble is hum (not intercarrier buzz which is dealt with by trimming the f.m. discriminator) and the usual cause is poor earthing of one or more of the large h.t. smoothing capacitors C1014 to C1017—see Figs. 12 and 13. These capacitors depend on their metal retaining straps for chassis connection and after a time an oxide film builds up between the case and the strap. Merely clouting each case in turn often effects a miraculous cure.

If the speaker is absolutely silent R7288 or R7289 may have been burnt up by a short in one section of V7010. D.c. checks should resolve this fault as well as distortion troubles due to incorrect bias. Much reduced gain can be caused by an open-circuit cathode electrolytic decoupler or by shorting turns in the output transformer about which one can do nothing. Unpleasant scratchiness is caused by a misaligned speaker voice coil.

Dull Picture

A case of a dull picture with watery colours was accompanied by the symptoms of poor e.h.t. regulation—ballooning and a still duller picture when the brightness control was advanced. The boost voltage was well down and the width control at maximum but no faults could be found in the line output stage. Only 0·9V instead of 1·2V was present across the e.h.t. stabiliser triode cathode resistor R5054 however. Readjusting the stabiliser circuit preset R5053 (see page 510, September issue) for correct conditions completely cleared the trouble. Checking that this adjustment is correctly set may therefore save a lot of line output stage testing.



LOWER CHASSIS LEAD CONNECTIONS

Plug 8—(Red)
Plug 9—(Yellow)
Socket 10—Scan coil socket

} Situated on the main chassis above the time-base panel

26	Pin3 V4003a
27	Pin6 Plug 9
28	Pin6 V4004
29	Pin3 Plug 10
30	Field centring plug
31	Pin7 Plug 9
32	Pin8 Plug 9
33	R4121/C4046
34	R4088/R4089—HT6
35	R7178/R7263—HT6
36	Pin3 V7010—HT5
37	C7116
38	R2103/R2098—HT9
39	R4134
40	Print earth below R4098
41	Print earth near C2048
42	Print earth near D7018
43	R2063/C2016—HT8
44	R7268/C7094—HT8
45	R2109—HT7
46	R7198/R7193—HT7
47	L1522—HT3
48	C2057/R2137—HT3
49	Pin8 V7005
50	C1033—ve/R1083
51	Pin1 V1301
52	FS1106
53	R4123/C4051
54	FS1109
55	System switch (tag 29)
56	C.R.T. aquadag
57	Meter earthing
58	Pin5 Socket 10
59	R2070
60	Pin1 V7010
61	System switch (tag 26)
62	R7296
63	R7201
64	R2163/X2151
65	R7258
66	R7204
67	Pin9 V2001
68	L1507
69	L1506
70	L1637/switch
71	L1638
73	C2054

Fig. 13: Control panel and lower chassis component layout.

curing RF INTERFERENCE

BRIAN L.PHILLIPS

A service engineer in the field may occasionally come across a case of interference to a receiver which is responding to a nearby radio transmitter, whether amateur, public service or military. In many of these encounters the trouble can be easily and speedily cured by inserting simply made-up filters in the receiver's aerial lead. The purpose of this article is to explain the best way to tackle some of these awkward jobs.

All radio transmitters can cause interference to nearby radio and TV sets even though there is nothing wrong at the transmitting end. What happens is that the locally powerful transmitter signal enters the receiver via a number of possible ways and then at the least causes patterning on the screen or at the worst "mutes" the receiver completely. Similar effects can occur in audio stages, hi-fi equipment, record players, tape recorders and in fact in any device which uses active devices for amplification. The problems are much worse with transistors and i.c.s than with valves.

First we'll deal with television sets, and later discuss possible cures for audio equipment.

The severity of interference to a set depends on a number of factors of which the most important is the distance between the transmitter aerial and the receiver/aerial system. Another factor is the transmitter frequency, also the frequency to which the TV set is tuned. If for instance the transmission is at say 87MHz and the receiver tuned to channel 2 v.h.f. (51·75MHz) then the interference will be severe; tuning the TV set to channel 9 v.h.f. (194·75MHz) will lessen the effect because the tuner circuits are now much farther removed in frequency and can discriminate much more between the wanted and the unwanted stations. A receiver operating at u.h.f. (625 lines) is much less likely to respond to a transmission on such a frequency therefore unless the distance between them is only minimal. The voltage pickup on a u.h.f. aerial from a 87MHz signal will of course be much less because the element lengths are so short in comparison to the transmitter wavelength.

It is possible even at u.h.f. however for comparatively low-frequency transmitters to cause trouble because of TV tuner design. Many tuners employ no r.f. input tuned circuits, the aerial feeder terminating in an *RC* coupling direct to the r.f. transistor (see Fig. 1). This constitutes a wideband input and even an 87MHz signal provided it is strong enough can drive this transistor to overload, producing harmonics up to a very high order at its collector circuit. These harmonics are readily accepted by the mixer stage and any further selectivity in the receiver is to no avail.

In a tuner employing a tuned strip-line at its aerial input (see Fig. 2) a high proportion of the 87MHz signal will be rejected, the small amount amplified by the r.f. transistor being insufficient to cause undue interference.

Even in a well designed receiver front-end however interference can still be severe due to an effect known as *cross-modulation* or more correctly *internal cross-modulation.* This occurs when the stronger local transmitter signal modulation causes the strength of the wanted TV signal to vary in sympathy, the effect on the screen being "bars" varying in brightness with the transmitter modulation. It is usually the r.f. stage which is responsible, though sometimes in severe cases the mixer stage is also responsible. What happens is that the transistor is moved in and out of saturation by the transmitter modulating frequency, thus varying the level of the wanted station. Patterning may also be seen in severe cases.

Cures

Provided the receiver is not picking up the interfering signal direct but via the aerial and coaxial feeder it is usually possible to effect a cure with simple filters made on the spot from either the feeder itself or some spare coax. Pickup directly into the receiver is beyond local attention of course and should be notified to the receiver manufacturer for his assistance since in addition to aerial filters some modification to the receiver may be necessary before a cure can be effected.

It can be said in general that low-frequency transmitter signals (1·8MHz-30MHz) get into the receiver via the outer braiding of the coax feeder (which acts as a long-wire aerial) because the isolator capacitance at the set is usually of too low a value at these frequencies to ground the signals adequately. For safety reasons this capacitor must *not* be increased in value or the braiding connection taken direct to the receiver chassis.

The Faraday Link

An alternative approach is to isolate the feeder completely using a 1 : 1 transformer or *Faraday link.* As will be seen (Fig. 3) the coaxial feeder outer is not then connected to the braid going to the receiver input. The one turn links are insulated from each other by the coax outer insulation and are magnetically coupled. Electrostatic pickup on the aerial

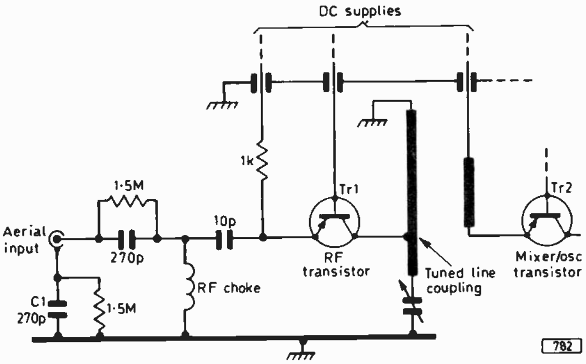


Fig. 1: Wideband RC coupled input to the tuner gives poor rejection of strong low-frequency signals picked up on both the inner conductor of the coaxial feeder and the braiding.

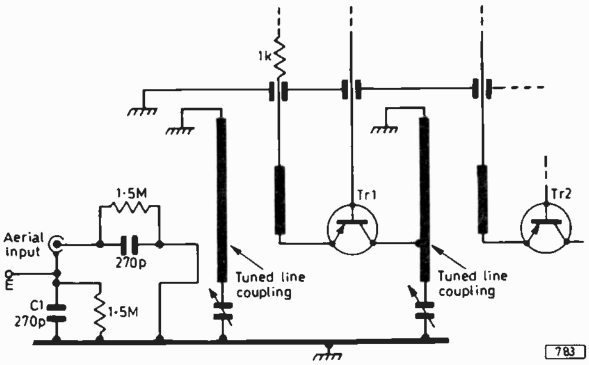


*Fig. 2: Tuned line coupling of the aerial input to the tuner gives greatly improved rejection of unwanted frequencies, especially those picked up on the aerial rods. Sufficient pickup on the coaxial feeder braiding can still cause cross-modulation as C1 has insufficient capacitance to earth low frequencies to chassis. This capacitor must **never** be increased in value because of the possibility of dangerous 50Hz voltages appearing at the aerial socket. An external earth can be used with effect at point E however to earth the feeder braiding.*

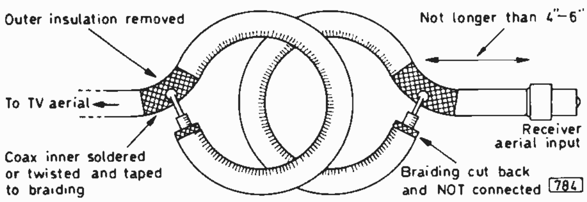


Fig. 3: The Faraday link. Tape over the joints with good (preferably plastic) insulating tape. When the optimum coupling has been found the whole link can be taped together.

feeder braiding is effectively prevented from entering the receiver. Any slight capacitive pickup between the two links can be minimised by running a good ground earth to the *aerial* braiding, the signal on the braiding then going direct to earth.

Even where no actual local interference is being experienced this ingenious filter (the author makes no claim to the design of this or any other filter described!) has been successfully used to remove obstinate slight patterning and general picture clutter on strong received signals—probably because the link coupled to the receiver places an effective signal path between input and chassis on tuners with only *RC* coupling.

The internal diameter of the links is not critical. For Band I use about 6-8in., for Band III 2-3in. and for Bands IV and V around 1-2in. Losses are highest at u.h.f. and can be as much as 6dB. Some experiment in size and tighter coupling can reduce this to 2-3dB however.

Link Attenuator

Incidentally, the links can be used an an effective attenuator, moving them apart varying the attenuation considerably. This characteristic can be used to advantage in cases of severe cross-modulation where the wanted TV signal is at a healthy level.

In some areas where receivers are operated close to a TV transmitter internal cross-modulation can take place in the tuner between the three service programmes. The effect seen on the screen is the wanted programme locked and one or two other pictures "floating" across the screen in the background. A Faraday link fitted as shown in Fig. 3 but loosely coupled can provide a cure as the received signals are attenuated to a point where cross-modulation in the tuner ceases. The optimum coupling is when the interference ceases and vision noise is not present.

Transistorised receivers or receivers with transistor tuners will cross-modulate more readily than their valve counterparts due to the much lower electrode voltages employed. Very often the interfering signal voltage injected into the tuner is greater than the standing d.c. bias on the transistors, pushing them into non-linearity which severely distorts the wanted signal. Transistors exhibit the input characteristics of a junction diode and it is not hard to see how the non-linearity can be introduced by a strong unwanted r.f. signal. Valves, having a gentler characteristic curve, require a much higher level of interfering signal before cross-modulation takes place.

Re-Radiation

Another form of cross-modulation takes place in metal objects such as downspouts, gutters, wire fences etc. This is the result of oxidised joints acting as non-linear paths between two or more metal areas. Usually this takes place only where two or more very strong radiated signals generate enough pickup in the metal for the oxidised joint to act as a detector. One signal may modulate the other in this joint and re-radiation from the metalwork may cause interference to a nearby TV receiver. Even if cross-modulation isn't present. re-radiated harmonics may fall in the TV band and cause patterning etc. The only cure is to make sure that all joints in metalwork near the transmitter aerial form good electrical conductors so that rectification cannot take place.

Quarter-Wave Stub

The coaxial $\frac{1}{4}\lambda$ stub can be a very effective filter.

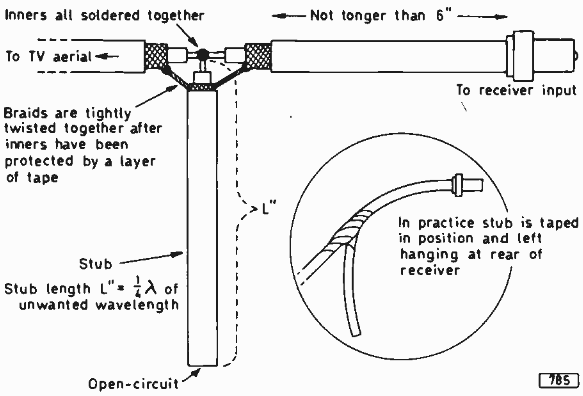


Fig. 4: Quarter-wave stub attached to the aerial input of a television set. At its resonant length the stub acts as a short-circuit across the feeder. It is critical to within ⅛in. of the actual length cut for a particular frequency. Due allowance must be made for the velocity factor of the cable.

For interference elimination it is used as an effective short-circuit across the coaxial feeder. All the stub consists of (see Fig. 4) is a length of standard 75Ω coax cut to a $\frac{1}{4}\lambda$ of the interfering signal and wired as shown. With the far end left open-circuit the stub forms an acceptance circuit which puts an effective short across the feeder, thus preventing the interfering signal reaching the receiver input. The Q of such a filter is high: thus it has a fairly narrow bandwidth, making adjustment tricky.

It has been found best in practice to cut the stub some two inches longer than the exact calculated length and to reach the optimum rejection point by carefully cutting off short lengths. The final exact length of the stub depends upon the velocity factor of the cable used and to a smaller extent on the input impedance of the receiver. In general the length will be about 1in. shorter than the calculated figure, though it has been found to vary between 1-2in. for a given stub used on different receivers.

The formula for determining stub length is:

$$\lambda \text{ (metres)} = \frac{300}{f \text{ (MHz)}}$$

For example a transmitter causing interference operating at 150MHz would require a stub length at the receiver of:

$$\lambda = \frac{300}{150 \text{ MHz}} = 2 \text{ metres.}$$

For $\frac{1}{4}\lambda = \frac{1}{2}$ metre $=$ *19·685* inches.

So in practice the stub would be cut to about 21-22in., wired to the feeder and trimmed gradually until the interference ceases. More than one stub can be used in obstinate cases, as long as they are fitted in the TV feeder more than $\frac{1}{4}\lambda$ apart.

To show how effective stubs are, the author has successfully fitted $\frac{1}{4}\lambda$ stubs to receivers operating only 1000yds. from a 1 megawatt radar installation where, without the filter, reception was intolerable!

Signal Balancing

Stubs can also be used to match an aerial system to a particular TV set where say two programmes are available but one station is weaker than the other. In this case the stub is fitted as before but left an inch or two longer than necessary and gradually cut until the weaker TV signal disappears into the noise. If the end of the stub is then shorted out the weaker station should appear stronger in relation to the other one. In effect the stub is being used in this case as a frequency dependent attenuator, balancing out feeder/aerial losses on the weaker TV channel at the expense of some signal loss on the strong transmission.

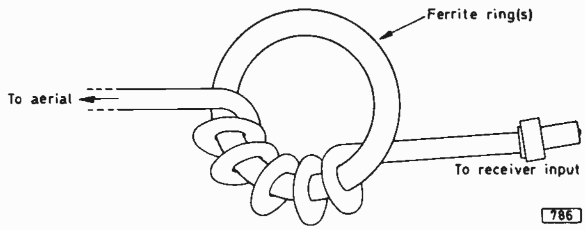


Fig. 5: Ferrite-ring filter. This introduces considerable series inductance in the coaxial feeder braiding. The number of turns required around the ferrite ring depends on the frequency of the interfering signal. Two rings placed together can further improve the efficiency, the feeder turns going around both of them.

Communal Aerial Systems

In the case of communal aerial systems filters should be fitted at the aerial preamplifier, not at each TV set. As the cross-modulation would occur in the preamplifier, either Faraday links or stub filters should be placed in the aerial input. Most modern transistor aerial preamplifiers are very wideband and will cross-modulate easily even when the transmitter frequencies are far removed from the TV band.

Ferrite-Ring Filter

Fairly low frequencies entering a receiver via the coaxial feeder braiding can very often be cured by introducing inductance in the braiding. A case in point is where short-wave stations at around 6MHz enter the receiver and cause interference to the intercarrier sound on u.h.f. Wind a few turns of the coaxial feeder round a pair of ferrite rings (Mullard type FX1588AIK). This introduces a quite considerable inductance in the braiding, thereby attenuating the 6MHz signals. The TV signal is virtually unaffected as losses are low, probably less than 1dB.

The frequency range of the filter can be altered up to the i.f. band of the receiver by reducing the number of turns on the ring. Without the ferrite many more turns would be needed, and possibly a tuning capacitor would be necessary to obtain the same sort of rejection. The coaxial feeder turns can be held in place by insulating tape, the filter being fitted close to the aerial input at the receiver.

Obstinate Cases

In obstinate cases a combination of filters will sometimes effect a cure—in spite of the ungainly look of the installation on the TV feeder! As this can be hidden away behind the set however appearance is not really a problem.

Audio Equipment

As an audio amplifier is not a radio receiver with an aerial the problem of r.f. pickup and rectification in such equipment requires a different approach. The first thing to do is to try to establish how the r.f. signal is entering the amplifier, then to fit the necessary filters such as ferrite beads, capacitors or resistive stoppers.

Valve Amplifiers

Valve equipment seldom responds to radio transmitters unless the signal level is very high. In general a cure can be effected by adding a resistive stopper in each control grid lead, close to the valve holder. The stopper resistor forms an r.f. filter with the valve's input capacitance which is in parallel with the input.

Often, especially in "unit audio" equipment used with long speaker leads, the interfering signal is injected into the amplifier via these leads and then via the negative feedback components to an early amplifier stage (see Fig. 6). Usually low-frequency r.f. signals, such as 3·5MHz amateur transmissions, find their way in by such a method and a cure can often be achieved by adding capacitors across each speaker socket at the amplifier. Values of the order 0·01μF to 0·1μF are suitable and due to the low output impedance should not affect the audio response.

R.F. pickup on the input leads (gramophone pickups, microphone lines etc.) is usually proved if altering the volume control affects the level of interference or unplugging a lead stops the effect. Small value ceramic capacitors (around 100-500pF) placed across the input concerned may stop the trouble. Ferrite beads fitted at the input grid of the first stage may also help. Sometimes a good r.f. earth attached to the screening of the offending lead will prevent the signal reaching the amplifier.

Transistor Amplifiers

Transistor amplifiers respond far more readily due to the effects mentioned earlier and in some instances the problem can be difficult to cure. Pickup via the speaker leads needs the same treatment as for valve amplifiers. Ferrite beads and capacitors at amplifier inputs are usually less effective however because of the low input impedances present in transistor circuitry. Some success (see Fig. 7) has been achieved by placing small capacitors between the base and collector of each stage (value order of 50-500pF) to produce negative feedback at the unwanted frequency, thus preventing the transistor either detecting or amplifying the interfering signal. The effect on the audio response will vary and depend on the exact circuitry and the component values used. The usual effect is a slight loss of treble response but this will probably be compensated by increasing the amplifier's treble lift. In all events the customer is likely to accept slight loss of treble rather than have a local transmitter belting through his equipment!

In severe cases of interference where all else seems to fail inserting a low-value resistor in the emitter lead close to the transistor can work wonders (see Fig. 8): being unbypassed, negative feedback is produced slightly lowering the stage gain, possibly enough to prevent the r.f. signal producing rectification effects.

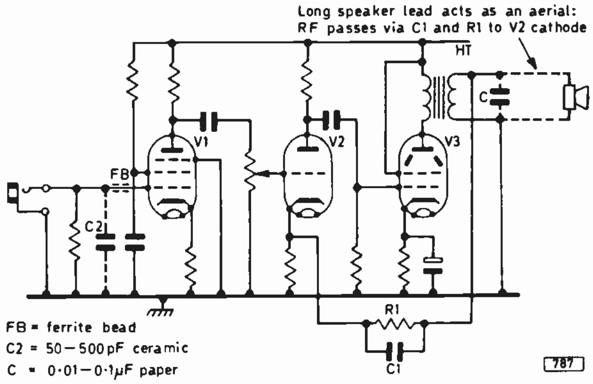


Fig. 6: Valve audio amplifier. R.F. pickup via the speaker leads results in V2 acting as a detector if the level is high enough. Pickup at the audio input can be prevented by a shunt capacitor (C2) or a ferrite bead (FB) on the grid lead. In serious cases a combination of filtering at each stage may be needed.

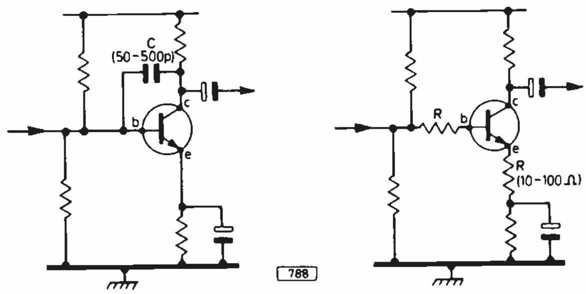


Fig. 7 (left): Placing a ceramic capacitor between the collector and base of a transistor can prevent it providing r.f. amplification.

Fig. 8 (right): Increasing negative feedback slightly by including a resistor (R) in the emitter circuit can prevent r.f. overload. Placing a resistor of similar value in series with the base provides a stopper filter in conjunction with the input capacitance of the transistor.

Values of around 10Ω to 100Ω have been successfully used. The slight loss of gain can be overcome by increasing the volume control setting. A similar effect is produced by placing a resistor of the same order of value in the transistor's base lead.

Amplifiers employing field effect transistors do not respond as much to strong local r.f. fields—the characteristics of these devices being similar to those of thermionic valves. Where problems are experienced with such devices, the techniques to use are those already outlined for use with valve amplifiers.

Integrated Circuits

Audio equipment which uses integrated circuits can behave in the following ways. In some cases it has been found that an i.c. amplifier responds to r.f. signals and local r.f. pickup and it is impossible to effect a cure by using external filter components. However another i.c. amplifier of exactly the same type does not respond at all! In i.c. stereo units it is possible for one channel to be riddled with r.f. interference while the other channel is quite normal! Audio response and performance are normally unaffected even though the i.c.s differ so much in r.f. response. Possibly manufacturer's characteristic spreads result in widely differing h.f. responses between i.c.s—it is not unusual for some audio i.c.s to give a hefty output at 1-2MHz! Electrolytic decoupling capacitors can make the situation worse because their inductance increases with increase in frequency—very often the circuit operation at r.f. is quite different from the normal operation at a.f. even though the same physical components are used. Shunting all decoupling electrolytics with 1,000pF to 0·01μF ceramics can help reduce the interference in difficult cases, plus trying the usual input/output r.f. filtering. In extreme cases changing the particular i.c. has cured the trouble.

Equipment Screening

No real benefit has been found in practice from screening equipment cabinets: aluminium foil has been tried but as bonding is difficult and short-circuits a high probability it is not easy to make much difference in the level of interference to audio equipment. A good r.f. rising water pipe earth can make a vast difference however, coupled to the metalwork in the amplifier. Mains socket earths are not usually very good r.f. earths and in some instances can give rise to increased interference.

Receiver Deficiences

No mention has been made of the classic receiver deficiencies such as second channel, i.f. breakthrough, oscillator harmonic beats etc. since these effects are usually curable only by modifications to the receiver itself (some relief can sometimes be obtained by using some of the previously mentioned filters however). So far as TV sets are concerned this ground was covered recently in Parts 3 and 4 of "Receiver Debugging" (see the October and November issues). For further reading the author recommends the R.S.G.B. *Amateur Radio Handbook*.

Conclusion

It is uncommon for r.f. interference to reach receivers and audio amplifiers via the mains lead. Normal click-type and general motor and impulse noises will easily travel long distances along the cable in the street but at frequencies above about 2MHz the cable attenuation is too great—only the receiver aerial will pick up the offending noise directly. A radio transmitter some houses away will cause interference by direct radiation to the receiver and aerial (or audio amplifier and speaker leads!), not via the mains lead. On rare occasions however it has been noticed that the last few feet of mains lead to a receiver have acted as an aerial injecting r.f. into the equipment: unplugging the lead from the wall socket will make no difference in this case. High-voltage capacitors, around 0·1-0·5μF, between live and neutral and neutral and earth will usually damp the lead enough—fit them inside the receiver or amplifier away from prying fingers.

It is hoped that this survey will be of help to engineers in the field who come up against these problems. It may even help some Amateur transmitter enthusiast with a few irate neighbours! ■

THE 'TELEVISION' COLOUR RECEIVER FORUM

In answer to many requests we are this month providing a set of instructions for setting up the decoder in the absence of elaborate test gear. Only a multimeter and simple diode probe (details given) are required. Details are also provided of ways in which you may be able to obtain improved performance from the line oscillator and the i.f. strip. Constructors of the receiver are urged to consider carefully the points raised this month and in the two previous Forum articles: they contain advice on all problems reported by readers to date.

The purpose of this feature is to co-ordinate hints and comments from readers who have successfully completed the project and to pass them on for the benefit of others. We invite constructors to send us notes on their findings, also any comments and suggestions. These will be carefully considered and points likely to be of help will continue to appear in this feature. All contributions published will be paid for at our normal rates. Contributors' addresses will not be published.

We regret that it is not possible for us to answer telephone enquiries regarding this feature or the set itself. The Fault Finding Advisory Service will continue—apply on the forms provided in the August, September or October issues.

Those wishing to build the power supply circuit devised by E. Erven (see last month) should note the dimensions which are approximately 5×5×10in.

DECODER ALIGNMENT WITH A MULTIMETER

Testing, fault finding and alignment of the various modules in the colour receiver can be achieved readily enough if a large selection of test equipment is at the constructor's disposal. Many constructors are not in this fortunate position however. Since the i.f. strip can be put in the hands of the Alignment Service we are left with the problem of aligning the rest of the set using only basic equipment. The timebase and display section can be set up quite easily provided you have a crosshatch generator and an e.h.t. meter. Both these items can be made very cheaply and articles have appeared previously on their construction (see for example June 1972, pages 367-8, for an e.h.t. meter and September 1972 for the crosshatch generator).

We are thus left with the problem of decoder alignment. This can be achieved using only a multimeter and the transmitted test card: it is not claimed that the precision of adjustment is as good as can be obtained by more sophisticated methods, but the displayed picture will nevertheless be of very good quality because alignment is carried out by carefully observing the display.

Initial Conditions

It is assumed to start with that the decoder is in working order, i.e. that there are no faulty components or wiring errors. The vast majority of home-built decoder faults will be due to incorrect positioning of components, errors in module interconnection, wrongly phased transformer windings and so on. Such faults can be traced by careful examination of the board itself and of the displayed picture. The use of an oscilloscope may however be essential in the rare case of a very obscure fault. A great deal of trouble can be saved by simple ohmmeter tests of the components, especially semiconductors, before fitting them to the board.

The other main proviso in providing the following instructions is that the rest of the receiver is fully working and tested. If setting up is to be done in this way it is rather pointless even connecting the decoder board into the set until a fully satisfactory monochrome picture has been obtained, with good grey scale, purity, geometry, convergence and resolution. A strong noise-free aerial signal is also a must.

First double-check that you have all the external connections to the decoder board correct. Ensure that the receiver is tuned correctly so that the subcarrier is being received. This can be checked by temporarily disconnecting C137 on the i.f. board: a crawling line pattern should then appear on the areas of the picture which are coloured.

You will need to carry out the alignment at a time when the test card is being transmitted on BBC-2. Fortunately the trade test films have now been discontinued so that the test card is available for much longer periods on weekdays.

Presetting

One of the main difficulties with this method of alignment is that the adjustments may initially be so far out that no output at all is obtained. To minimise this possibility the various adjustments should be set initially as follows:

I.F. Board: R149 a.c.c. bias midway; chroma notch

filter L114 core fully out of former; chroma output coil L121 core level with top of former (do *not* alter L121 however if the i.f. strip has been aligned by the Alignment Service).
Decoder Board: L1, L3, L4, L6, L10, L13 core level with top of former; L5, L7, L14, L15 core fully out of former; potentiometers R11, R75 and trimmers C14, C38 midway.
Front Panel: Saturation control midway.

Setting up the Reference Oscillator

The first stage is to make the reference oscillator lock correctly to the incoming burst. Remember that the line output stage must be operating and synchronised in order to provide the correct burst gating pulse. Proceed as follows:

(1) Check with a multimeter that the +20V and −8V supplies are present.

(2) Connect the negative lead of the multimeter to the a.c.c. output terminal 1C, positive lead to chassis.

(3) Screw the core into L5 until the first peak in the a.c.c. voltage is reached.

(4) Further peak up the reading by adjusting L1 and the i.f. strip chroma output coil L121 (unless the i.f. strip has been through the Alignment Service). Recheck the setting of L5. The reading should now be in the region of −10V.

(5) Disable the colour killer by connecting a shorting link across D8. This should result in some sort of colour (no doubt completely incoherent) on the screen. If not, then probably the adjustment of L3 is so far out that no reference signal is being obtained. Roughly set L3 to give some sort of output.

(6) Connect a shorting link across R19 (6·8kΩ) to disable the reference oscillator.

(7) Connect the multimeter from Tr3 collector to chassis. Adjust R11 (a.p.c. bias) to give a reading of +6V.

(8) Remove the link across R19. Adjustment of C14 should now enable a lock to be obtained so that the colour is not divided into broad horizontal bands but is steady although it will still have considerable patterning on it.

(9) Having obtained a lock, finally set C14 to again give a +6V meter reading. If no lock can be obtained go on to step (10) and then try again.

(10) We now need to adjust L3 for maximum output from the oscillator. For this we need a diode probe—a suitable circuit is shown in Fig. 1. Connect the probe from connection 2 of T2 to chassis and adjust L3 for maximum reading. Now recheck step (9).

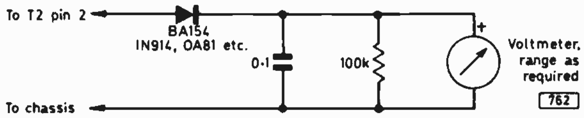


Fig. 1: Diode probe for setting L3.

Phasing the Signals

Stage two is to line up the chroma amplifier and bring the chroma and reference signals fed to each demodulator into phase with each other. We also set up the delay line circuit to give optimum cancellation of phase errors.

(11) Adjust L6 for maximum saturation, ignoring any Hanover bars or patterning.

(12) A coarse pattern which wriggles with the sound will be visible over the whole picture. This pattern, predominantly blue in colour, is the 6MHz signal after passing through the chroma demodulators. Advance the a.c.c. bias or saturation controls if necessary to make the pattern easily visible. Screw the core into L7 until the pattern is notched out.

(13) This is a convenient point at which to establish the correct operation of the ident circuit, and here we can make use of the fact that the ident output is also used to operate the colour killer.

Remove the short-circuit across D8. This will probably cause the colour to drop out, but adjustment of L4 will bring it back again. Reducing the input signal by means of the a.c.c. bias preset on the i.f. board will enable a more accurate setting of L4 to be made.

The ident should now be correct, that is reds should be red and greens green rather than vice versa. If not there are two possibilities. Try interrupting the aerial signal several times. If the ident can eventually be made correct by this method then the ident signal itself is adequate. Turning L4 a couple of turns one way or the other should put matters right. Alternatively if the ident is wrong *every* time reverse the connections to *one* winding of T4.

(14) We must now bring the reference signal and chroma signal applied to each demodulator into phase with each other. As is well known, the purpose of the chrominance delay line is to remove the effects of phase errors. For the present however we wish to show up the errors, so we take the delay line out of use by connecting a shorting link across R77 (100Ω).

There are several adjustments which affect both the R−Y and the B−Y phasing. In the B−Y channel however there is another variable, the quadrature trimmer C38. For the moment therefore we concentrate on the red picture by switching off the green and blue guns. Observe that on areas of the picture where a large R−Y signal is present—such as the cyan, green, magenta and red colour bars (the middle four on the screen), the red dress on the test card, etc.—there is a coarse Hanover blind pattern which consists of two dark picture lines followed by two brighter lines, repeated over the whole area in question. This pattern appears to drift up the screen. The pattern is due to the reference signal fed to the R−Y demodulator being out of phase with the R−Y component of the chroma signal. To put this right we shift the phase of the reference signal, first by adjusting L13. This has only a small range and if the bars cannot be nulled out a small adjustment of L1 should do the trick.

There are nearly always some slight Hanover bars with simple PAL operation, which is what we are in effect using here, especially on transitions between one colour and another. It is often found that the adjustment giving a null on some parts of the picture is not quite right for others. Do not worry about this —the delay line will take care of the errors. Just aim for least bars over the whole picture. This incidentally demonstrates why hue errors are so common on the NTSC system and why simple PAL operation is seldom used.

The actual phase error present depends a lot on component tolerances and wiring capacitance. There may be the odd case where adjustment of L1 does not provide enough range to cancel the errors without causing undue loss of gain in the burst channel, the latter effect showing itself as a reduction of the a.c.c. output and hence an increase in saturation, or even difficulty with the colour lock.

In these cases L6 must be used to shift the phase of the chroma signal. This is preferable to too much detuning of L1.

(15) When you are quite satisfied that the red signal is correct, switch on the blue gun only and set the quadrature trimmer C38 to minimise the Hanover bars.

Delay Line Circuit

(16) Unfortunately we now need to make the phase adjustment wrong again! This is because we need to set up the delay line for optimum cancellation of phase errors and for this we need some errors! Switch on all three guns and detune L1 so that fairly bad Hanover bars are visible. Turn up the saturation if necessary to make them clearer. Now remove the short-circuit across R77 (which will cause an increase in saturation of about 2: 1). Carefully set R75 and L10 until all Hanover bars are eliminated. Then briefly restore the short-circuit across R77 to enable L1 to be reset to its correct position.

(17) Turn off the colour and set the i.f. strip subcarrier notch filter L114 for minimum line pattern on coloured areas (e.g. the colour bars). Turn up the colour again and set L14 (red picture) and L15 (blue picture) for minimum patterning.

Overall Chrominance Response

So far we have set the 4·43MHz tuned circuits in the chroma amplifier for maximum output at that frequency. The overall bandpass response however is the combined response of the i.f. amplifier and the chroma channel. It is often forgotten that this *overall* response must be symmetrical and centred exactly on 4·43MHz for optimum cross-colour performance. This is just one of the reasons why i.f. alignment is so critical.

Fortunately there is an adjustment which tilts the response without any side effects (except for a small change in overall bandwidth). This is the chroma output coil on the i.f. strip, L121. We do not recommend altering the tuning of this however if the i.f. strip has been aligned by the Alignment Service.

(18) Disconnect the luminance input to the RGB output board. On advancing the brightness a display of just the colour-difference signals will be seen. The cross-colour will be observed as a pattern corresponding to where the vertical lines would be on the luminance image.

(19) Some cross-colour is inevitable of course but adjustment of the i.f. strip chroma output coil L121 should enable a definite null in the cross-colour to be found. If this coil does not give enough range without excessive loss of gain L6 may be adjusted, but this should be done only as a last resort since any tampering with L6 means that the phase adjustment of L1 must be done again.

Correct Saturation Setting

(20) Finally, restore the luminance signal and set the contrast control for a normal picture. Switch off the green and blue guns and reduce the brightness so that picture highlights are just visible. Set the user saturation control midway. Set the a.c.c. bias preset R149 (i.f. panel) so that the two pairs of red bars seen at the top of the test card are of equal brightness. This establishes the correct saturation.

Grey Scale

Now on switching on all three guns and resetting the brightness control you should have a high-quality colour picture. If you don't have a reference white source the RGB drive controls R401-R403 may be set up carefully for a good skin tone on the test card (having first checked the c.r.t. first anode "background" adjustments R435-R437 as these have a profound effect on the colour fidelity). The background controls are used to remove any colouring in dark grey areas. They can be set up on a test card with the brightness control set for a normal picture. Turn the controls to maximum, note which are the dominant colours, then reduce the settings as appropriate to balance the beams for correct dark grey reproduction.

So there it is—setting up the colour circuits can be done without an oscilloscope, wobbulator etc. It takes longer this way, but the results are in no way inferior.

SIGNAL BOARDS

The impression given by the way in which we drew Fig. 3 last month could be misleading. The boards are mounted side-by-side with the tuner board at the *front* of the cabinet, the i.f. board in the centre and the decoder board at the *rear* of the cabinet.

Dear Sir,

MODIFIED LINE OSCILLATOR

Students of the sinewave line oscillator will know that there is a number of ways of arranging this circuit. In the design published for the TELEVISION Colour Receiver the quadrature feedback in the reactance stage is from the anode of V301 triode via C321 to its grid. This particular Mullard circuit was never adopted by any of the setmakers and after experimenting with other variations of the circuit to obtain the best line locking I have found that the more usual configuration, with the quadrature feedback to the cathode of the triode reactance valve, gives much improved results—it is well worth making the change I'd say. The circuit is shown in Fig. 2. Fortunately the total number of components used is the same as before though some values are changed and the layout must of course be rearranged (Fig. 3 shows the changes needed). The signal developed across R341 is fed via C321 to V301a cathode to establish the quadrature conditions in this valve: the feedback via C320 is to reduce the damping of the tuned circuit.

B. J. Hutton.

Editorial note: We have tried this one out and although it involves some modification to the board agree that it gives a worthwhile improvement.

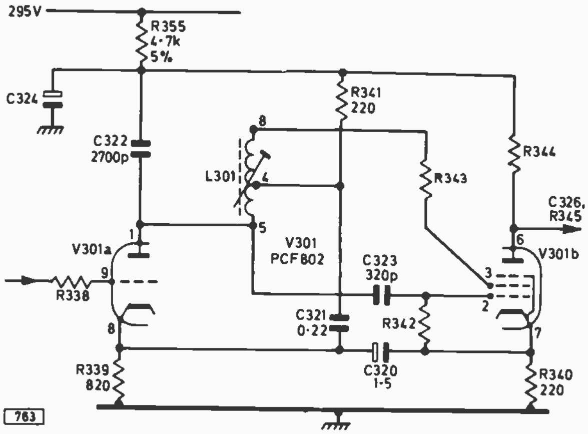


Fig. 2: Modified line oscillator circuit. L301 is the standard line oscillator coil available from Forgestone Components. Component values are shown only where they have been changed. Component ratings: R355 1W 5%: C320 40V; C321 400V; C322 5% 400V; C323 400V. Forgestone Components tell us that they can provide the components required to carry out this modification.

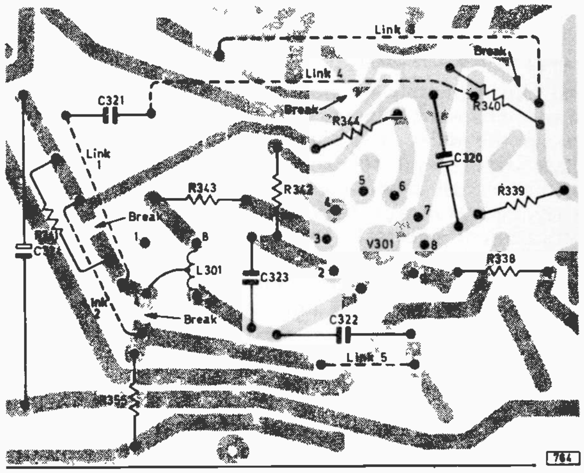


Fig. 3: Timebase board alterations required to carry out the modifications shown in Fig. 2.

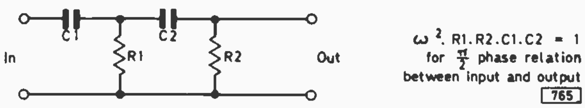


Fig. 4: The coupling from the anode to the grid of the PCF802 reactance triode consists of a two-section phase-shift network—see letter from H. Pursey.

Dear Sir,

LINE OSCILLATOR LOCKING

I have read with interest E. Erven's comments on the line oscillator in the November issue. The reason why the oscillator will not lock in satisfactorily when the tuning of the tuned circuit is adjusted by adding an 0·01μF capacitor across it as previously suggested is as follows. C322 in the original circuit serves two functions. First it forms part of the capacitance tuning the coil L301, and in this respect can be regarded as having its upper end virtually earthed to a.c. by the low resistance of R341. Secondly however it also forms part of a two-stage phase-shift network along with C321, R341 and R338. The condition for a $\pi/2$ phase shift from such a network is shown in Fig. 4. The component values given in the original circuit satisfy this relationship. By adding an 0·01μF capacitor to tune the tuned circuit correctly however the phase quadrature feedback in the reactance stage is disturbed so that the lock-in arrangement may no longer operate satisfactorily. Indeed by introducing a resistive component into the variable reactance the Q of the system could be lowered sufficiently to stop oscillation altogether. This could explain why the circuit then operates better with a PCF80 since this has a higher mutual conductance than a PCF802. I suggest that adding a capacitor of about 0·0025μF across the whole of L301 should correct the tuning error without upsetting the phase-shift network.

H. Pursey.

Editorial note: Replacing L301 with a standard line oscillator coil for this type of circuit and leaving the tuning capacitance as originally overcomes. the problem. Amending the circuit as suggested in the letter above provides improved performance.

Dear Sir,

I F STRIP

I have been experimenting with a number of i.f. strips built to the original published design. As a result the suggestions below are made. These certainly produce a worthwhile improvement in the performance of some i.f. strips though with others the improvement is only marginal—it rather depends on how good the performance of the strip is to start with (some variation is inevitable with home-constructed modules). The following points are well worth observing however by anyone having difficulty with the i.f. board.

Note first that it is vital to keep component lead lengths to the absolute minimum except where otherwise specified (i.e. the TAA350 i.c.).

As mentioned in previous articles the critical components are the capacitors associated with the

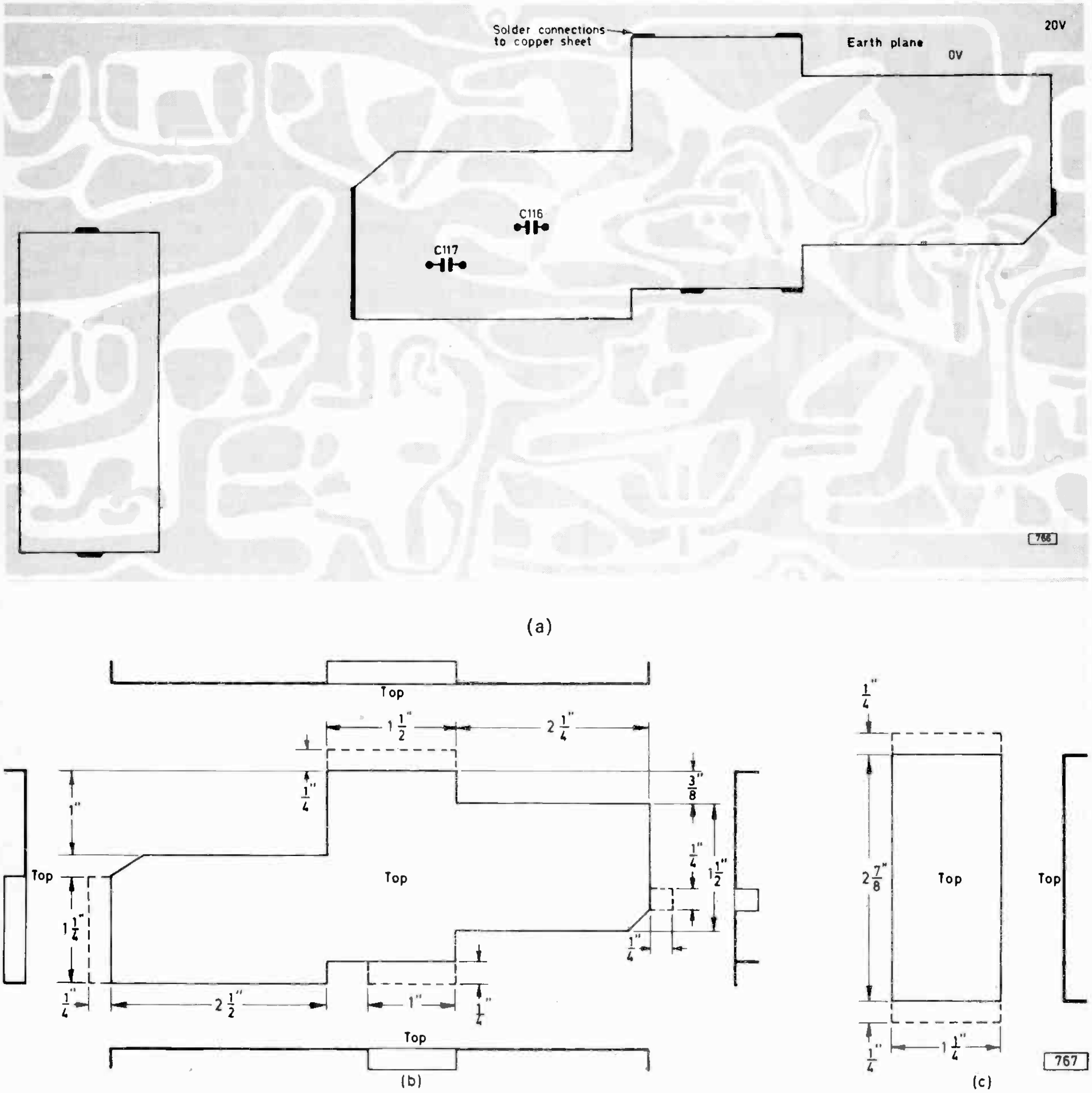


Fig. 5: (a) The performance of the i.f. strip can be improved by adding copper screening on the print side as indicated here. The soldered connections between the screens and the board must be in the positions marked above in heavy line. Transfer C116 and C117 to the print side of the board—ensure that they are mica types and mount them with the shortest possible leads. The dimensions of the two screens are shown in (b) and (c).

upper section of the cascode stage—C116, C117, C118, C120 and C121. They *must* be mica types, C117 as well. Try mounting C116 and C117 on the print side of the board, as close to the board as possible, then place copper shielding over the print side of the board as shown in Fig. 5. Unetched printed circuit board sheet bolted to the board can be used if you have difficulty obtaining copper sheet. Whichever you use however the soldering points shown in Fig. 5 are critical and must be observed. There must be no other connection points. Once this has been done the value of R130 (if different from the original circuit) can be restored to 1·2kΩ to increase the i.f. gain.

E. R. Hill.

MAINS TRANSFORMER

Electrokit tell us that they have written to all purchasers of Pack 18 offering to supply a replacement mains transformer. Details can be obtained from Electrokit at their new address 8 Cullen Way, London NW10. The price of Pack 18R with the new transformer (type 0748) is £16·95.

FAULT FINDING GUIDE

8 John Law

BRC 1400 CHASSIS-1

The Thorn/BRC 1400 series chassis was a new departure in the design of television receiver chassis. Instead of the more familiar horizontal chassis which could be lifted out of the cabinet for servicing or vertical chassis which hinged down from the vertical to the horizontal position for access the 1400 chassis hinges sideways like a door. The large square printed panel supported on a metal frame contains all the components apart from the tuners and the c.r.t. Component reference numbers are printed on the panel, greatly facilitating component location when fault finding.

The 405/625 system switch is operated by solenoid coils which are brought into circuit by the station selection switch. Turning to the u.h.f. position energises a coil momentarily so that the system switch slides across to the appropriate setting. Reverting to a v.h.f. channel activates the second coil on the solenoid, the system switch then returning to the 405 position. The solenoid unit is protected by the fuse-link resistor R123. If this fuse opens the a.c. mains input to the receiver is removed (see circuit diagram, Fig. 1, pages 120-1).

This was the last all-valve (except for the u.h.f. tuner) chassis produced by Thorn/BRC. It is fitted in some 50 Ferguson, DER, HMV, Baird, Ultra, Marconiphone and various rental models. Before turning to faults we will briefly examine the circuit.

Receiver Stages

The usual vision chain of EF183 and EF184 i.f. valves plus PFL200 video/sync valve is not used in this chassis. Instead the EF183/6F29 is followed by the pentode section of a 30FL14 and then a 6F28 pentode is used as the video amplifier. Separate detector diodes are employed for v.h.f. and u.h.f., W4 and W3 respectively, the outputs being selected by S2H. This results in a positive-going video signal being in each case a.c. coupled to the video pentode via C34. The video output from this stage is a.c. coupled to the cathode of the c.r.t. via L22 and C39, the potential divider R119, R120 providing a d.c. reference level. Note that R120 also serves as the brightness control, the c.r.t. grid being tied to chassis through R122. Field flyback blanking is applied to the c.r.t. grid via R129, C102 and line flyback blanking via R134, C103.

A mean-level a.g.c. potential is derived from the sync separator (V6A) grid circuit and fed back to the common vision and sound i.f. amplifier via R18, R17 and to the v.h.f. tuner via R16 and P1/1. Separate contrast controls are linked to the a.g.c. line via R4 and R7, W1 clamping the a.g.c. line to prevent it swinging positive. If the video signal from the detector W3 on 625 lines is excessive W2 cathode will be negative with respect to its anode and it will conduct to supplement the a.g.c. action. Otherwise excessive drive to the video amplifier could result in sync pulse clipping at its output and in consequence failure of the a.g.c. circuit to provide an adequate control potential.

The v.h.f. tuner unit incorporates a PC97 triode r.f. amplifier and PCF805 triode-pentode oscillator-mixer: on 625 lines the r.f. amplifier and the pentode section of the PCF805 act as additional i.f. amplifiers. A.G.C. is applied to both valves. The u.h.f. tuner employs an AF239, AF139 or AF186 as the r.f. amplifier and an AF139 self-oscillating mixer.

The 405 sound i.f. signal is coupled via L23 to the sound i.f. stage V7. W7 provides demodulation and feeds the audio valve V8. The triode section of this valve also provides interference limiting (determined by the time-constants of C79/R91 and C78/R92) and for this reason the volume control is connected in the grid circuit of the pentode section. On 625 lines the 6MHz intercarrier sound signal is taken from the anode of the video amplifier and coupled via C36, L24 and C58 to V7 grid. V7 acts as a limiter, its screen grid voltage being reduced when S2D switches R74 into circuit. A ratio detector circuit is used, with diodes W8 and W9.

The Timebases

Three sections of two double valves and used in the sync separator and line oscillator circuit. V6 pentode section is the sync separator, the triode section being the line blocking oscillator. The triode section of V4 acts as a d.c. amplifier in the flywheel sync circuit, diodes W5 and W6 forming the flywheel sync discriminator.

Field sync pulses are fed to the field generator circuit via C91 while the line sync pulses are fed via C43 to the flywheel sync discriminator circuit after integration by R50 and C44. A reference pulse from tag E on the line output transformer is integrated by R56/C42 with shaping provided by C48 and applied to the discriminator. The discriminator diodes W5 and W6 develop a voltage, either positive- or negative-going, depending on the timing of the

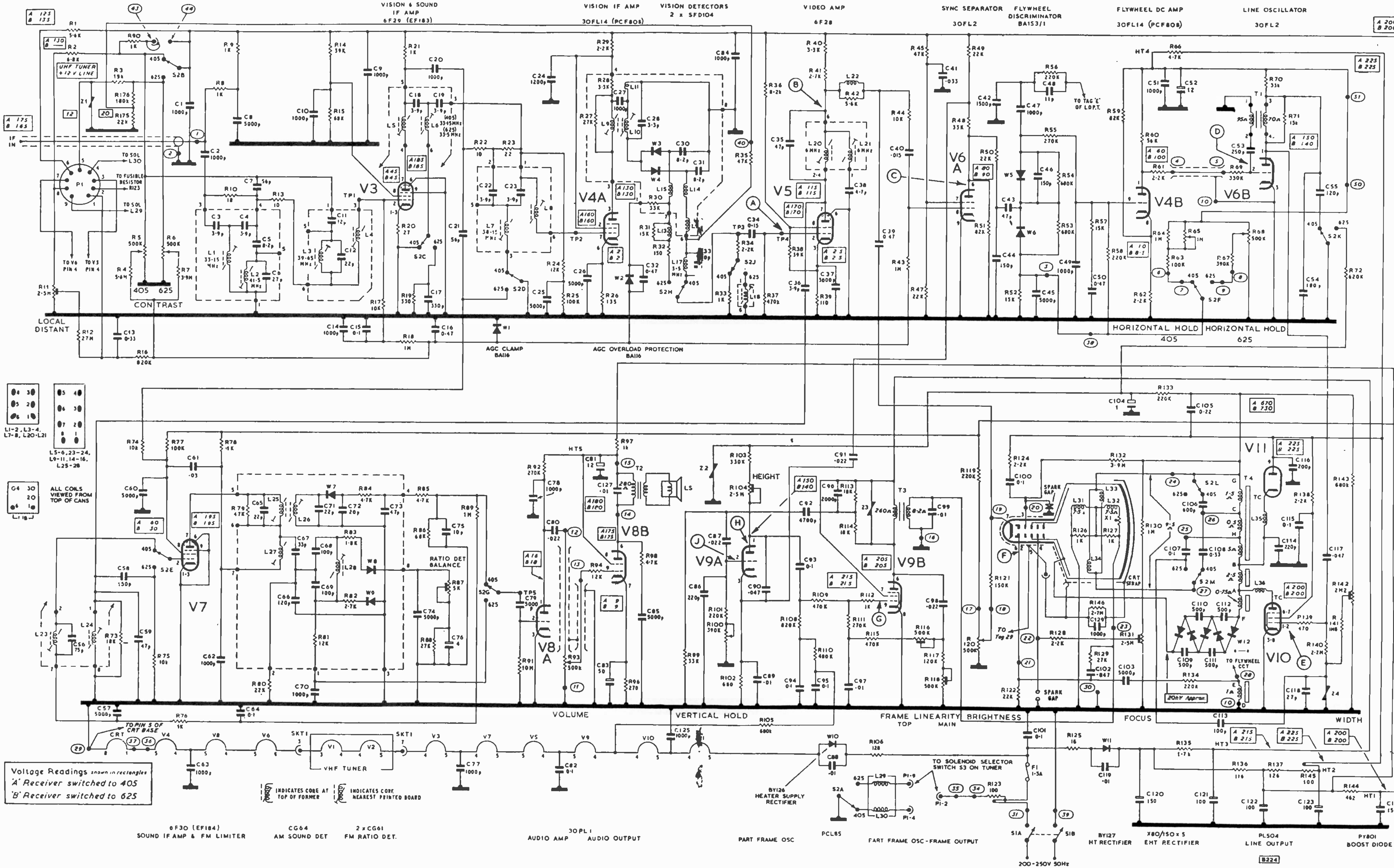


Fig. 1: Circuit diagram of the Thorn/BRC 1400 chassis, Schedule E version incorporating the modifications which will be listed next month. R137 is 226Ω in early versions in which R145 is not fitted. Voltages were measured with no signal and R11 and the contrast controls at maximum, using a 20,000Ω/V meter (AVO Model 8) except for the e.h.t.—variations of 10-20% are not to be taken as indicating a fault condition.

VARICAP/FET PREAMPLIFIER

DAVID BUNYAN

Field effect transistors (f.e.t.s) are well suited for use in v.h.f. television reception, especially for pre-amplifiers. In addition to providing high gain with a very low noise figure they have an important advantage over bipolar transistors.

Being essentially square-law devices (i.e. slope varies linearly with applied bias) they are capable of handling signals of hundreds of millivolts before cross-modulation makes itself apparent. At this sort of signal level a bipolar transistor would have given up long ago! Absence of cross-modulation is especially important when weak signals are being sought. With conventional bipolar transistors cross-modulation becomes troublesome in the vicinity of a strong transmitter—usually TV or f.m.—and is noticed when a weak, supposedly-DX signal turns out to be a local TV channel on an entirely spurious wavelength. The use of f.e.t.s should considerably ease this particular problem.

In the preamplifier to be described the 2N3823E transistor is used. This is an n-channel epitaxial junction f.e.t. in a plastic encapsulation. From the manufacturer's data the typical performance of this transistor in the common-source mode is: frequency 100MHz; bandwidth 10MHz; gain 16dB; spot noise figure 1·5dB.

One of the difficulties with the common-source configuration for an r.f. amplifier is the need for neutralisation to achieve high gain with good stability; also the required neutralisation is dependent on frequency. The alternative and very satisfactory solution is to build a cascode circuit. This gives high gain, very low noise and high stability; no neutralisation is required and this makes setting up very easy.

Circuit Description

In the cascode arrangement (see Fig. 1) Tr1 is connected in the common-source mode, its output load being provided by Tr2 which is connected in the common-gate configuration. As the output impedance of Tr1 is high while the input impedance of Tr2 is low Tr1 is very heavily loaded. This reduces its voltage gain to unity but provides a very good impedance match to the input and as a result the stability is very good. As an aid to maintaining a high degree of stability, even with the input unterminated, both Tr1 source and Tr2 gate are decoupled by a total of 2,000pF while a 2·2pF capacitor is used to decouple the junction between Tr1 drain and Tr2 source.

In order to achieve coverage over the whole of Band I varicap diodes type BA110 were connected across the input and output coils. A voltage change of 0 to −7V applied as a bias to the varicap diodes is sufficient to give coverage of from 45 to 70MHz. Capacitors C2 and C11 decouple the tuning voltage and provide d.c. isolation. In order to prevent a possible loss of Q at low bias levels a resistor is placed in series with the supply to each diode: the value is not critical but should be between 100kΩ and 500kΩ.

Control Unit

The circuit of the control unit is shown in Fig. 2 and as can be seen is very simple. It consists of an on/off switch, a logarithmic potentiometer and a preset potentiometer. The only disadvantage of using a battery supply is the long term drift that occurs as the battery gradually runs down. This can be countered to some extent by adjusting the preset potentiometer so as to maintain correct calibration of the main tuning control. No doubt a zener stabilized power unit would be considerably better but as this circuit started off as an experiment the cost had to be kept low. A logarithmic potentiometer is specified for VR1 in order to counteract the non-linearity in the voltage/capacitance characteristic of the varicap diodes.

Construction

The control unit can be put together in any conveniently sized metal box. The layout is not critical.

The preamplifier itself is constructed on a small tin subchassis which is mounted in a diecast box measuring $4\frac{3}{4}$ x $3\frac{1}{4}$ x 2in. In order to provide a little more "elbow room" a couple of the resistors are

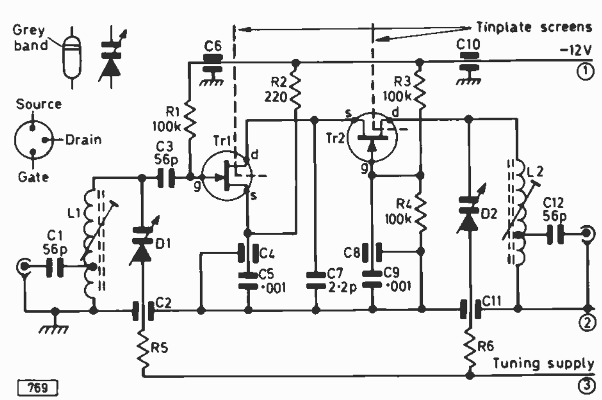


Fig. 1: Circuit of the preamplifier. Physically, C4 and C8 are at Tr1 source and Tr2 gate connection respectively—see layout. Transistor connections viewed with leads facing. The cathode end of the varicap diode is indicated by a grey band.

reference signal when the sync pulse arrives. This voltage is filtered and applied to the grid of the flywheel d.c. amplifier V4B whose anode potential controls the line oscillator timing circuit, i.e. the rate at which C53 discharges via R69, R61 and R60 between the conduction periods of the blocking oscillator V6B. When V6B is non-conductive C54 charges via R70 to provide the line drive waveform: on 405 lines C55 is added in parallel with C54.

C117 couples the line drive to the line output pentode grid circuit to which a conventional width stabilisation circuit is connected. This relies on the v.d.r. Z4 which rectifies line frequency pulses fed back to it via C113. R141 links this circuit to the width control R142 which is fed via R143 from the boost line. C105 is the boost reservoir capacitor while C104 smooths the boost potential applied to the field generator.

The e.h.t. is produced by a tripler unit using pencil selenium rectifiers (W12a-e). The c.r.t. aquadag coating acts as the e.h.t. reservoir capacitance, being charged through C109-C111.

The field timebase is arranged around a PCL85, the triode and pentode sections being cross-coupled to form a multivibrator with the pentode also acting as the output valve. C90 charges via the height control R104 and R103 from the boost line to provide the field scan waveform, being discharged to give the flyback when the triode section of the PCL85 briefly conducts. S2K connects R72 between the boost feed and chassis on 625 lines to counteract the rise in the boost voltage on this system. The v.d.r. Z2 across the boost feed stabilises the height while v.d.r. Z3 across the field output transformer primary winding limits the field flyback peak voltage and C99 across the secondary bypasses line frequency components which might otherwise be fed back from the field scan coils. Thermistor X1 in series with the field scan coils stabilises the field amplitude and conventional linearity feedback is provided between the anode and grid of the field output valve via C98 etc.

An unusual feature of the field output stage is that instead of the conventional cathode bias the bias is applied to the grid from a point along the heater chain. Rectifier W10 supplies the valve heaters with half-wave rectified d.c. pulses which are negative to chassis. If this rectifier goes short-circuit the heater chain voltages will be excessive, damaging the valves and c.r.t. To draw attention to this condition the a.c. applied to the heater chain when W10 shorts appears in the field timebase giving the sympton of lack of sync. It is important to remember this in the event of a complaint of loss of field hold.

Fault Finding

Fault tracing in this chassis is greatly simplified by the way in which the panel can be swung out and the printed component identifications. Valve checks and visual inspection should always be the first step of course. Check valves for heater glow and signs of overheating, and inspect screen grid and cathode resistors for discolouration. Check electrolytics for leakage. Note that excessive leakage from the main smoothing can may seep down the panel and damage the solenoid assembly which is mounted beneath. Inspect the panel overall for signs of burning or damage to the print leads. Check the soldered ends of high-wattage resistors for dry-joints.

Perhaps one of the most common symptoms on this chassis is a grey picture with no contrast control on one system. The usual cause is that one of the rather flimsy preset contrast control potentiometers (R5, R6) has an open track. The resistors in series with the sliders, R4 and R7, can change value again affecting the range of the contrast control. Weak signals can also be caused (on both systems) by R14, the upper section of the potential divider feeding the screen grid of the common vision and sound i.f. stage V3, going high-resistance or open-circuit. The associated decoupler C10 sometimes shorts or leaks, damaging R14.

With such a large panel intermittent faults due to hair cracks in the print can be difficult to pin-point. When in doubt scrape the varnish off the track and run solder liberally along it. Pay particular attention to the tag ends of the main smoothing can where they project through the panel: cracked solder joints here can give very odd effects.

Power Supply Faults

Valves alight but no h.t. usually indicates that the surge limiter section R125 of the mains dropper is open-circuit. The original h.t. and heater rectifiers W10 and W11 were miniature units: it is worthwhile replacing them with the more robust type BY127 rectifier. Also the original position near the dropper sections led in some cases to failure through overheating: it is preferable to mount the rectifiers on the outside of the panel where they run cooler.

There are six sections of the dropper. R106 is the series feed to the heater rectifier, R125 the surge limiter in the feed to the h.t. rectifier, while R135, R136, R144 and R137 are h.t. smoothing resistors. Since the heater supply is half-wave rectified d.c. a true reading cannot be obtained with an Avo meter. A check from chassis to the d.c. side of W10 should however give a negative reading of just over −80V on an Avo Model 8.

Running an Avo meter along the dropper tags will show whether a.c. is reaching the set (R106 and R125) and if there is a break in any of the h.t. supplies (R135, R136, R144, R137). No d.c. on any of the latter four resistors suggests that the rectifier W11 or R125 is defective.

E H T Tripler

The e.h.t. tripler unit clips on to the line output transformer and contains five pencil elements packed with selenium discs. Failure of one or more of these pencils can cause the picture to balloon and disappear as the brightness is advanced—similar symptoms that is to those obtained with a low-emission DY87 valve. Another fault is a sizzling and apparent line tearing, again affected by the brightness control setting. Individual pencils can be obtained but a quicker and more certain cure is to replace the complete tray. The BRC part number is 6M3-034. Note that there are different trays for different BRC chassis and e.h.t. voltages: they are not interchangeable.

COMPLETE CIRCUIT ON FOLLOWING PAGES

CONTINUED NEXT MONTH

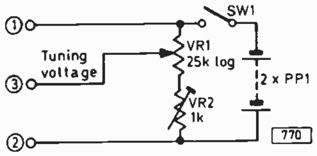


Fig. 2: Circuit of the control unit. VR1 provides channel tuning by varying the bias applied to the varicap diodes D1 and D2.

mounted on the underside of the subchassis. Fig. 3 shows the layout used.

Having cut, drilled and shaped the subchassis solder the feedthrough capacitors and interstage screening. Don't forget to make a cut out in each screen for the transistors. A 60W iron will be needed for soldering to the chassis. Solder as many components as possible before soldering into circuit the transistors and diodes, and use a heatsink—especially when soldering in the diodes.

The coils were wound before attaching the formers to the subchassis. Each coil consists of 9 turns of 26 s.w.g. enamelled copper wire tapped at 2½ turns from the earthy end and slightly spaced. Standard ¼in. diameter x ⅞in. Aladdin formers with dust cores were used and to facilitate construction four-tag tagrings were used to anchor the ends of the coils.

The subchassis is held in place by means of the nuts and bolts that secure the coaxial sockets to the sides of the diecast box. The connections for the −12V supply and tuning voltage are made via a three-pin DIN socket mounted on the lid of the diecast box. Connections were made to the control unit using a three-pin DIN socket and a couple of yards of twin screened audio cable. It is highly advisable to use screened cable in order to prevent any stray hum affecting the diode tuned circuits. As a final point note that one end of the BA110 diode is marked with a grey band: this is the end that is connected to the "hot" end of the input and output coil.

components list

Resistors:

R1	100kΩ	R4	100kΩ
R2	220Ω	R5	100kΩ*
R3	100kΩ	R6	100kΩ*

All 5% or 10%. ¼W carbon. *See text.

Capacitors:

C1	56pF ceramic	C7	2.2pF ceramic
C2	1,000pF feedthrough	C8	1,000pF feedthrough
C3	56pF ceramic	C9	1,000pF disc ceramic
C4	1,000pF feedthrough	C10	1,000pF feedthrough
C5	1,000pF disc ceramic	C11	1,000pF feedthrough
C6	1,000pF feedthrough	C12	56pF ceramic

Semiconductors:

D1, D2 BA110 Tr1, Tr2 2N3823E

Control unit:

VR1 25kΩ log VR2 1kΩ preset
SW1 s.p.s.t. on/off switch
Battery connections, tagstrip, metal box to suit.

Miscellaneous:

Coaxial sockets, 3-pin DIN plugs and sockets.
See text for coil and box details.

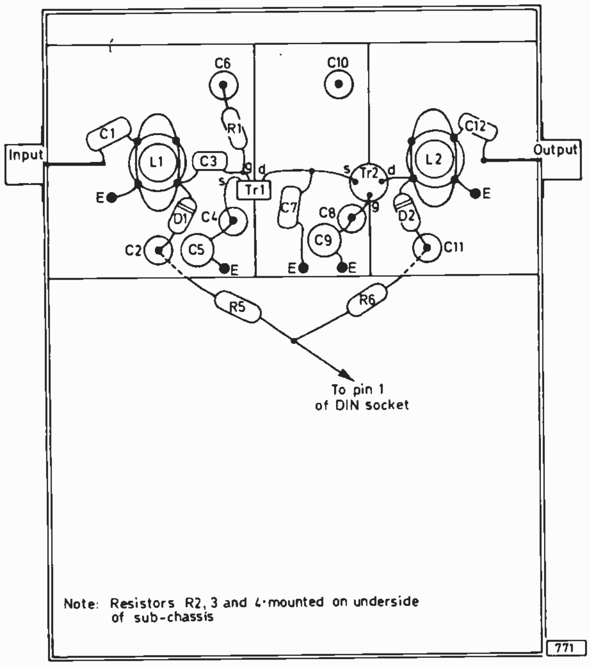


Fig. 3: Layout of the preamplifier which is housed in a diecast box.

Alignment

When initially connecting the preamplifier check first of all that the total current consumption is approximately 5mA, of which 500μA or thereabouts is taken by the diodes.

To align the preamplifier adjust VR2 to full resistance and VR1 to minimum resistance, both with respect to the chassis. Tune the DX TV receiver to Ch. E2; then peak L2, followed by L1, for maximum signal. Next tune the TV set to Ch. E4 and using only VR1 adjust for maximum signal on this channel. Now carefully adjust each coil slightly in turn. You will probably obtain even better gain but obviously at the expense of Ch. E2. The idea of course is to obtain even gain and good tracking over the whole of Band I, so a little "juggling" of core settings is required. Once Chs. E2 and E4 are set up Ch. E3 will be automatically lined up. It may be necessary to run over the adjustments two or three times before the best results are obtained. The "staggering" of the tuning that results from this procedure is conducive to obtaining the best picture quality as too narrow a bandwidth may result in an objectionable loss of definition.

Finally back off the preset potentiometer VR2 a little way. This gives a slight extension to the l.f. range of the preamplifier. I have found it of most help to know that I have in fact peaked the preamplifier on channel 2 and not missed anything!

Calibrate the tuning knob so that you can always tune to the required channel accurately, even when there is no signal present.

Performance

A rough check on the gain was made as follows. A strong Band I signal was located and fed into an up-converter and the resulting (u.h.f.) output measured with a Labgear u.h.f. field strength meter.

—*continued on page 129*

RBM S-S COLOUR CHASSIS

common faults

PAUL E. SOANES

THE 90° single-standard all solid-state Rank-Bush-Murphy colour chassis has been in production since late 1969. A goodly number of modifications have been introduced during this time. Many of the stock faults relate to the power supply circuit (Fig. 1) which is of the stabilised thyristor variety (so far as the h.t. supply is concerned).

Power Supply Faults

No sound or raster with the correct voltage at the mains fuse (8F2) but zero voltage at the anode of the h.t. rectifier thyristor (8THY1) for example is often due to a defective thermistor (8TH2, type VA1104) in series with the feed to the rectifier. The soldered leads from the thermistor can come apart.

No results with a failed mains fuse is in most cases due to a faulty thyristor rectifier (8THY1). Failure of this thyristor can be caused by transients on the mains supply. A modification which has been fairly recently introduced to overcome this problem is to fit an 0·47μF capacitor in series with a 33Ω resistor from the junction of 8L1/8TH2 to chassis as shown in our circuit. The capacitor should be of good quality with an a.c. rating of around 300V.

The bridge rectifier (8BR1) providing the l.t. supply is also a source of trouble. In earlier versions it is a BY164; in later versions four BY126 rectifiers are used. On failure of the bridge the l.t. fuse 8F1 blows leaving the tube heaters glowing as the only visible sign of life.

The symptom of a fluctuating or pulsating picture is due to the h.t. line varying. This trouble is due to either the thyristor (8THY1) or the zener diode (8D2) in the base circuit of the regulator transistor 8VT1 being faulty.

A case of sound but no picture led us to remove the back of the receiver to take a look for anything obviously wrong. It turned out that the neon (5N1) in the overload protection circuit (Fig. 2) on the scan drive panel (type A803) was alight. When this neon strikes the base of 5VT3 becomes biased by the voltage at the junction of 5R11/12 and as a result it conducts heavily, shunting the line oscillator tuned circuit (5L3 etc.) so that the oscillator no longer functions and there is no line drive. The neon strikes when the h.t. voltage rises above the correct value of 200V. The voltage at the h.t. fuse 8F3 was checked and found to be high at around 240V. Adjusting the set e.h.t. control 8RV1 (Fig. 1) had no effect so it was clear that the h.t. stabilising circuit was not functioning. Checks were then made of the regulator transistor 8VT1 voltages and the normal base voltage of −1·5V was found to be missing. This suggested that the feedback resistor 8R9 (390kΩ) might be open-circuit: on checking this was found to be so and on replacing it and resetting the h.t. voltage to 200V (by means of 8RV1) the picture was restored.

Overvoltage Setting

Correct overvoltage protection circuit adjustment is important in order to protect the line output transistors. The procedure is as follows. Switch off the receiver and connect a 220kΩ resistor from the h.t. fuse 8F3 to the junction 5R11/5R12/5N1. Switch the receiver on and adjust 5RV1 until 5N1 just strikes. Switch off and remove the 220kΩ resistor. The setting of 5RV1 should not be altered after this procedure has been carried out.

Line Output Stage Faults

In another case of sound but no picture we started taking voltage readings and found that the h.t. was missing on one side of the h.t. fuse 8F3. Were we to consider this an isolated case of fuse failure, or was a fault condition present? We looked around for any burnt or disfigured components and found that 6R7 (Fig. 3, 2·7kΩ) on the scan control panel was badly discoloured. This resistor is in series with the rectifier (6D2) which provides the supply to the c.r.t. first anode presets and the fault appeared to be likely to be due to the associated reservoir capacitor 6C13 (0·01μF) shorting. A meter test on the capacitor proved this assumption to be correct. 6D2 was also checked with the meter in case it had been damaged but was found to be satisfactory. Replacing 6R7, 6C13 and the fuse restored the picture.

A short-circuit in any of the following components will result in 8F3 blowing: the line output transistors (6VT1 and 6VT2); the 4,700pF capacitors 6C5 and 6C6 which shunt the line output transistors and serve to equalise the peak flyback voltages appearing across them (a different type of capacitor is used in later models and failure is rare with these); the scan-correction capacitor 6C3 (0·47μF); the rectifier 6D3 (BA148) and its associated reservoir capacitor 6C11 (200μF) which provide the horizontal shift potential. A short in the pincushion distortion correction transductor 6T3 has also been known to result in 8F3 blowing.

As already mentioned no e.h.t. will result if the neon in the overload protection circuit strikes, removing the line drive. Failure of the line output transistors will also remove the e.h.t. of course: if it is necessary to replace them it is worth checking the value of their 2·2Ω series base resistors (6R1 and 6R2) since these sometimes change value with the

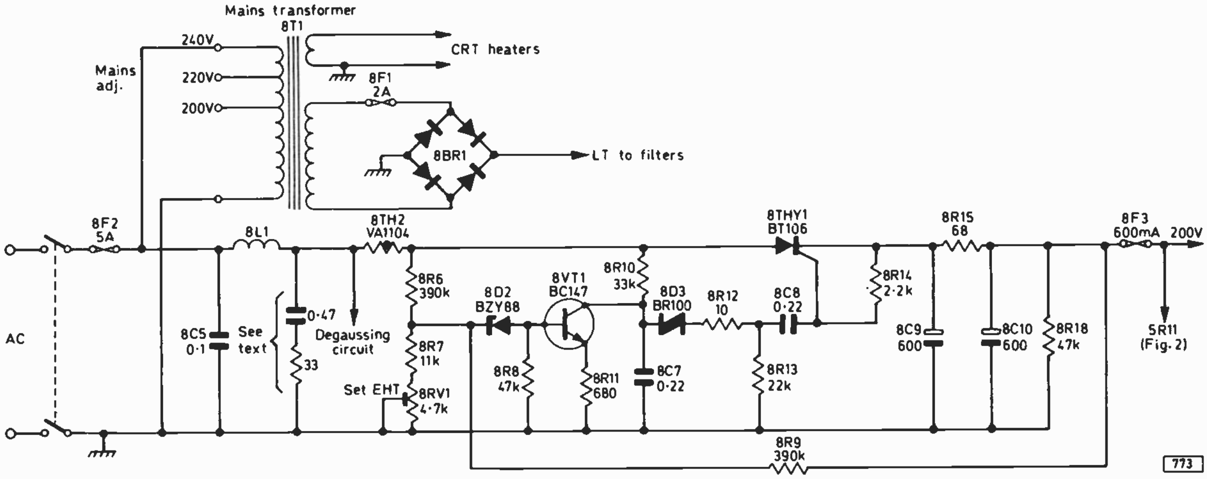


Fig. 1: Power supply circuits of the RBM single-standard colour chassis. 8R13 has been reduced to 1kΩ in current production and this modification is recommended where field jitter is experienced.

result that the transistors fail. 6R6 in the output transistor flyback voltage balancing circuit can overheat in the event of faulty output transistors.

The symptom of a defocused picture is occasionally encountered. This would occur if the e.h.t. was low of course—it should be 25kV. If the e.h.t. is correct check the voltage at point 4Z3 (focus potential connection) on the tube base panel. This should be around 4kV but can be low—say around 1kV. The component to suspect is 6R10 (4·7MΩ) in series between the e.h.t. tripler and the focus v.d.r. 6VDR1. We have found this to increase in value to over 10MΩ. Replacing it and adjusting the focus should restore a normal picture.

A point to be remembered when replacing 6R10 is that it is essential not to leave any spiky soldered joints at its hot end. Otherwise the focus lead to the tube base could be damaged. It could also cause ionization of the focus assembly which if damaged would have to be replaced.

On occasions 6R10 has gone completely open-

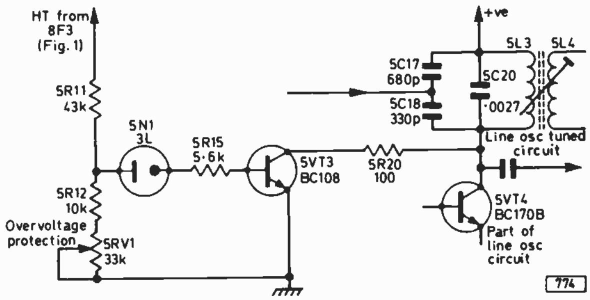


Fig. 2: The overvoltage circuit stops the line oscillator if the h.t. voltage rises excessively, resulting in no line drive and consequently no e.h.t.

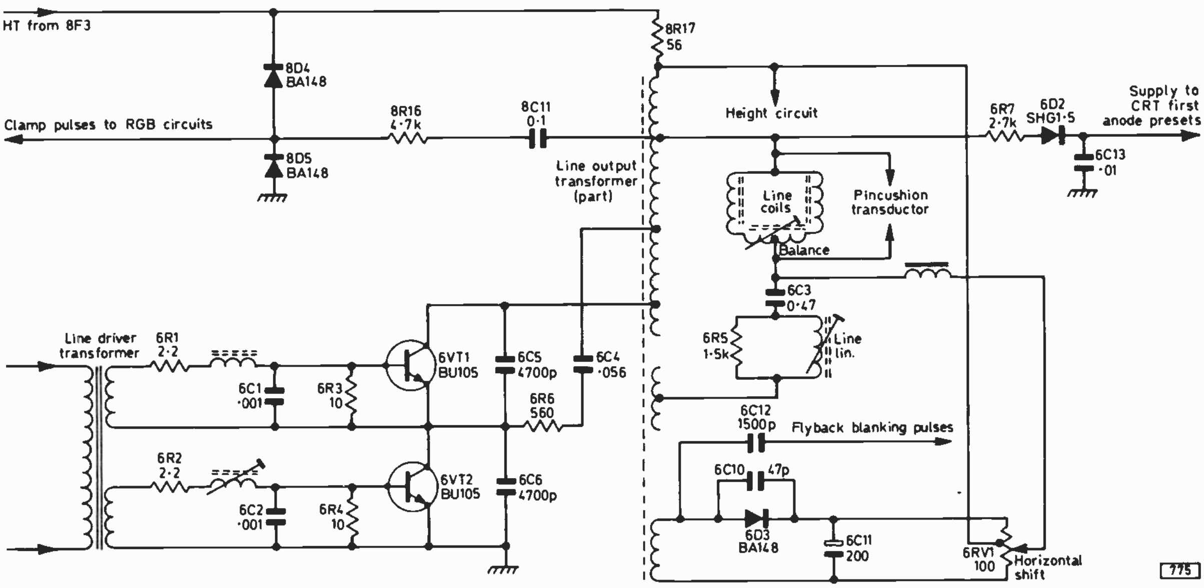


Fig. 3: Line output stage circuit (part only shown). In later production sets 6R6 and 6C4 have been deleted.

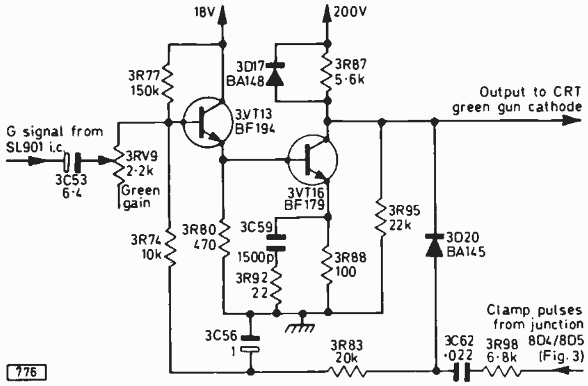


Fig. 4: The G channel. The circuits of the R and B channels are identical. The clamp pulses are also inverted and fed to the SL901 i.c. via the brightness control which thus acts on the clamping level.

circuit giving the symptom of no brightness. This is a rather misleading condition at first sight.

Electrolytic Faults; Intermittent Colour

As usual, electrolytics can give rise to various troubles. 5C5 (400μF) for example which decouples the supply to the sync separator can be responsible for weak field sync. 3C43 (100μF) which decouples the supply to the second burst gate/crystal driver in the decoder can be responsible for intermittent colour drop out.

The ident/colour-killer bias source transistor 3VT11 (BC158) on the decoder panel can also give the latter symptom when it is faulty. When it goes open-circuit colour disappears completely. Its collector voltage should be 17·3V on a colour transmission (0·6V on monochrome). To over-ride the colour-killer action on this chassis link test points 3TP11 and 3TP14 on the decoder panel.

Receiver Unit

On earlier versions fitted with i.f. unit type A809 problems of caption buzz and distorted sound were common. In some instances this was due to a faulty intercarrier sound i.c. (TAA350) but usually the 0·1μF decouplers 2C67, 2C68 and 2C69 on pins 4, 9 and 7 respectively of the i.c. were the cause of the trouble. We have found that after replacing the TAA350 the easiest way of adjusting the input tuned circuit (2L26/2L27) without any equipment—e.g. when making a replacement in a customer's home—is to reduce the contrast and i.f. gain so that a picture just locks, then to adjust 2L26 and 2L27 for minimum buzz. In later models buzz was eliminated by using a modified i.f. panel.

Faulty 0·01μF decouplers in the i.f. strip can cause unstable sound and vision. It is best to replace them with disc types.

Line Collapse

Line collapse—with a line approximately two inches wide—is likely to be due to the R/G horizontal tilt control 7RV3 in the convergence circuit being faulty. This component carries the line scan earth return current. Its value is 7Ω and it tends to burn out.

Brightness Trouble

The symptoms of varying and no control of brightness were fault conditions often encountered with earlier versions of this chassis. The cause of this was usually capacitor 8C11 (Fig. 3, 0·1μF) being open-circuit. It is mounted on the bottom chassis near the smoothing capacitors and feeds flyback pulses from the line output stage to the brightness control and RGB clamp circuits on the decoder panel. When it goes open-circuit the pulses are missing and the RGB output stages are no longer clamped, resulting in no control of brightness.

Clamp Fault

The complaint of a green picture led to rather a lot of checking. With the colour control at minimum the fault was still present and adjustment of the brightness and contrast controls still left green predominant. The chassis employs RGB drive and from these symptoms we concluded that the fault was in the green channel on the decoder panel. The circuit is shown in Fig. 4.

We first checked the supply voltages to the pre-amplifier (3VT13) and output stage (3VT16). These proved to be correct. We next tried transistor voltage checks. The voltages at the base (4·5V) and emitter (4·2V) of the preamplifier transistor were high; the base (4·2V) and emitter (3·5V) voltages of the output transistor were both high while its collector voltage was very low at 17·5V. Since the circuits used in the R, G and B channels are identical clues can be obtained by checking for the sake of comparison the voltages in the other channels. The result of doing this led us to look more closely at the G preamplifier stage. Since the preamplifier stage uses an npn transistor and the base voltage was above normal this would explain the other incorrect voltages—the higher emitter voltage as a result of the increased conduction of the preamplifier transistor and the incorrect output stage voltages since this is d.c. coupled to the preamplifier. It seemed likely therefore that the preamplifier biasing was incorrect and our next check was to substitute the coupling capacitor 3C53 at its input in case this was leaky. There was no change however. The base resistors 3R77 and 3R74 were found to be within their tolerance and the transistor itself, after being taken out of circuit and checked, proved to be in order. Attention was then turned to the feedback clamping arrangement used. The clamp diode 3D20 was checked and found to be o.k. We next measured 3R83 and found it to be open-circuit. Replacing it restored correct voltages in the G channel and a normal picture. The electrolytic 3C56 was not checked but since the charge which is established on this serves to set the bias at the input to the G channel it would if defective affect the colour balance.

Defiant Models

Single-standard colour sets distributed by the Co-op under the Defiant brand name are also fitted with the RBM chassis dealt with in this article.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

OCTOBER reception generally has followed the direction of the Autumn leaves—downwards! Fortunately there were two welcome respites, an unexpected period of Sporadic E during the middle of the month and a marked improvement in the tropospheric scene at the end. Indeed the latter spell brought its reward with two new ORTF (French) network stations, Niort ch.E22 and Amiens ch.E44. The rather elusive CLT (Luxembourg) transmitter has been well received on its u.h.f. outlet, at times equalling the Lille ch.E21 transmitter in signal strength: the Band III ch.E7 transmitter remains very reluctant to show itself however. The log here for the period follows:

1/10/73 TVP (Poland) ch.R1; DFF (East Germany) E4—both MS (meteor shower).
2/10/73 DFF E4—MS; SR (Sweden) E4—SpE.
5/10/73 DFF E4; CST (Czechoslovakia) R1—both MS.
6/10/73 DR (Denmark) E4—MS.
7/10/73 DFF E3, 4; MT (Hungary) R1—all MS; unidentified SpE signal on ch.R1 at 1800.
8/10/73 SR E4—MS.
9/10/73 DFF E4—MS.
11/10/73 CST R1; MT R1; ORF (Austria) E2a; SR E2, 3—all MS.
12/10/73 TVP R1; WG (West Germany) E2; CST R1—all MS.
13/10/73 TVP R2; DFF E4; DR E4—all MS.
14/10/73 TVP R1, 2; DFF E4—all MS.
15/10/73 SR E4—MS.
16/10/73 TSS (USSR) R1; TVP R1; DFF E4; SR E2—all MS.
17/10/73 DFF E4; DR E4; SR E3—all MS.
18/10/73 CST R1; TVP R1; SR E4; TVE (Spain) E2—all MS.
19/10/73 DFF E3, 4; DR E3—all MS.
20/10/73 TVP R2; CST R2; DFF E4; DR E3—all MS; unidentified SpE signal on ch.R1 at 2000.
21/10/73 DFF E4—MS; TVE E2, 3, 4—SpE, afternoon; MT R1, 2; Albania IC; WG E2; JRT (Yugoslavia) E3, 4; also many unidentified SpE signals 1800-2100 up to ch. R4.
22/10/73 TVP R1; DFF E4; ORF E2a—all MS; SR E4; CST R1; TSS R1, 2—all SpE; also several unidentified SpE signals up to ch. R3.
23/10/73 CST R1; TVP R1; DFF E3, 4; SR E2—all MS.
24/10/73 DFF E4; CST R1—MS.
25/10/73 TSS R1; CST R1—both MS; improved tropospherics in to ORTF, BRT (Belgium), NOS (Holland) and CLT (Luxembourg) at u.h.f.
26/10/73 DFF E4; DR E4—both MS; improved trops into ORTF, BRT and NOS at u.h.f.
27/20/73 SR E2—MS; also improved trops including unidentified ORTF-2 station on ch. E52 to SSE.
28/10/73 CST R1; DFF E4—both MS; also improved tropospherics notably BRT up to ch. E61.
29/10/73 DFF E4; SR E2—both MS.
30/10/73 DFF E4; DR E3; CST R1—all MS; also improved tropospherics with a very weak ch. E21 Monschau WG.

At the time of writing a stationary high-pressure system covers the Southern UK and all being well when it departs and a slight drop in air pressure occurs the tropospherics should "open up". One point worth noting relates to my reception of CST on October 23rd at 0840: the usual CS U 01 type pattern was observed carrying an alternative identification. Preceeding the conventional identification which was in its normal position was a series of smaller letters unfortunately too small to be deciphered in the rather short MS burst. Has anyone else seen this?

The WTFDA bulletin recently came to hand and carries a report which is a rather depressing sign of the times. Apparently in the Chicago area there is considerable pressure on radio frequency space for business communications and the FCC (Federal Communications Commission) is testing the feasibility of allowing such communications within "vacant" TV allocations. Chicago is the first test area where ch. A14 (471-476MHz) is being used for such two-way communication and the FCC is seeking any reports of interference etc. with television viewing. The WTFDA comment that if complaints are few the practice of using "vacant" channels is likely to spread to other areas and that the situation must be closely watched and any problems reported to the FCC.

"Exotic" Test Cards

In the next few columns we shall be featuring "exotic" test cards—that is cards used in the more distant parts of the globe. All shots have been lent by our friends Keith Hamer and Garry Smith of Derby. The first photo in this series shows the well known test card C as used by one of the commercial stations at Recife, Brazil on ch. A2.

News

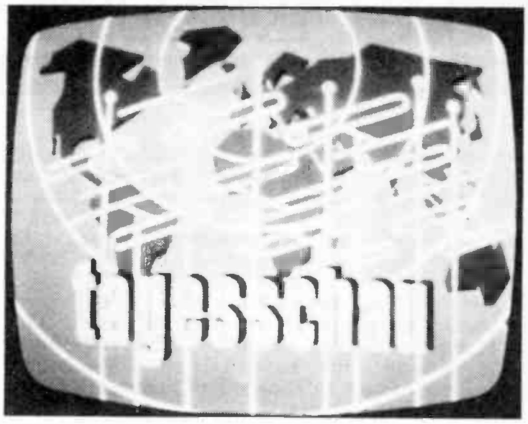
Yugoslavia: A new high-power Band I transmitter is now operating atop Mt. Pellister in Macedonia. The 5kW transmitter unit came into operation in late August at its 8500ft high site. We do not know the channel yet but are seeking information on the frequency.

Greece: Further u.h.f. coverage is indicated by news of a recent order from the Greek Government for a ch. E23 transmitting array to be erected atop a 100m self-supporting mast at the highest point on Thassos Island to serve the Greek mainland around Kabala. A 1000kW transmitted e.r.p. will be employed.

An "exotic", test card C as used by Jornal do Commercio Recife, Brazil (courtesy K. Hamer).

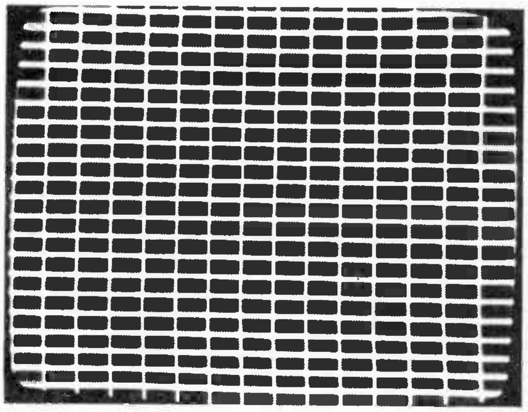
DATA PANEL 29—2nd Series

Typical West German transmitter identification slide.



West German news caption.

Unter brechung—breakdown/interval caption, West Germany.



Test grid used by the DFF (East Germany) second network.

Photographs courtesy of Dieter Scheiba (Brussels) and P. F. Vaarkamp (Holland).

Zaire (ex Congo Republic): A large order for colour broadcasting equipment has been placed with RCA to augment television facilities in Kinshasha though the commencement date has yet to be announced. System B transmissions are in operation (channel unknown) with a set count of 6,500.
USSR: The new radio/TV centre at Kiev, Ukraine has been equipped with a 380m high tower radiating three TV programmes at present with an eventual target of five.
South Africa: The television service opening will be on January 1st 1976 in PAL colour and at that date will be available to 80% of the population. An exact 50:50 ratio of programming in English/Afrikaans is aimed for. We understand that the transmitting array for the television service at Johannesburg is already in situ and that test transmissions are not far off. There will be no regional variations. The master control will be at Johannesburg although a small studio facility will be opened at Cape Town later.
Hong Kong: Two new transmitters are shortly to come into operation—RTV-1 and RTV-2. RTV-1 will transmit in Cantonese, Mandarin and other Chinese dialects from approximately 1400-2400 local time. RTV-2 will transmit in English (some programmes will have Chinese subtitles) from 1700-2400. Although the channels have not been indicated they are likely to be in Band IV (u.h.f.) to compete with the present ch. E21 and E25 outlets of HK-TVB. PAL colour at 625 lines will be used.
Tunisia: SECAM colour transmissions are due to commence before the end of the year over the whole network. We understand that one of the transmitters is carrying Italian language programming.

Wideband Band I Aerial

There has been considerable interest in the various wideband Band I arrays we have featured in the past. Yet another type (see Fig. 1) has been evolved and two months of testing confirms that it works very well for both SpE and tropospheric signals. This design is unusual in being much smaller than previous ones, requiring a boom length of only 43in. maximum. As will be noticed it is a variation on the well known Antiference "Trumatch" design. The dipole consists of two elements, an active dipole cut to 109in. and a passive element cut to 87¾in. The reflector is cut to 119½in. This gives a bandwidth of 47-65MHz—the elements are cut to 47MHz (reflector), 51·5MHz (dipole) and 65MHz (passive dipole). Connection is via conventional 75Ω coaxial feeder.

Increased gain could be obtained by adding a director ahead of the 87¾in. element, also cut to 87¾in. and spaced at 27in. The array performs well over the bandwidth in its original version as shown however.

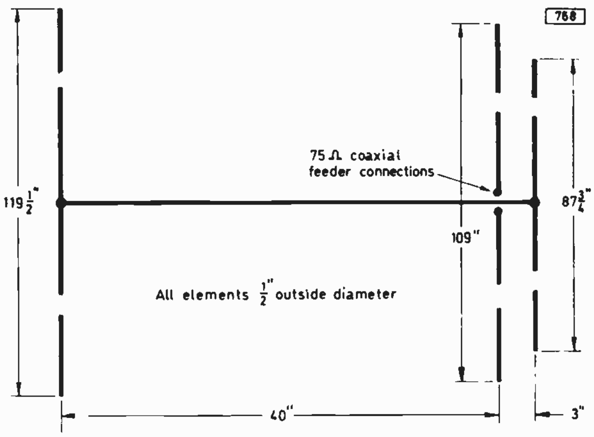


Fig. 1: A new wideband Band I array.

From Our Correspondents . . .

Increasing numbers of ORTF-3 transmitters are coming into operation. The following information on projected openings and channels has been received from M. C. Minot of Saint-Denis, France. We include only the high-power transmitters and those in areas reasonably close to the UK but can provide the full list on request. All transmitter powers are before aerial gain, i.e. *not* e.r.p.

Parisienne		
Paris-Tour Eiffel	50kW ch. E28	In operation.
Alsace		
Strasbourg-Nordheim	50kW ch. E43	In operation.
Mulhouse	50kW ch. E24	In operation.
Champagne		
Reims	50kW ch. E40	First half 1974.
Troyes	50kW ch. E21	First half 1975.
Mezieres	20kW ch. E26	First half 1976.
Nord		
Lille	50kW ch. E24	In operation.
Dunkerque	4kW ch. E45	Second half 1974.
Boulogne	4kW ch. E37	First half 1975.
Basse-Normandie		
Caen	50kW ch. E28	First half 1974.
Cherbourg	4kW ch. E62	First half 1976.
Alencon	4kW ch. E54	Second half 1976.
Haute-Normandie		
Rouen	20kW ch. E26	First half 1974.
Le Havre	20kW ch. E40	Second half 1974.
Neufchatel	4kW ch. E54	Second half 1976.
Pays de la Loire		
Nantes	50kW ch. E26	First quarter 1974.
Le Mans	50kW ch. E21	Second half 1974.
Laval	4kW ch. E60	First half 1976.
Picardie		
Amiens	20kW ch. E44	In operation.
Abbeville	20kW ch. E60	First quarter 1974.
Hirson	20kW ch. E51	First half 1977.

We assume that the following will apply: 50kW = 1000kW e.r.p.; 20kW = 500kW e.r.p.; 4kW = 100kW e.r.p.

John White (Scunthorpe) has written telling us of his successes using an up-converter. These include various Danish, West German, Dutch and Belgian Band III transmitters. Despite having only a wideband Band I array he has also logged two Swedish u.h.f. transmitters on chs. E42 and E49. It shows what can be received on quite simple equipment when conditions are "just right".

A very long letter has arrived from D. Minns of Bahrain, Arabian Gulf describing TV conditions in this area. Several important points come up in this letter. Bahrain has one transmitter on ch. E4 operating with PAL colour. Transmissions commenced in August 1973. The e.r.p. is approximately 10kW with an increase forecast. The identification is "RTV Bahrain" with a stylized flower in the three primary colours to the left of the raster and a large Arabic 4 (٣) with other Arabic writing to the right. The usual test card is the grey scale but at times test card F with "RTV" identification is radiated. Some 25 miles distant is the Dhahran transmitter of Aramco (Arabian American Oil Co.) operating on ch. A2 (i.e. 525 lines, 60 fields, 45.MHz sound). This station uses the Indian Head pattern (has anyone a shot of this for our exotic test card series please?) which changes five minutes before programmes start to a circular type grey scale (often known as the bulls eye pattern) with the identification HZ22 in the centre. Whereas the RTV Bahrain programmes are partly in English and partly in Arabic the HZ22 programmes are all in English. Aramco also provides f.m. stereo radio incidentally. Further information from this letter must be held over until next month. Sufficient to say in conclusion that a mystery ch. E2 transmitter is operating in the Gulf area suspected to be in Iran.

VARICAP/FET PREAMPLIFIER

—continued from page 123

The preamplifier was then connected in circuit and the output measured. A Ch. B3 signal was boosted from 60μV to 750μV, a similar increase being noted on Ch. B4. This indicates a gain of approximately 24dB.

Off-screen results indicate the very good noise figure of this preamplifier. Even when connected in front of a TV set with a transistor v.h.f. tuner and i.f. strip a noticeable reduction of "snow" on weak transmissions was observed. In front of an old all valve receiver weak "wishy-washy" pictures were brought up to solidly-locked noisy pictures—as good as those obtained using the previously mentioned transistor receiver.

Two prototypes were originally constructed, both for Band I. One has since been modified for Band II and using 7 turns a coverage of about 68-90MHz was obtained. This unit is used in conjunction with a Labgear up-converter feeding into the u.h.f. aerial socket of one of the TV sets. So far good results have been obtained from the USSR, Rumania, Italy, and Hungary on Chs. R3, IC and R4.

The whole thing originally started off as a simple experiment and I had no idea that the amplifier would prove so successful. Field effect transistors certainly seem to be capable of extremely good performance, at least as good as bipolar transistors as regards noise figure and gain and, from the manufacturer's data, much better as regards cross-modulation.

The 2N3823E transistors and BA110 diodes can be obtained from A. Marshall and Son Ltd., G. W. Smith and Co. or Henry's Radio Ltd. ■

PART 2

COLOUR BRIGHTNESS CONTROL

S. GEORGE

As we saw in Part 1 brightness control in a colour receiver cannot be applied directly to the c.r.t. because of the need to keep the three c.r.t. beams correctly balanced to avoid incorrect tinting, i.e. interference to the grey-scale setting. When colour-difference c.r.t. drive is employed we saw that the brightness control is usually linked to a d.c. restorer or clamp in the luminance output stage. With RGB drive we don't have a luminance output stage driving the c.r.t. of course so the brightness control action must be arranged to have an equal effect in the R, G and B channels. Once again a.c. coupling is generally employed somewhere in these channels to avoid the problem of drift and this means that d.c. restoration or clamping is needed. Brightness control can again be achieved therefore by linking the brightness control potential to the restorer/clamp action. Some of the clamping arrangements used in sets with RGB drive are quite complex, often involving a feedback loop. Operation becomes clearer however once this basic feature is appreciated.

Colour-difference drive has the advantage that although the separate luminance and colour-difference signals must all be correctly related to black level nevertheless imperfections in clamping the colour-difference signals have no real effect on a monochrome display or from black through the grey scale to white on colour reception. Grey-scale tracking is rather more critical with RGB drive, while in addition the three R, G and B channels must be matched for frequency response, gain and linear input/output characteristics. RGB drive on the other hand has the advantage that smaller peak-to-peak outputs more suited to transistor capabilities are required while with cathode c.r.t. drive the grids afford considerable protection for the output transistors against e.h.t. flashovers within the tube.

D C Coupled Circuit

Before looking at clamping arrangements used in RGB circuits however we will take a look at the circuitry used in the Hitachi PAL receivers being sold in the UK. These employ d.c. coupling from the video detector through the luminance channel and from the R−Y and B−Y synchronous demodulators through the RGB channels to the c.r.t. cathodes. This affords a simple introduction to RGB circuitry therefore. Fig. 1 shows the circuit of the luminance channel and one of the RGB channels (the others are basically the same). The brightness control is set well back in the luminance channel, setting the bias at the emitter of the second luminance amplifier TR12.

The negative-going output from the vision detector (a separate detector is used for the 6MHz intercarrier sound and chrominance signals) is d.c. coupled to the emitter-follower TR11 whose output, developed across R303, drives TR12. The emitter potential of TR11 is thus the base potential of TR12 while the brightness control sets TR12's emitter potential: the brightness control thus sets the forward bias applied to TR12 and its mean collector voltage. As a result of the continuous d.c. coupling of the succeeding stages any variation in TR12's mean collector voltage is amplified and transmitted through the circuit to the c.r.t. cathodes. The important point is that each beam in the c.r.t. is affected similarly by variations in the brightness control setting. The contrast control is also placed in the TR12's emitter circuit. This varies the negative feedback developed in its emitter circuit, the electrolytic capacitor C304 preventing changes in the setting of the contrast control affecting the d.c. conditions established by the brightness control.

Line flyback blanking is undertaken at the base of the third luminance stage TR19 to which in addition to the luminance signal from the luminance delay line DL301 positive-going line flyback pulses are applied via L303, R312, C307 etc. Field flyback blanking is achieved by feeding blanking pulses to the R−Y and B−Y demodulators. Applying the line and field flyback blanking to different points in the circuit ensures greater freedom from line pairing or bad interlace by preventing line pulses reaching the field generator. Both sets of flyback pulses pass through the video circuitry to cut off the c.r.t. during the flyback periods. Negative-going excursions of the line flyback waveform are removed by CR12 while CR11 protects the base-emitter junction of TR19 by conducting to ensure that the amplitude of the positive-going flyback pulses at TR19 base do not exceed the potential at the junction R339/R340.

TR19 is connected in the emitter circuits of the R, G and B output transistors. Thus the luminance signal appearing at its emitter is simultaneously introduced into the R, G and B channels. The demodulated colour-difference signals, R−Y in the circuit shown in Fig. 1, travel via preamplifier stages to the base of the appropriate output transistor which therefore in addition to driving the c.r.t. also carries out the signal matrixing to derive the appropriate primary-colour signal from the luminance and colour-difference signals applied to it.

BRC 8000 Chassis

The RGB circuitry used in the comparatively recent BRC/TCE 8000 chassis is shown in Fig. 2. The RGB circuits are all d.c. coupled through to the

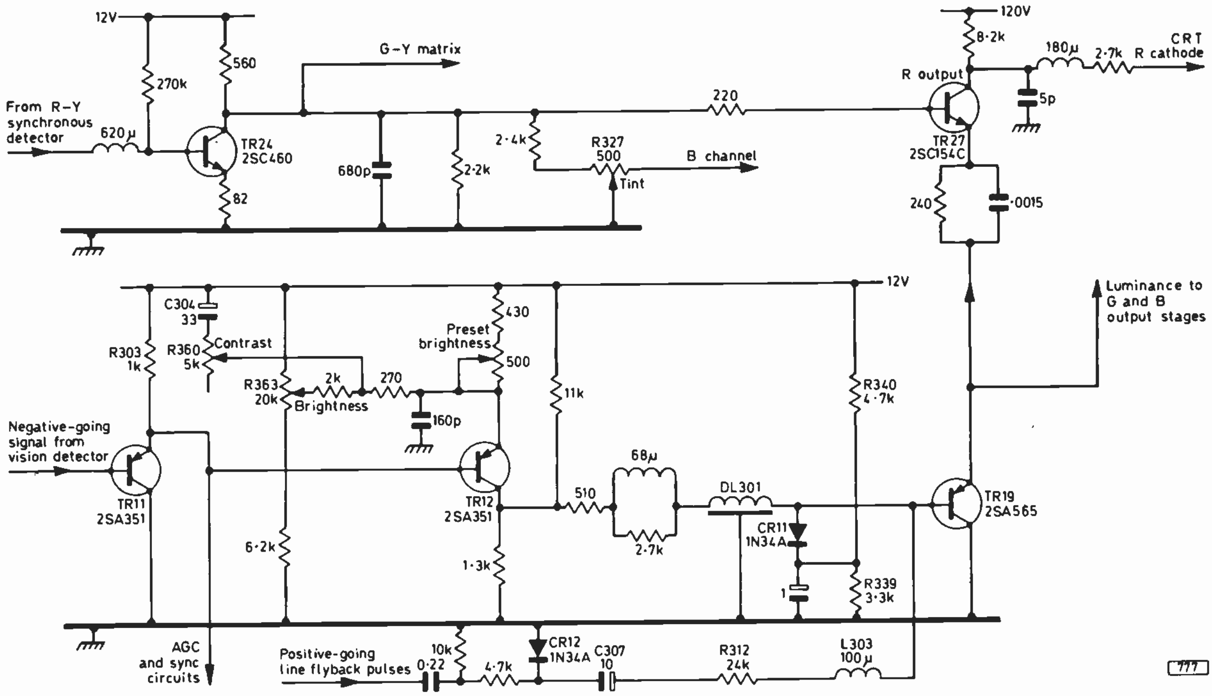


Fig. 1: Circuit of the luminance channel and one of the RGB channels in the Hitachi colour chassis. The brightness control adjusts the bias at the emitter of the second luminance transistor TR12. Since the circuit is d.c. coupled throughout this in turn varies the drive applied to the three c.r.t. cathodes.

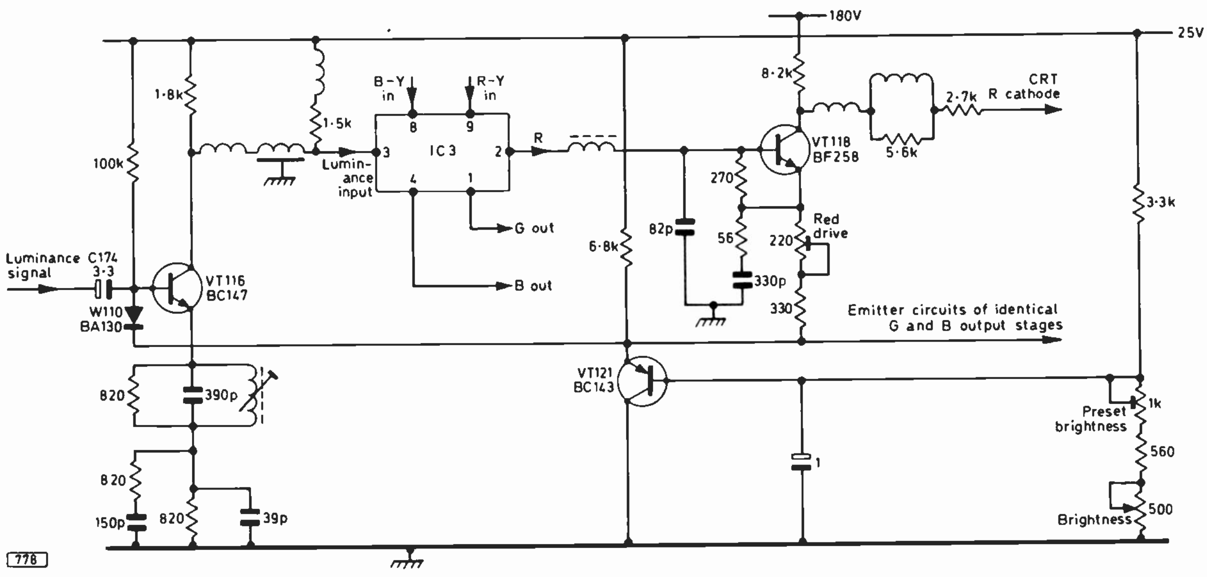


Fig. 2: The emitters fo the RGB output transistors in the BRC 8000 chassis are returned to chassis via VT121 whose base bias is set by the brightness control. The cathode of the d.c. restorer diode W110 is also returned to VT121, whose emitter voltage thus determines the d.c. potential on which the luminance signal (negative-going at VT116 base) is imposed. The overall gain of the output stages, and the luminance level, are thus varied by the action of the brightness control.

c.r.t. cathodes but a.c. coupling (C174) is used at the input to the luminance amplifier VT116. The d.c. restorer diode W110 follows C174 and its cathode is returned via the emitter-base junction of VT121 to the brightness control circuit. We thus have an arrangement similar to the type of circuit described in Part 1. In addition the emitters of the R, G and B output transistors are returned to the same "brightness source", VT121 emitter. Thus changes in the brightness control setting have the same effect on each c.r.t. beam. Matrixing of the luminance and the colour-difference signals in this chassis is

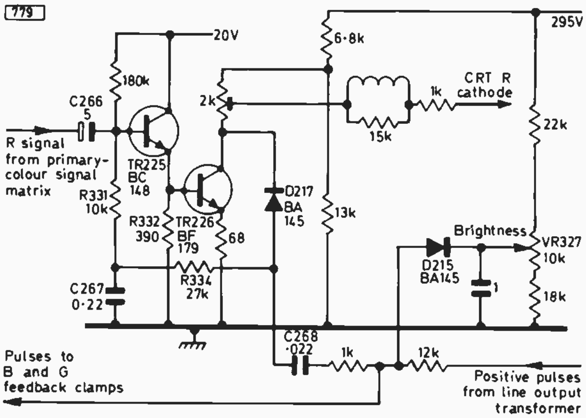


Fig. 3: Feedback clamps are used in the RGB channels of the Decca Series 10 colour chassis. The brightness control sets the amplitude to which the clamp pulses are clipped and thus the action of the three clamps.

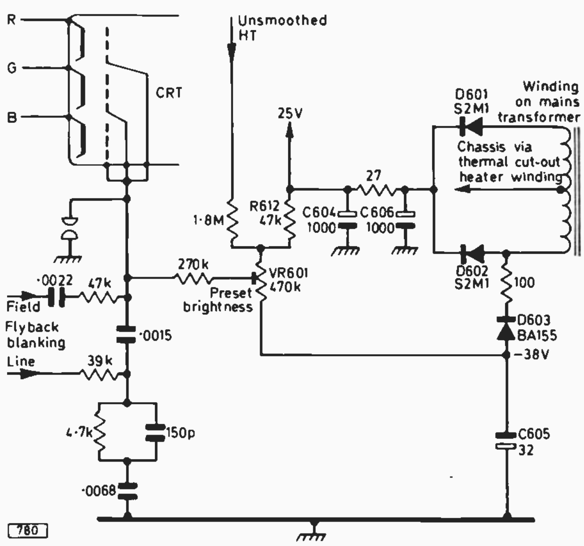


Fig. 4: The preset brilliance control circuit used in the Decca Series 10 chassis. The main brightness control establishes the c.r.t. cathode voltages during the blanking periods: the preset brightness control by varying the potential applied to the c.r.t. grids sets an optimum operating range for the main brightness control.

carried out in the MC1327PQ i.c. (IC3) at low level—in contrast to the high-level matrixing used in the Hitachi chassis. IC3 also contains the chrominance synchronous demodulators, the PAL switch, the G−Y matrix and the flyback blanking system.

Feedback Clamp

As an example of a feedback clamp system Fig. 3 shows the R channel of the Decca "Bradford" chassis—the G and B channels are identical. Similar RGB circuitry is used in the single-standard RBM and ITT/KB colour chassis. The matrixing to obtain the R, G and B primary-colour signals is again carried out at low level. A.C. coupling is used in these circuits at the input to each channel—via C266 at the input to the R channel (TR225 base) in Fig. 3—with d.c. coupling thereafter through to the c.r.t. cathodes. D.C. feedback is applied from the collector of the output transistor TR226 via D217, R334 and R331 to the base of the preamplifier transistor TR225 and the clamping required, also the brightness control action, is introduced in this feedback loop.

The base of the preamplifier transistor TR225 is biased by a potential divider but instead of the lower limb of this (R331) being returned to chassis it is taken to the capacitor C267. This in turn is linked via the d.c. feedback loop comprising R334 and D217 to the collector of the output transistor TR226. Positive-going clamp pulses are fed via C268 to the junction of D217 and R334 If they exceed the voltage at TR226 collector D217 conducts and C268 acquires a negative charge which passes via R334 to C267. As a result TR255 conducts less, the voltage across R332 falls, TR226 also conducts less and its collector voltage rises. This process occurs until D217 no longer conducts when a clamp pulse arrives and the d.c. conditions are thus stabilised. The clamp pulse arrives at the end of each line when the collector voltages of the three output transistors should be at the same level. As the same clamp pulse is applied to the clamp in each channel the drives to the three c.r.t. guns are equalised. Thus if the amplitude of the clamp pulse is varied the overall picture brightness level changes—the circuit capacitance maintaining the correct bias conditions during the following line period. For this reason the positive-going clamp pulse feed is returned via D215 to the slider of the brightness control VR327. D215 clips the clamp pulses to the level set by VR327 slider which thus sets the clamping level in each channel and the basic drive level applied to each c.r.t. gun. The action of a feedback clamp circuit is fast and in consequence very effective.

To increase the brightness control range in this chassis the circuit shown in Fig. 4 is used. This permits considerable variation in the potential applied to the c.r.t. grids. A winding on the mains transformer supplies the full-wave rectifier D601/D602 which produces an output of approximately 25V across its smoothing capacitor C604, and also D603 which produces a negative output of approximately −38V across its reservoir capacitor C605. The preset brightness control VR601 is connected in series with the limiting resistor R612 across these supplies and thus provides a wide variation in the c.r.t. grid potential, enabling the main brightness control to operate from an optimum position. Line and field flyback blanking are also applied to the c.r.t. grids.

IC Clamp

The basic idea of using the brightness potentiometer to control the clamping action in RGB circuits is widely used. Some chassis use rather more complex arrangements than those illustrated here however. The most recent colour chassis make greater use of i.c.s—see for example the four i.c. decoder circuit shown in Fig. 1 on page 19 of the November issue. Here again an a.c. coupling is found, the 68μF electrolytic feeding the luminance signal to pin 3 of the TBA560. The necessary clamping occurs within this i.c.: the brightness control is connected to pin 6 and acts in the same basic manner as outlined above. ■

SERVICING television receivers

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GEC SERIES ONE CHASSIS—cont.

Line Oscillator

The next common offender in the line timebase is the PCF802. This doesn't as a rule stop oscillating so there is still something on the screen even if it is only a mass of lines. The clue is that the hold control has no effect at all over its travel. A replacement valve will nearly always put things right but a word of warning to newcomers: let the set cool off before fitting the new valve. If a cold valve is fitted with the PY88 and PL504 still warm they will operate long before the PCF802 and will therefore overheat. The PL504 may not mind this too much but the PY88 will probably short internally which means two valves to be fitted instead of one.

Once in a while one or both of the discriminator diodes (block D201-D202) may go open-circuit. If the back-to-front resistance of each half is much different replace the block with a pair of matched diodes, e.g. BA144 or similar. Check associated components if necessary.

Field Timebase

A PCL85 is used in the time honoured field timebase circuit which has been employed, with only very minor alterations, in practically every receiver from this stable over the past ten years. It should be reliable therefore and is except for the 1·2MΩ boost line feed resistor R230 (from the line output stage to the height control). This rises in value to give ever increasing loss of height outside the range of the

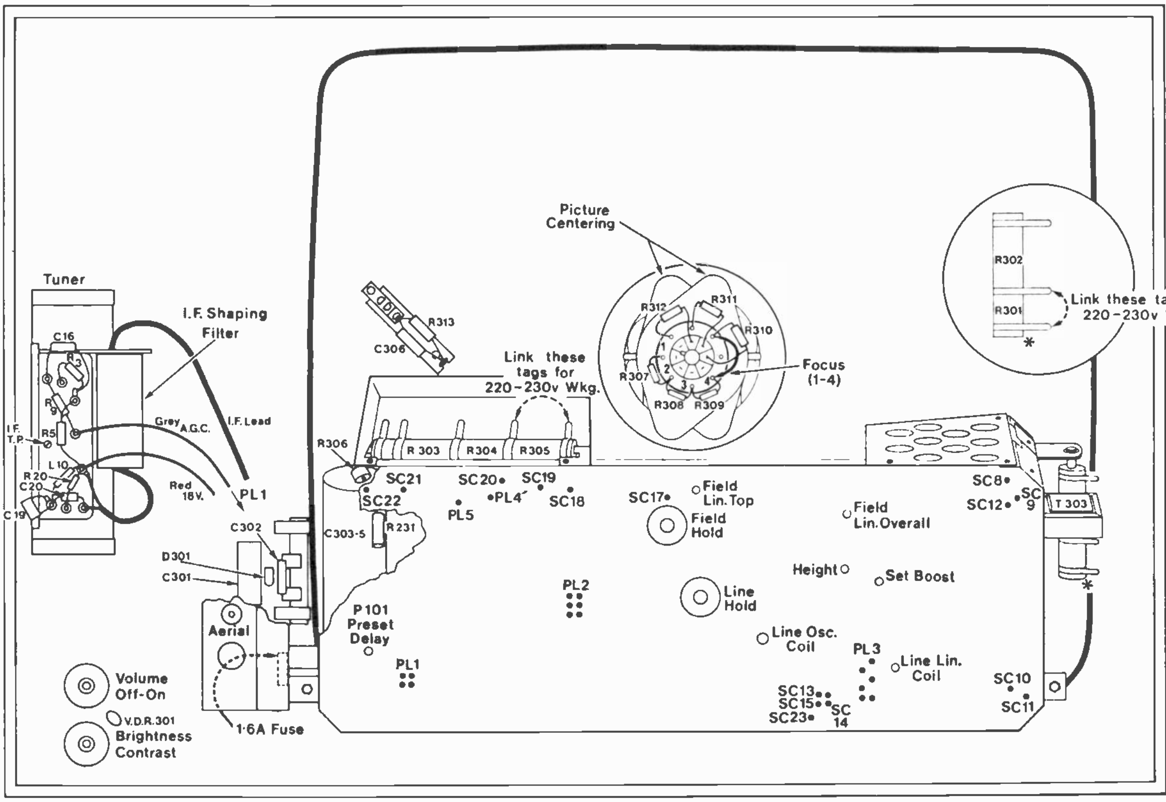

Fig. 2: Rear view (back removed), GEC Series One chassis.

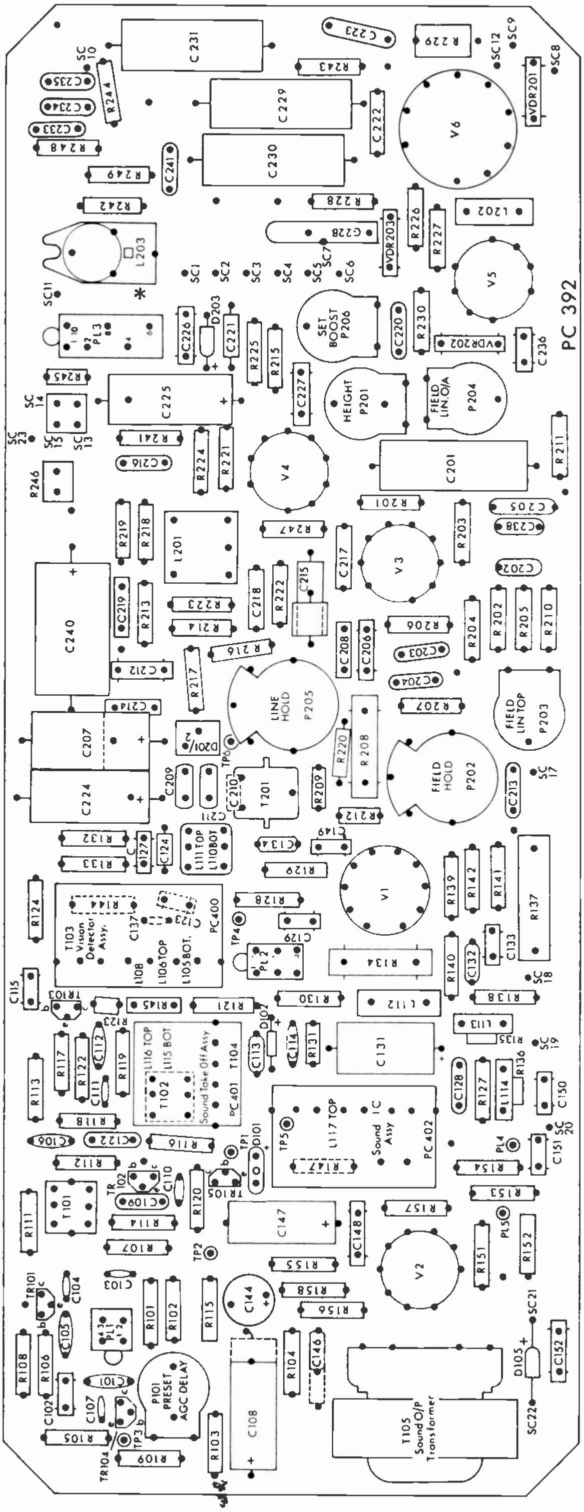

Fig. 3: Panel layout viewed from the top.

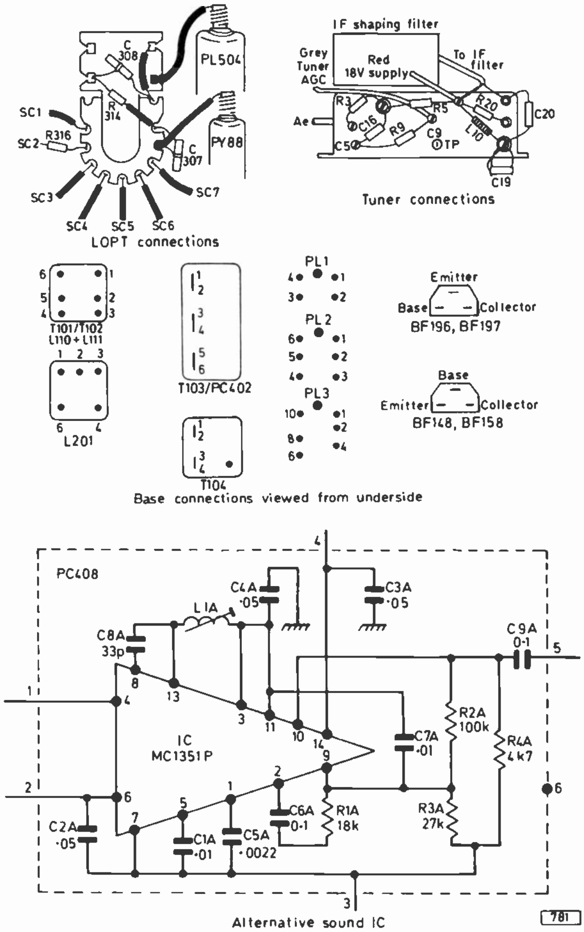

Fig. 4: Connection data and alternative intercarrier sound i.c. circuit.

height control. Replace with a 1W type. If the loss of height is sudden and is much more pronounced at the bottom however check C207 (250μF). Give an eye to the colour of the cathode resistor R208 (390Ω) and if it has lost its bright appearance check its value, particularly if the PCL85 has had to be replaced.

The PCL85 is still responsible for its quota of timebase troubles. The symptoms are usually a rolling picture for the first few minutes, loss of height or complete collapse of the scan leaving a white line across the screen.

The field sync pulse integrating capacitor C208 (0·047μF) does not now give the trouble it used to, i.e. a compressed and rolling picture due to its habit of going open-circuit.

Another irritating fault is the effect caused by dry-joints. This usually shows as intermittent lines across the screen, mainly at the bottom, with the lower part flicking up and down. Quite often the poor connection is not on the panel at all but at the end of the cathode capacitor C207, showing up more obviously when the capacitor is disturbed. Check the panel joints of the PCL85 and the linearity control P204, also the contact of the wiper of this control.

There is a thermal cut-out in the HT4 line to the field output stage. In the event of a short in the PCL85 this should open to cut off the h.t. until the fault has been rectified (usually by replacing the valve) and the cut-out reset. There is a similar cut-out in the supply to the PFL200 and the PCF802 (HT3).

Power Supply Circuits

The mains input is through a 1.6A fuse to the on/off switch. On the set side of this switch is an 0·1μF filter capacitor (C301) which on occasions can short when the set is switched on ("there was a loud bang and the set didn't come on"). This shatters the fuse of course. It is also quite likely to blow the end out of the capacitor but not necessarily so.

From the switch the supply goes to the junction of the two diodes D105 and D301. D301 is the heater circuit rectifier which having no reservoir capacitor effectively chops the mains in half and allows only the positive half cycles to be fed to the heater circuit (about 120V a.c., 105V d.c.). This is further dropped by R302 (100Ω) and R301 (50Ω), provision being made to short out the latter on 220V mains. The low end of R301 feeds SC12 on the main panel then the PL504 heater and so on through the rest of the chain, emerging from SC20 to feed the c.r.t. heater.

The h.t. rectifier D105 fills up the reservoir capacitor C303 via the surge limiter R303 (15Ω). This is the section (extreme left) which is most likely to fail of the h.t. wire-wound resistors on the upper left side, shutting off the h.t. supply and leading to the complaint "no results but heaters glowing."

The reservoir capacitor's job is to supply the total h.t. requirement of the set. The other two sections of the dropper are the smoothing resistors R304 and R305, both 90Ω, the right side one of which can be shorted out for 220V operation. Either section can become open-circuit leading once more to the above symptoms.

From this point the h.t. supply splits up through various resistors and their associated smoothing capacitors to provide the various h.t. lines—HT2, HT3 and HT4. Apart from obvious failures of particular h.t. lines due to open-circuit resistors the less obvious faults resulting from insufficient smoothing—varying from curves travelling up the screen and rhythmic contraction and expansion of the field scan to vision-on-sound and sound-on-vision—may present themselves for identification and rectification. Whilst jumping a test capacitor across a suspect will often immediately clear the effect it will not do so if there is leakage between sections in one particular can. In this event it is necessary to disconnect the tag and fit a separate replacement.

It is essential to use a fast-acting diode as the rectifier in circuits where the l.t. supply is obtained from the line output transformer by scan rectification. The type of rectifier at present being fitted by GEC in this position (D203) and recommended by them for replacement purposes is the BYX36-600. Note that the associated surge limiter resistor R316 also acts as a fuse: if it fails the replacement *must* be of the same type ($\frac{1}{4}$W carbon film).

C R T Voltages

The voltage drop across the c.r.t. heater should be 4V d.c. and 4.5V a.c. The first anode voltage at pin 3 should be about 660V and the cathode voltage at pin 7 about 160V. The grid voltage at pin 2 or 6 will vary (or should) between 220V (maximum) and 50V (minimum) depending on the setting of the brilliance control.

A G C Faults

Troubles occur from time to time as a result of faults in the a.g.c. circuit. As would be expected the electrolytic capacitor C108 is the most frequent offender: when it becomes leaky the operation of the a.g.c. circuit is impaired since the a.g.c. line does not go sufficiently positive to provide correct forward a.g.c. action in the controlled stages. If the a.g.c. rectifier D102 becomes open-circuit there is no a.g.c. action at all, resulting in excessive contrast with symptoms such as sound-on-vision on strong signals since the receiver continues to operate at full gain. The zener diode D101 is another "possible" (it *is* shown connected the right way round in our circuit diagram, Fig. 1, although this is not what one might expect). It can be tested by simply connecting a 1·5V battery in its place. Note that the cathode connection is on the right-hand side when the diode is held with the identification spot at top centre and the leads pointing towards you.

Series Two Chassis

This is a later version of the Series One chassis, differing mainly in the type of tuner unit used and the positions of the mains dropper assembly (moved to the right-hand side) and the main electrolytic capacitor block. Alternative intercarrier sound i.c.s which have been used include the SAA570, TBA480Q and SN76660N/07.

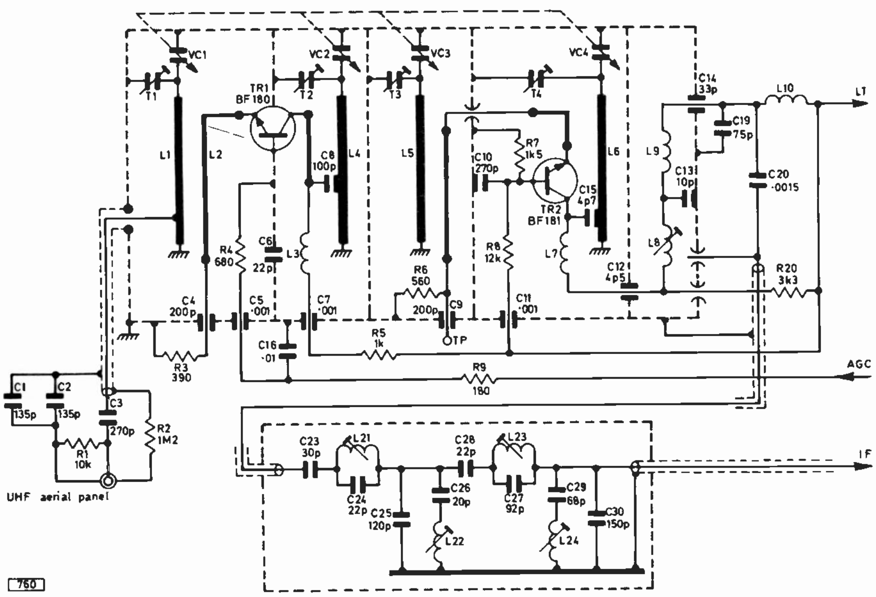

Fig. 5: Tuner and i.f. filter unit circuits.

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PHILIPS G24T300

There is a sync problem with this set. At high brightness levels the picture slips to the left and the field starts to flick upwards. The fault varies with picture content, and may just pull to the left at the bottom of the screen. The contrast control setting also affects the critical level at which loss of sync occurs. Various "probables" published in past issues—e.g. the anode load resistor (R2144) of the line sync pulse shaper valve (V2003A) and the a.g.c. line clamp diode—have been tried without success. I have also checked the anode resistors of the flywheel comparator section (V2003B) of the flywheel sync valve. There are also striations, though the common causes—linearity coil damping resistor and the line output valve screen decoupler—have been tried without success. Previously the S-correction capacitor C2069 was found to be short-circuit, causing cramping at the centre of the screen and three extra dark bars equally spaced across the screen—H. Lowdes (Manchester 8).

We suspect the video preamplifier transistor T2188 (BC148), but also suggest checking the d.c. restorer diode X2194, the electrolytics in the video output stage (C2046/7/8), the video output/sync valve (PFL200) and the screen feed resistor (R2136) of the sync separator section of this valve.

BUSH CTV25

Following recent replacement of the BF115 R−Y preamplifier transistor I would be grateful if you could advise on the correct setting of the associated preset 5RV2 in its emitter circuit—the picture at present seems to be excessively blue. There are also pronounced vertical striations at the left of the picture.—T. Owen (Rochester).

It is possible that 9RV23 which controls the luminance drive applied to the c.r.t. blue gun is advanced too far. Check its adjustment on highlights with a test pattern. If necessary also check the blue gun first anode preset 9RV5 if there is any blue tinting in the darker areas. It is only after the basic grey-scale adjustments have been carried out correctly that 5RV2 may need to be set to obtain correct red to magenta tones. For the striations check the 1.5kΩ damping resistor 3R25 across the linearity control (may be open-circuit), also the flyback blanking transistor 6VT6 (BC108).

GEC 2048

When the set is switched on the sound is slightly distorted. The distortion then becomes progressively worse over the next two-three hours after which it is very bad. The volume does not diminish, and the distortion is less when the volume control is turned up. The signal from a tape recorder has been applied to the volume control to check the audio circuits and the sound was found to be loud and without distortion after two-three hours. The TAA570 intercarrier sound i.c. was tested by feeding into it the output from a signal generator, varied about 6MHz, but the response at the output was linear and did not vary after two-three hours' use. The quadrature coil adustment is very critical, the sound being highly distorted if it is only slightly misadjusted, even when the set is first switched on. —G. Henderson (Camberley).

The l.t. supply in this chassis is derived from the line output stage. It is important therefore to ensure that the set boost control is correctly adjusted—for 890V at point SC6 on the underside of the main printed panel. When the set boost control P206 has been correctly set the voltage across C144, i.e. at the l.t. input pin (5) of the TAA570, should be 12V. After making this adjustment trim the quadrature coil L117 and the secondary (L116) of the input transformer for best sound. (GEC Series 1 chassis.)

PHILIPS G22K520

This set is fitted with a varicap tuner unit and after about three hours the set changes channel. Three replacement tuners have been tried and the i.f. panel has also been replaced.—R. King (Pembroke).

The component to change is R2143 (33kΩ) which is in series with the feed to the TAA550 stabiliser. It is mounted on the i.f. board. Whilst the i.f. panel has been replaced R2143 could still be at fault and has proved to be so in all the cases of this sort we have met. Check the preset R6145 (4·7kΩ) on the tuner panel as well. (Philips G8 chassis.)

PYE V210

The field slips and will not lock. Also the height has decreased and the picture is split in two with the bottom half upside down. The PCL82 field timebase valve has been replaced as the original was glowing red hot, but this has had no effect and the new one also glows.—G. Reynolds (Fulham).

The usual causes of this trouble are leaky 0·1μF capacitors (C47 and C48) between the triode and pentode sections of the PCL82.

PHILIPS 1768U

There are two white flyback lines visible on BBC only at the top of the picture, about an inch apart. This seems to be the result of incorrect field flyback speed and I would appreciate your comments on how to tackle the fault.—G. Rattigan (Ipswich).

As you say, the flyback time is incorrect. The field multivibrator used in this chassis employs the triode sections of two ECL80 valves. The valve which produces the flyback is the triode section of V13 (the other section of this valve is the sync separator). Check the anode load resistor connected to pin 1 of V13 therefore: it should be 22kΩ but may have gone high in value. If the value of this resistor is correct change the associated time-constant coupling capacitor (connected to the same pin) from 0·033μF to 0·022μF).

KB KV117

The sound on 405 only is very weak—hardly audible a few inches from the loudspeaker with the volume control at maximum—although the 625-line sound is completely normal. The system switch contacts have been cleaned in case of trouble there.—T. Gayford (Blackpool).

The most likely cause of your lost sound is change of value of R115 (10MΩ, 1W) which provides forward bias to the 405-line sound interference limiter diode. If the resistor is in order check the diode itself (OA81), also the 405-line sound detector diode (OA81 in the screening can). (ITT/STC VC51 chassis.)

PHILIPS 19TG170A

The picture is perfect when the set is switched on but after two or three minutes both line and field hold are lost. The line and field oscillator valves have been replaced without improving matters.—K. McLosky (Liverpool).

The fault is in the sync separator or video amplifier stage. First replace the PFL200 video/sync valve therefore. If this fails to effect a cure check the voltages round the PFL200, especially the sync separator section, and check the two electrolytics in the video amplifier section—the cathode decoupler C254 and screen grid decoupler C255. If the fault persists replace the feed capacitor to the sync separator, C257.

SOBELL SC34

A while ago this set developed a field fault. The picture would not lock on switching on from cold but bounced continually, getting slower as the set warmed up. A sharp tap on the cabinet sometimes settled the picture. On occasions foldover occurred at the top. The valves associated with the field timebase, V7 and V8, were replaced. This cleared the fault for a while but it has now returned. Once again a sharp tap on the cabinet clears the fault about half an hour after the set has warmed up. The field hold control P4 is at the centre of its travel but the slightest touch to it sets the picture rolling and it is quite a job to get it to settle down. The linearity controls P5 and P6 provide control over vertical linearity but only a slight movement of them results in picture bounce and foldover. When the picture is steady the top is slightly stretched and the bottom cramped. The bottom tends to creep up leaving a black bar, about half an inch, at the bottom.—R. Butcher (Blackburn).

We suggest increasing the value of the coupling capacitor (C48) between the anode (pin 1) of the interlace valve V7a and the grid (pin 2) of the triode section of the PCL85 from 150pF to 300pF. It would be advisable to replace the PCL85 pentode cathode bias combination R58/R59/R60 with a single 270Ω 1W resistor and to renew the associated 250μF decoupler (C54) to get rid of the bottom compression. More reliable operation would be obtained by replacing the field timebase presets P4, P5 and P6.

FERGUSON 3624

On receiving this set the h.t. smoothing choke L40 was found to be open-circuit. This was replaced producing a very dark raster with trapezoidal distortion. The scan coils and e.h.t. rectifier were then replaced, giving a near normal raster. The v.d.r. (Z3) in the width circuit was found to be running very hot however. The pulse feed capacitors C105 and C106 leading to it were replaced but on switching on again the raster appeared but the EY86 glowed blue with flashes inside and at the same time heavy arcing from the top cap to base. Before voltage checks could be made the EY86 burned out.—D. Richards (Basildon).

The trouble appears to be excessive line drive. The origin of the trouble was the short-circuit in C106 which damaged the width v.d.r. Z3. Check all components in the width circuit, including Z3 (type E298ZZ/06), also the connecting tracks, and ensure that the width control (R132) is intact at its chassis end. (Thorn 900 chassis.)

BUSH TV135R

Sometimes when the line hold control was adjusted the screen would go blank with no raster, then the picture would come on again. Now the raster has been lost completely. Within 30 seconds of switching on the PY800 boost diode glows cherry red and if the set is not switched off parts of the mains dropper resistor start to glow. There is complete absence of line whistle. Removing the boost diode top cap makes no difference except that it no longer glows. All timebase valves have been replaced.—T. Jones (Newport Pagnell).

On the left-hand side of the screened line output section (inside) you will see two 0·1μF capacitors. These are connected in parallel and together comprise the boost reservoir capacitor. Replace both, using components rated at 1kV, or alternatively use a single 0·22μF one rated at 1kV. One of the two capacitors is short-circuit but both should be removed.

ULTRA 6634

The PL504 line output valve had to be replaced owing to internal shorting but having done this there are alternate light and dark vertical bars superimposed on the picture, visible on a blank or a mid-grey screen; the verticals are bent and slightly wavy, more so on change of pictures to captions; and there is white after black and black after white. All valves have been replaced, also the width control and R131 in series with its slider.—G. Bottomly (Leeds).

Make sure that the PL504 grid return resistor R130 is in order and making proper contact with the panel, also that its screen grid decoupling electrolytic C103 is o.k. Check C102 connected to the anode of the boost diode and C47 which decouples the supply to the line oscillator and the associated d.c. amplifier. We have known shorts in the PL504 damage the width v.d.r. (Z3) and in one case apply h.t. to it so that it became excessively hot and disconnected itself at the chassis end. If the problem is still present try replacing the S-correction capacitor C98 (assuming the fault is present on 625 lines only) or the width circuit pulse feedback capacitor C106. (BRC 950 chassis.)

GEC 2000

The picture is not very bright but if the brilliance control is advanced only a little the picture blows up in size and the raster disappears. Adjusting the boost preset control makes no difference.—K. Bowler (Barnet).

Since the picture increases in size when the brightness control is advanced the e.h.t. supply is faulty. Check the PL500 line output valve and DY86 e.h.t. rectifier, also the 4Ω resistor in its heater circuit. Make sure that R125 in series with the set boost control is the correct value (470kΩ), also the line output valve screen grid feed resistor R122 (2·2kΩ).

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TELEVISION JANUARY 1974

TEST CASE

133

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.

After a protracted period of trouble-free operation a Decca Model CS1730 colour receiver suddenly emitted a brief yet sinister mechanical buzz which was followed immediately by the picture dissolving into a fading patch of light at the centre of the screen. The sound was completely unaffected by these happenings.

A quick test revealed a blown 500mA anti-surge fuse in the h.t. line to the line output stage. To check that a supply surge was not responsible for the trouble the field technician tried a replacement fuse, with the same result but excluding the fading picture effect.

It was noticed that the PY500 boost diode had been running extremely hot, and after removing the supply an insulation check was made between the cathode of the PY500 (top cap) and chassis. A resistance of about 30Ω was measured, indicating that the diode was trying to pass several amperes—hence its overheating! The diode was removed and the supply reconnected and the voltage at the anode of the diode (pins 2, 7 and 8) was found to be perfectly correct (after replacing the blown fuse of course). The supply was again removed and resistance tests to chassis were made at other tappings on the line output transformer. At the anode (top cap) of the PL509 line output valve the d.c. resistance was somewhat higher than that at the PY500 cathode; it was higher still at the e.h.t. doubler tapping.

It was also noticed that the resistance to chassis reduced slightly at all tappings when the convergence circuits were unplugged.

What could have been responsible for this trouble and what tests should have been made next by the technician to expose the faulty component? See next month's TELEVISION *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 132

Page 91 (last month)

Colour intermittency of the type described last month strongly suggests that the reference oscillator is at fault. This is confirmed almost certainly when colour can be restored by applying an instrument test prod to the oscillator transistor or to a component associated with the oscillator circuit.

The trouble can be caused by a capacitor in the oscillator stage, by a crystal of low activity or indeed by a low-gain transistor. In the case under discussion the emitter capacitor checked normally and since a replacement crystal was not at hand the BF115 oscillator transistor was replaced. This restored normal operation and eliminated the intermittency; but it is possible that a replacement crystal would have done the same if it had greater piezo activity than the original.

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