

SERVICING·VIDEO·CONSTRUCTION·COLOUR·DEVELOPMENTS

Television

JANUARY 1976

40p

servicing

**The THORN
8000/8000A/8500
Colour Chassis**

PART 1

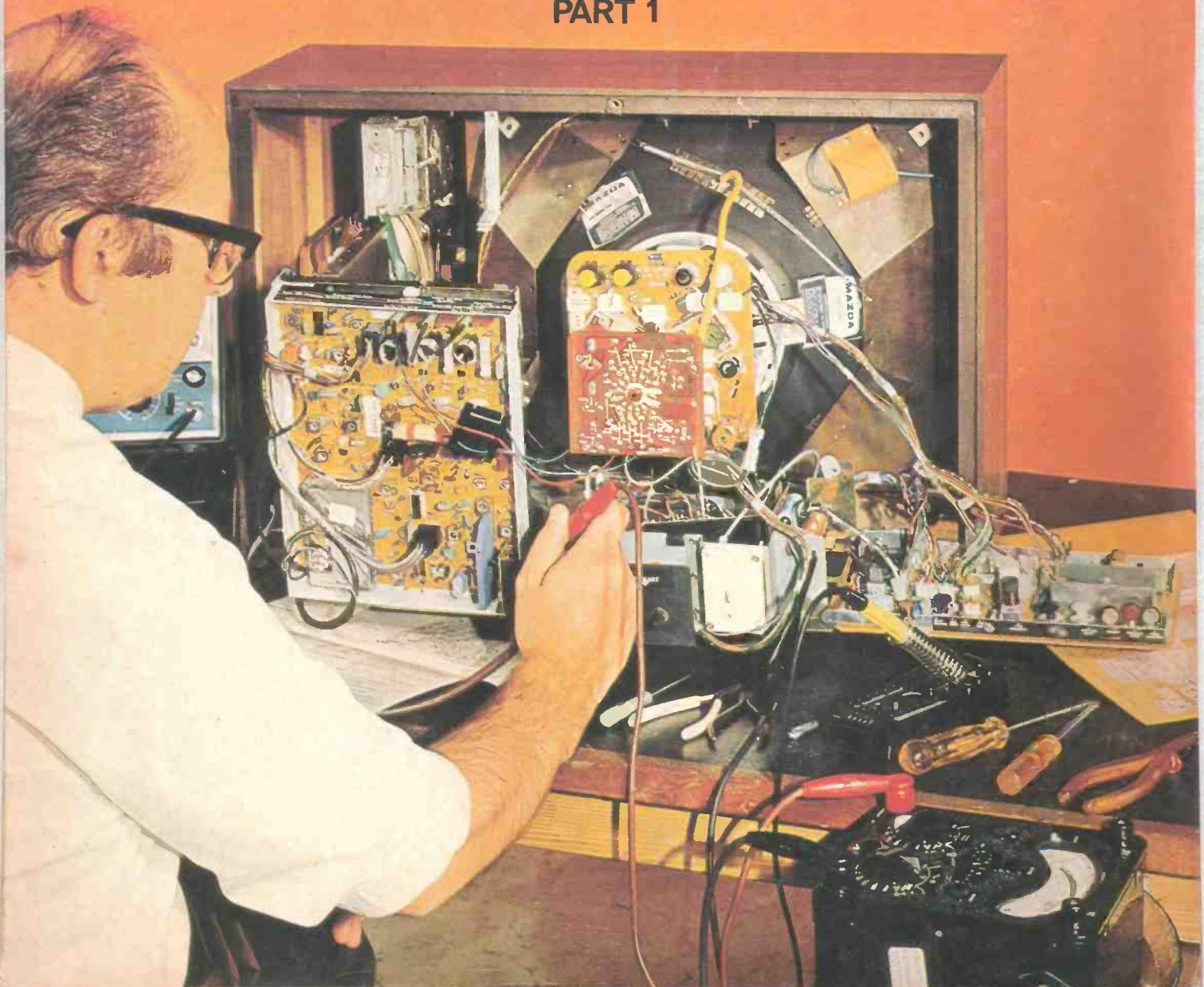
ALSO:

Simple U.H.F. Preamplifier

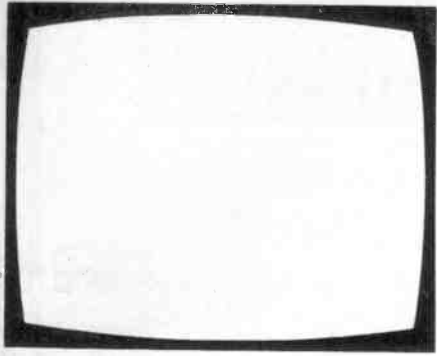
Faults in Solid-State

Mono Receivers

N1500 VCR Maintenance



TRANSISTORS, ETC.		Type Price (£)	Type Price (£)	Type Price (£)	DIODES	LINEAR	DIGITAL	ZENER DIODES
Type Price (£)	Type Price (£)				Type Price (£)	INTE-GRATED CIRCUITS	INTE-GRATED CIRCUITS	400mW 3.0-33V 12p each 1.3W 3.3-100V 18p each
AC107 0.35	BC177 0.20	8F241 0.22	MPSU56 1.26	2N3133 0.54	AA113 0.15	CA3045 1.35	7400 0.20	VDR'S, PTC & NTC
AC117 0.24	BC178 0.22	8F244 0.18	MPSU55 1.26	2N3134 0.60	AA119 0.09	CA3046 0.70	7401 0.20	RESISTORS
AC126 0.25	BC178B 0.22	8F254 0.45	OC26 0.38	2N3232 1.32	AA129 0.20	CA3065 1.90	7402 0.20	Type Price (£) Type Price (£)
AC127 0.25	BC179 0.20	8F256 0.45	OC28 0.65	2N3235 1.10	AA143 0.10	MC1307P 1.19	7403 0.20	E295ZZ
AC128 0.25	BC179B 0.21	8F257 0.49	OC35 0.59	2N3250 1.02	AAZ13 0.30	MC1310P 2.94	7404 0.24	/01 14 P354 all 8
AC141 0.26	BC182L 0.11	8F258 0.66	OC42 0.55	2N3323 0.48	AAZ17 0.12	MC	7406 0.45	E295ZZ
AC141K 0.27	BC183 0.11	8F259 0.93	OC44 0.25	2N3391A 0.23	BA100 0.15	1327PQ 1.01	7408 0.25	/02 14 VA1015 50
AC142 0.20	BC183K 0.12	8F262 0.70	OC45 0.32	2N3501 6.99	BA102 0.25	MC1330P 0.76	7410 0.20	VA1026 41
AC142K 0.19	BC183L 0.11	8F263 0.70	OC70 0.32	2N3702 0.13	BA110U 0.30	MC1351P 0.75	7411 0.25	E298CD
AC151 0.24	BC184L 0.13	8F273 0.16	OC71 0.32	2N3703 0.15	BA115 0.12	MC1352P 0.82	7412 0.28	/A258 7 VA1033 8
AC152 0.25	BC186 0.25	8F336 0.35	OC72 0.32	2N3704 0.15	BA141 0.17	MC	7413 0.50	E298ED
AC153K 0.28	BC187 0.27	8F337 0.35	OC73 0.51	2N3705 0.11	BA145 0.17	1358PQ 1.85	7416 0.45	/A262 6 VA1053 8
AC154 0.20	BC208 0.12	8F458 0.60	OC75 0.25	2N3706 0.10	BA154 0.13	MC1496L 0.87	7417 0.30	/A265 6 VA1077 12
AC176 0.25	BC212L 0.12	8F459 0.63	OC76 0.35	2N3707 0.13	BA155 0.16	MC3051P 0.58	7420 0.20	/P268 6 VA1104 35
AC178 0.27	BC213L 0.12	8F596 0.70	OC81 0.53	2N3715 2.30	BA156 0.15	MFC	7425 0.37	E298ZZ
AC187 0.25	BC214L 0.15	8F597 0.15	OC81D 0.57	2N3724 0.72	BA157 0.25	4000B 0.43	7430 0.20	/05 7
AC187K 0.26	BC238 0.12	8FR39 0.24	OC139 0.76	2N3739 1.18	BAX13 0.06	MFC	7440 0.20	/06 6
AC188 0.25	BC261A 0.28	8FR41 0.30	OC140 0.80	2N3766 0.99	BAX16 0.07	4060A 0.70	7441 0.85	RESISTORS
AC188K 0.26	BC262A 0.18	8FR61 0.30	OC170 0.25	2N3771 1.70	BA110 0.52	MFC6040 0.91	7445 1.95	Carbon Film (5%) ea
AC193K 0.30	BC263B 0.25	8FR79 0.24	OC171 0.30	2N3772 1.90	BB104 0.52	NE555 0.72	7447 1.30	1/2W 5.6 Ω-330k Ω (E12) 1.5p
AC194K 0.32	BC267 0.16	8FT43 0.55	OC200 1.30	2N3773 2.90	BB105B 0.52	NE556 1.34	7450 0.20	1/2W 10 Ω-10M Ω (E24) 1.5p
ACY28 0.25	BC268C 0.14	8FW10 0.55	OC201 0.92	2N3790 4.15	BB105G 0.45	SL414A 1.91	7451 0.20	1W 10 Ω-19M Ω (E12) 3p
ADY39 0.68	BC294 0.37	8FW11 0.55	ON236A 0.65	2N3794 0.20	BR100 0.50	SL901B 3.84	7452 0.20	2W 10 Ω-10M Ω (E6) 5p
AD140 0.50	BC300 0.60	8FW16A 1.70	ORP12 0.55	2N3819 0.35	BY100 0.22	SL917B 5.12	7470 0.33	WIREWOUND (5%)
AD142 0.52	BC301 0.35	8FW30 1.38	R2008B 2.05	2N3820 0.49	BY102 0.16	SN	7472 0.38	2 1/2W 0.22 Ω-270 Ω 15p ea
AD143 0.51	BC303 0.60	8FW59 0.19	R2010B 2.95	2N3823 1.45	BY126 0.22	76001N 1.45	7473 0.44	5W 10 Ω-8.2k Ω 13p ea
AD149 0.50	BC307B 0.12	8FW90 0.28	TIC44 0.29	2N3866 1.70	BY127 0.17	76003N 2.92	7474 0.48	10W 10 Ω-25k Ω 18p ea
AD161 0.48	BC308A 0.10	8FX16 2.25	TIC46 0.44	2N3877 0.25	BY133 0.23	SN	7475 0.59	CAPACITORS
AD162 0.48	BC309 0.15	8FX29 0.30	TIC47 0.58	2N3904 0.16	BY140 1.40	76013N 1.95	7489 4.32	Full range of C280, C296,
AF114 0.25	BC323 0.68	8FX30 0.35	TIP29A 0.49	2N3905 0.18	BY176 1.55	SN76013	7490 0.65	tubular ceramic, pin-up ceramic,
AF115 0.25	BC377 0.22	8FX84 0.25	TIP30A 0.58	2N3906 0.15	BY179 0.70	ND 1.72	7492 0.75	miniature electrolytics,
AF116 0.25	BC441 1.10	8FX85 0.26	TIP31A 0.65	2N4032 0.43	BYX10 0.15	SN	7493 0.65	mica, mixed dielectric and
AF117 0.20	BC461 1.58	8FX86 0.26	TIP32A 0.67	2N4033 0.54	BYZ12 0.30	76023N 1.95	7494 0.85	TV electrolytics stocked. -
AF118 0.50	BCY33 0.36	8FX87 0.28	TIP33A 0.99	2N4036 0.52	FSY11A 0.45	SN76023	7495 0.85	Please see catalogue.
AF121 0.32	BCY42 0.16	8FX88 0.24	TIP34A 1.73	2N4046 0.35	FSY41A 0.40	ND 1.72	7496 1.00	MASTHEAD AMPLIFIERS
AF124 0.25	BCY71 0.22	8FY18 0.53	TIP41A 0.80	2N4058 0.17	OA10 0.20	76033N 2.92	74100 2.16	Labgear uhf group amplifier
AF125 0.25	BCY88 2.42	8FY40 0.40	TIP42A 0.91	2N4123 0.13	OA27 0.07	SN	74122 0.80	complete with mains power
AF126 0.25	BD115 0.65	8FY41 0.43	TIS43 0.30	2N4124 0.15	OA81 0.12	76530P 1.05	74150 1.44	unit CM6001/PU.
AF127 0.25	BD123 0.98	8FY50 0.25	TIS90 0.23	2N4236 1.90	OA90 0.08	SN	74151 1.15	Groups A, B, cr C/D
AF139 0.35	BD124 0.88	8FY51 0.23	TIS91 0.23	2N4248 0.12	OA91 0.07	76533N 1.20	74154 1.66	please specify £12.65
AF147 0.35	BD130Y 1.42	8FY52 0.23	ZTX109 0.12	2N4284 0.19	OA95 0.07	SN	74164 2.01	Labgear CM6030 WB vhf/uhf
AF149 0.45	BD131 0.45	8FY57 0.32	ZTX300 0.16	2N4286 0.19	OA99 0.07	7666N 0.90	74192 2.05	ultra wideband amplifier
AF178 0.55	BD132 0.50	8FY64 0.42	ZTX304 0.22	2N4289 0.20	OA99 0.07	TAA300 1.76	74193 2.30	(channels 1-68). Complete
AF179 0.60	BD135 0.40	8FY72 0.31	ZTX310 0.10	2N4290 0.14	OA99 0.07	TAA320 0.94		with mains power unit
AF180 0.55	BD136 0.46	8FY90 0.70	ZTX313 0.12	2N4291 0.18	OA99 0.07	TAA350A 2.02		CM6001/PU £18.95
AF181 0.50	BD137 0.48	8FY90 0.70	ZTX500 0.17	2N4292 0.24	OA99 0.07	TAA435 0.85		Labgear CM6019 WB vhf
AF186 0.40	BD138 0.50	8FX25 1.90	ZTX502 0.17	2N4392 2.84	OA99 0.07	TAA450 2.70		ultra wideband amplifier
AF239 0.40	BD139 0.55	8FX29 1.70	ZTX504 0.42	2N4392 2.84	OA99 0.07	TAA550 0.55		(channels 1-68). Complete
AF279 0.84	BD140 0.62	8FX52 1.90	ZTX602 0.24	2N4871 0.24	OA99 0.07	TAA570 2.02		with mains power unit
AL000 1.10	BD144 2.19	8RC4443 0.68	2N525 0.86	2N4902 1.30	OA99 0.07	TAA611A 1.70		CM6001/PU £18.95
AL102 1.10	BD145 0.75	8RY39 0.47	2N525 0.86	2N5042 1.05	OA99 0.07	TAA611B 1.85		Labgear CM6019 WB vhf
AL103 1.10	BD163 0.67	8RY56 0.40	2N525 0.86	2N5060 0.32	OA99 0.07	TAA630Q 4.18		ultra wideband amplifier
AL113 0.95	BD183 0.56	8R101 0.47	2N525 0.86	2N5061 0.35	OA99 0.07	TAA630S 4.18		(channels 1-68). Complete
AU103 2.10	BD222 0.78	8SX19 0.13	2N525 0.86	2N5062 0.35	OA99 0.07	TAA661B 1.32		with mains power unit
AU110 1.90	BD234 0.75	8SX20 0.19	2N525 0.86	2N5063 0.42	OA99 0.07	TAA700 4.18		CM6020/PU £9.85
AU113 2.40	BD410 1.65	8SX76 0.15	2N525 0.86	2N5064 0.45	OA99 0.07	TAA840 2.02		PATTERN GENERATORS
BC107 0.12	BD519 0.76	8SX82 0.52	2N525 0.86	2N5067 0.32	OA99 0.07	TAA861A 0.49		Labgear CM6004/PG giving
BC107A 0.13	BD520 0.76	8SY19 0.52	2N525 0.86	2N5068 0.32	OA99 0.07	TAD100 2.66		crosshatch dots, greyscale
BC107B 0.14	BD599 0.75	8SY41 0.22	2N525 0.86	2N5069 0.32	OA99 0.07	TBA120S 0.99		and blank raster on 625-lines.
BC108 0.12	BDX18 1.45	8SY54 0.50	2N525 0.86	2N5070 0.32	OA99 0.07	TBA240A 2.97		Tuning can be preset for
BC108B 0.13	BDX32 2.55	8SY56 0.80	2N525 0.86	2N5071 0.32	OA99 0.07	TBA281 2.28		anywhere in Bands IV and V
BC109 0.13	BDY18 1.78	8SY65 0.15	2N525 0.86	2N5072 0.32	OA99 0.07	TBA281 2.28		as well as Band III (for relays)
BC109C 0.14	BDY20 0.99	8SY78 0.40	2N525 0.86	2N5073 0.32	OA99 0.07	TBA281 2.28		£58.80
BC113 0.13	BF115 0.20	8SY91 0.28	2N525 0.86	2N5074 0.32	OA99 0.07	TBA281 2.28		Labgear CM6038 DB Pocket
BC114 0.20	BF117 0.45	8SY95A 0.27	2N525 0.86	2N5075 0.32	OA99 0.07	TBA281 2.28		size vhf/uhf generator. Out-
BC115 0.20	BF120 0.55	8T106 1.24	2N525 0.86	2N5076 0.32	OA99 0.07	TBA281 2.28		puts as CM6004 PG above but
BC116 0.20	BF121 0.25	8T116 1.20	2N525 0.86	2N5077 0.32	OA99 0.07	TBA281 2.28		can be used either on mains
BC117 0.20	BF123 0.28	8U105/02 1.95	2N525 0.86	2N5078 0.32	OA99 0.07	TBA281 2.28		or battery £46.60
BC119 0.29	BF125 0.25	8U108 3.25	2N525 0.86	2N5079 0.32	OA99 0.07	TBA281 2.28		COLOUR/BAR
BC125 0.22	BF127 0.30	8U126 2.99	2N525 0.86	2N5080 0.32	OA99 0.07	TBA281 2.28		GENERATORS
BC126 0.20	BF158 0.25	8U204 1.98	2N525 0.86	2N5081 0.32	OA99 0.07	TBA281 2.28		Labgear CM6037/DB: Dual
BC132 0.15	BF159 0.27	8U205 1.98	2N525 0.86	2N5082 0.32	OA99 0.07	TBA281 2.28		standard band generator gives
BC134 0.20	BF160 0.22	8U207 3.00	2N525 0.86	2N5083 0.32	OA99 0.07	TBA281 2.28		standard 8 band colour bars
BC135 0.19	BF161 0.45	8U208 3.15	2N525 0.86	2N5084 0.32	OA99 0.07	TBA281 2.28		· greyscale step wedge · red
BC136 0.20	BF162 0.45	8U209 2.55	2N525 0.86	2N5085 0.32	OA99 0.07	TBA281 2.28		· raster · centre cross · centre
BC137 0.20	BF163 0.45	8U209 2.55	2N525 0.86	2N5086 0.32	OA99 0.07	TBA281 2.28		· dot · crosshatch · dot pattern
BC138 0.20	BF167 0.25	8U209 2.55	2N525 0.86	2N5087 0.32	OA99 0.07	TBA281 2.28		· blank raster. Sync output
BC142 0.30	BF173 0.25	8U209 2.55	2N525 0.86	2N5088 0.32	OA99 0.07	TBA281 2.28		also provided £125.15
BC143 0.35	BF177 0.30	8U209 2.55	2N525 0.86	2N5089 0.32	OA99 0.07	TBA281 2.28		VHF/UHF CONVERTERS
BC147 0.13	BF178 0.33	8U209 2.55	2N525 0.86	2N5090 0.32	OA99 0.07	TBA281 2.28		Labgear "Televistas" for
BC148 0.12	BF179 0.33	8U209 2.55	2N525 0.86	2N5091 0.32	OA99 0.07	TBA281 2.28		DX-ing or single-standard
BC149 0.14	BF180 0.35	8U209 2.55	2N525 0.86	2N5092 0.32	OA99 0.07	TBA281 2.28		receiver use on relay systems.
BC152 0.25	BF181 0.33	8U209 2.55	2N525 0.86	2N5093 0.32	OA99 0.07	TBA281 2.28		Type 6022/RA £15.90
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BC158 0.13	BF185 0.26	8U209 2.55	2N525 0.86	2N5097 0.32	OA99 0.07	TBA281 2.28		P. & P.: UK £0.12 per order.
BC159 0.15	BF194 0.15	8U209 2.55	2N525 0.86	2N5098 0.32	OA99 0.07	TBA28		



Television

SERVICING
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JANUARY
1976

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QUERIES

We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.

Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved".

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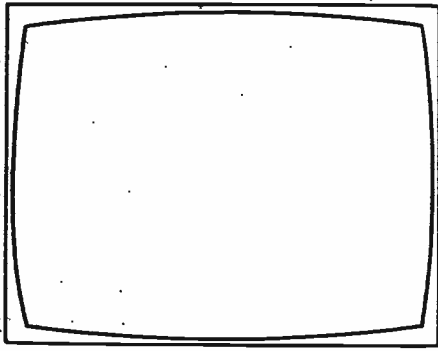
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Television

TV4 Etc.

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The Annan Committee of Enquiry into the Future of Broadcasting has been sitting, in case you forgot, for over a year. The original idea to set up such an enquiry goes back considerably farther, having been proposed, rejected and subsequently set up as governments came and went. The members of the Committee certainly have our sympathy: there are few subjects capable of generating more hot air than broadcasting and "the media". That said however, important issues are at stake: who is to control and exploit (nothing derogatory intended here) the wavelengths, which are in a sense public property, available for broadcasting — both radio and television.

Now that the Committee's evidence taking phase has been completed, it is faced with the task of sifting through the mass of proposals and opinions that have been put to it and coming to some sort of conclusions. The final report is expected towards the end of 1976, which is not bad going really. Is it possible to see any likely outcome yet?

In spite of their detractors, we would expect to see the BBC and IBA left much as they are at present. They have amply proved their worth and have achieved world wide recognition. If they cause the occasional annoyance to some party or another, that is all to the good, proving their independent status. The BBC in fact is the envy of much of the world, and is far removed from the weak, insipid and often corrupt government dominated bodies that control broadcasting in so many countries. For its part, the IBA has evolved a way establishing and running commercial broadcasting in a manner that has succeeded in overcoming the fears so many people initially expressed. The two bodies in fact typify the best British traditions of pragmatism and compromise. If you don't agree, try a dose of what is churned out over the wavelengths in most of the rest of the globe.

But the Committee's purpose, in addition to reviewing the present broadcasting arrangements, is to consider their extension — in particular what to do about the fourth TV channel. And here we find widely supported a proposal that looks as if it could well stand beside the BBC and IBA in usefulness and at the same time be a valuable complement to them — the idea of setting up a National Broadcasting Foundation. This seems to have received, though in rather different form, the approval of both the BBC and the IBA, in addition to that of other organisations. Certainly the BBC seems to feel that it has enough on its plate with its present substantial commitments. The BBC considers that the new v.h.f. radio network to be set up should also be under the Foundation's control.

The purpose of the Foundation would be to establish the fourth TV channel — and the new v.h.f. radio network if this was added — as a fresh, independent public service concentrating on providing more specialised programmes. To this end the Foundation would operate in a manner rather different from either the BBC or the IBA. It would not itself produce programmes, but neither would it hand over complete responsibility to other organisations. Instead, it would be responsible for commissioning programmes from and encouraging outside bodies and individuals, in the expectation that this would open up new approaches and ideas. It would act rather like a publishing house, seeking out and working with independent programme makers. Finance is of course the crux of any extension of broadcasting, and it is not too clear at present how this could be arranged. Nevertheless those who have put the proposal forward seem to have made a fairly thorough effort at presenting it as a practical proposition.

Another proposal that has been put forward by the BBC in its evidence to the Committee is that a Broadcasting Research Institute should be set up as a permanent review body and to collate research and promote discussion. If this overcame the political manoeuvring that is inclined to occur whenever the BBC Charter and the IBA Act come up for reconsideration it would be all to the good. It need not be a large organisation which might start to vie for power with the established broadcasting bodies: perhaps it exists already in embryo form, since in recent years the Royal Television Society has to a large extent concerned itself with the problems of the sorts of broadcasting services required and how to provide them and maintain standards.

COVER PHOTO

Featured on our cover this month is a Ferguson Colourstar receiver, fitted with the 8500 chassis. Our thanks to Thorn Consumer Electronics for the loan of this equipment.



teletopics

TV SLUMP AT BOTTOM?

THE recession in the UK consumer electronics industry – of which colour TV set production accounts for roughly 70% – is estimated to have resulted in the loss of over 10,000 jobs this year alone. The industry was already in recession before the imposition of 25% VAT at the last budget: this nearly turned a very bad period into a disaster. The reduction in the workforce amounts to 18% in recent times compared to 6% in all other industries. These figures do not include the effects on the component suppliers, so the overall loss must be appreciably higher. Pye's managing director Jim Griffiths has suggested that employment in the domestic electronics field will fall to 45,000 by the end of 1975 compared to 69,000 at the end of 1973 – the boom year.

These figures were brought out by the Electronics Economic Development Committee during a recent meeting with Secretary for Industry Eric Varley. It was emphasised that no major plants have been closed so far, but that if this became necessary the problem of meeting increased demand when this came would probably lead to another flood of imports. The Committee wants to see a controlled stimulus to colour set demand, either through lower VAT or easier deposit terms, and a planned approach to the future growth of the consumer electronics industry. It also wants help for the colour c.r.t. makers (see below).

The latest figures from BREMA confirm this dismal tale but also suggest that the market may be beginning to turn up. September deliveries of colour TV sets to the trade were 142,000, a fall of only 7% compared to September 1974. This is the smallest monthly drop since the 25% VAT became effective. The total number of colour sets delivered during the first three quarters of 1975 was 1,163,000, a fall of 29% compared to the same period during 1974. It looks as if the estimated 1.6 million colour set sales for 1975 may just about be reached, given a good pre-Christmas trading period. Imports this year are running at 15% of deliveries.

Monochrome set deliveries are continuing to do reasonably well. At 95,000 during September they were 32% higher than in the same month in 1974: for the first nine months the total was 8% higher.

COLOUR TUBE LATEST

Secretary for Industry Eric Varley has called for an urgent review of the future of the UK colour c.r.t. industry, which is at present operating at only 50% capacity. The examination now being carried out by Ministry officials could lead to a

restructuring of the industry. It seems that the Ministry is concerned about the very real possibility of the c.r.t. industry collapsing, leaving setmakers dependent on imported tubes. Since the tube represents about 40% of the cost of a new set this would have serious implications for the TV industry's trade balance.

INDIRECT HT STABILISATION

The subject of transistor line output stage techniques and the associated power supply arrangements has been a preoccupation of ours in recent issues. One approach we have not so far illustrated is the "indirect" h.t. line stabilisation technique used in the Rank A816 and Thorn 1600 monochrome chassis. The starting point is the need with a transistor line output stage to have a stable h.t. supply – otherwise the width will change with variations in the h.t. voltage. Generally this means the use of a stabilised mains rectifier arrangement, e.g. a thyristor or chopper (switch-mode) system. In the two chassis mentioned above however a simple half-wave mains rectifier is used to provide the h.t. supply, with stabilisation of the voltage applied to the line output stage effected via the action of a shunt l.t. supply regulator. The basic circuit configuration is shown in Fig. 1. It will be seen that the anti-boost technique is used, i.e. the emitter of the line output transistor is

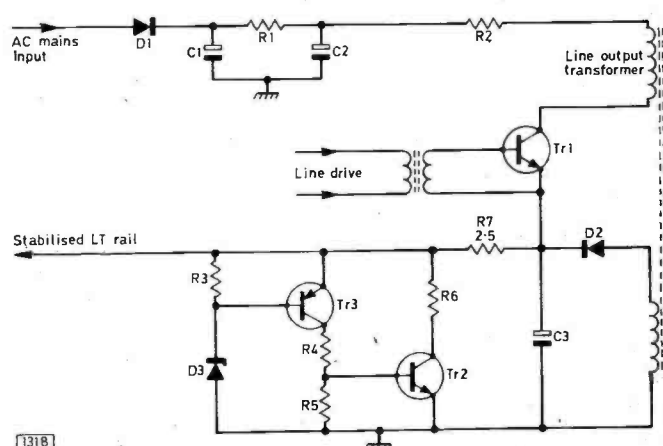


Fig. 1: The indirect method of stabilising the h.t. supply to a transistor line output stage – by means of a shunt stabilised l.t. supply in the emitter circuit of the line output transistor. If either of the three transistors goes open-circuit the result will be no sound and no e.h.t. In practice Tr1 or Tr2 or both of these tend to fail. A typical value is shown for R7.

returned to the l.t. rail instead of to chassis, so that the effective line output stage supply is the h.t. voltage minus the l.t. voltage (if the h.t. voltage is say 200V and the l.t. voltage 30V, then the supply to the line output transformer is 170V). The l.t. supply is provided by D2 which acts as a scan rectifier, charging C3. Tr2 is as the shunt regulator which stabilises the l.t. supply and, indirectly, the h.t. supply to the line output stage.

The conduction of Tr2 is controlled by the voltage-sensing transistor Tr3 whose base is held at a constant voltage with respect to chassis by zener diode D3. If the l.t. voltage tries to rise, the conduction of Tr3 will increase since its p-type emitter is driven positively. The increased current through R4 and R5 will result in Tr2 conducting more heavily, the increased current through and voltage across R7 then counteracting the original increase in the l.t. voltage. Since the line output transistor's current flows via Tr2, R6 and R7 however the effect acts on the h.t. supply as well. Say the h.t. voltage rises as a result of an increase in the mains voltage. The l.t. rail will try to rise since D2 will be presented with a higher voltage input. Tr2 then conducts more heavily, as we have seen, and the increased current via Tr1 and the series resistances pulls down the h.t. voltage applied to the line output transformer – the action required to stabilise the width. Increased beam current demand will tend to decrease the voltages in the circuit. Tr2 then conducts less and the reduced voltages developed across the resistive elements again restore the voltage applied to the line output transformer.

It's certainly a convenient way of providing the supplies for a monochrome table model, but from the service angle increases the difficulty of fault diagnosis.

TUNER JUICE

Trade Laboratory Services (77 High Street, Poole, Dorset) have introduced an aerosol containing a special formulation preparation called Tuner Juice – for cleaning TV tuners. The "juice" is emitted at high pressure so that hardened grease is removed from the vanes and earthing strips of tuners. A 12oz can will serve to clean twelve tuners and costs £1.25 plus 8% VAT. A dozen cans can be obtained for £12 plus VAT.

VARICAP TUNING POTENTIOMETERS

To provide the tuning voltage, helical potentiometers were specified in the components list for the ultrasonic remote control unit featured in our September/October issues last year (VR1-4, 100k Ω). These are rather expensive. Forgestone Colour Developments Ltd. (Low Street, Ketteringham, Wymondham, Norfolk) tell us that they can supply the multi-turn type used by setmakers for 30p each, or a set of four for £1.30 including post and packing, plus VAT at 25% (30p).

TRANSMITTER LATEST

BBC-1 and ITV services from the **Limavady** (Northern Ireland) main u.h.f. station have started. BBC-1 is on channel 55 and ITV (Ulster Television programmes) on channel 59. Signal polarisation is horizontal. The **Londonderry** relay station is also now transmitting BBC-1 and ITV, the former on channel 51 and the latter on channel 41, with vertical polarisation. A group C/D aerial is required for Limavady and a group B aerial for Londonderry.

In Scotland the IBA has brought its **Pitlochry** (Tayside)

relay station into service. Grampian Television programmes are transmitted on channel 25 with vertical polarisation. Receiving aerial group is A.

It seems that due to their financial situation and to government pressure on spending, the broadcasting authorities are having to delay the further extension of their u.h.f. services. The BBC and IBA had been hoping to extend coverage to all but the smallest communities in the British Islands by 1979, but the date is now more likely to be 1981-2.

UNUSUAL WIDTH FAULT

Writing in a recent issue of Rank's *Service Skill*, G. Marshall reports an unusual width fault. The set was an old Bush Model TV145U which had had a new line output transformer fitted only to find that for full width the line stabilisation control had to be fully advanced. After replacing various components it was eventually discovered that the line linearity inductor was the cause of the trouble, though showing no signs of distress. A replacement enabled the line stabilisation control to be reset to its original position. The timebase section of the TV145/T148 series is basically the same as the earlier TV141 series and the later very popular TV161 series, so it's worth bearing in mind that a possible cause of lack of width in older sets is the linearity inductor.

NEW TV SETS

Rank Radio have extended their range of colour sets fitted with the Z718 chassis – the one designed around the in-line gun tube, described in our July 1975 issue. First addition was the **Murphy Model MC6103**, fitted with an 18in. c.r.t. and housed in a two-piece moulded cabinet finished in white. The recommended retail price is £295.14 including VAT. More recently a 22in. set, Model BC6300, has been added to the Bush range. The only changes with this are to the line output panel, all other panels being interchangeable with the 18in. versions. The 22in. in-line tube is of the black matrix type, i.e. with a black coating on the areas between the phosphor stripes. Rank say this increases the picture brightness by 10%. The recommended retail price of the 22in. model, which is housed in a teak finished cabinet, is £379 including VAT.

Tandberg sets are now coming from their new factory at Haddington, Scotland. To coincide with this Tandberg have reduced the recommended retail prices of their range of colour models and are mounting an advertising campaign.

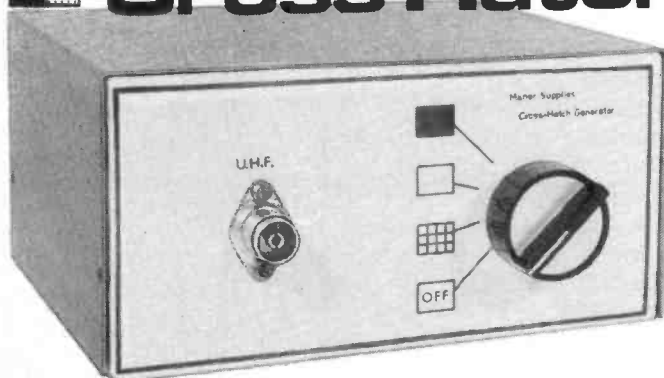
National Panasonic have introduced a new range of colour sets fitted with their Quintrix in-line gun tube. Screen sizes vary from 13in. to 20in. and the range continues to feature the company's "magic line" tuning. The new models are as follows: TC261G, 20in., £312.95; TC862G, 18in., £289.95; TC48G, 14in., £265.95; TC361G, 13in., £231.95. All prices include VAT. A converter is available as an optional extra for use with the 14in. model to enable it to be run directly off a 12V car battery. This is priced at £59.95 and incorporates a "fail safe" device to avoid running the car battery flat – the device automatically cuts the set off when the battery output voltage falls to 11V. National Panasonic say that a normally charged battery in a family saloon car will provide four to five hours' viewing before the cut-out operates.

Pye have added a 24in. monochrome set to their range, Model T184, which is fitted with the 176 chassis. **Sony** have introduced a new version of their 13in. Trinitron colour receiver, Model KV1340UB.

SPECIAL PRODUCT REPORT

The 'Manor Supplies' Mk II Cross Hatch Generator Kit

Roger BUNNEY



RECENTLY I took the opportunity of buying a secondhand colour set that required some attention. It was felt essential to have a crosshatch generator, so I decided to build the current Manor Supplies' crosshatch generator (Mk. II) and try it out. The Mk. II generator is a development from the initial design. It now includes a sync pulse generator and u.h.f. modulator so that the output can be fed into the set's aerial socket with no need for any internal connections. The u.h.f. output is at approximately channel 40 and is easily tuned in.

There are two ready-drilled printed circuit boards, one for the crosshatch generator and the other for the sync pulse generator and u.h.f. modulator. The latter comes preassembled, in an aluminium screening can, and simply plugs into the appropriate board. The crosshatch generator itself is the same as in the Mk. I design, and those already in possession of this can buy the remainder of the Mk. II kit in order to up-date their original one. The complete kit of components includes six integrated circuits and six transistors. A coaxial socket and a three-pole, four-way Yaxley switch with a black knob complete the package. Two alternative cases to house the unit are available: these are quoted for separately.

Full details are provided on five sheets, including instructions, circuit diagrams and descriptions and component layouts. It was felt that the addition of one item could be helpful to some – details of how to shift the u.h.f. carrier slightly in cases where this might produce pattern beats with a strong co-channel local transmitter.

Construction was simplicity itself, the component layout diagrams being both clear and accurate. The unit worked immediately on being switched on, the only adjustments required being the setting up of the line and field sync controls – as detailed in the setting up instructions provided. The four switch positions give on-off, crosshatch, and both peak white and black level rasters.

After some thought it was decided to connect the PP9 battery externally – the consumption of approximately 100mA would result in tiresome battery replacement if mounted internally since there are four screws to remove to gain internal access. If the unit is to be used in the field

however it is obviously more convenient to have the battery in its intended internal position.

The only criticism we have is that the smaller and more convenient "de luxe" metal case is rather pricey at £2.50 plus VAT. The case comes undrilled with a PVC covering of contrasting white and blue. We are informed that an improved front fascia is in preparation.

To summarise, the Manor Supplies' Mk. II kit provides the constructor or technician with a most useful tool for setting up and converging colour receivers. The cost is very low and we can recommend the kit to anyone requiring such an item. There is the added enjoyment too of actually "building it yourself"! Manor Supplies tell us that they take full responsibility for the units and will service and check them free of charge in case of difficulty being experienced.

Prices at present are: Complete kit £11.00 plus 45p post/packing/insurance. Sync plus modulator kit for adapting original crosshatch generator £7.40 plus 45p ppi. Plain aluminium case measuring 6 x 6 x 3in. £1.25 plus 55p post and packing. De luxe metal case measuring 6 x 5 x 3in. £2.50 plus 55p pp. Post and packing for complete kit plus metal case 65p. Prices subject to VAT at 8%.

Kits are available wired and tested at £14.60, though the supply is limited. Kits assembled, tested and fitted in the aluminium case are available at £16.60, or if fitted in the de luxe metal case £18.00. These prices are again subject to VAT at 8%.

An export version with a v.h.f. modulator is envisaged. ■



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5Z4G 0.55	6H5GT 0.53	30PL14 0.82	ECC807 1.41	GZ34 0.80	QQV03/10
6/30L2 0.80	6J6 0.35	30L15 0.82	ECP80 0.50	HN309 1.76	2.10
6AC7 0.60	6JUBA 0.88	30L17 0.76	ECP82 0.50	KT66 2.93	3.50
6AH6 0.80	6K7G 0.35	30P12 0.80	ECP86 0.88	PC86 0.70	R19 0.75
6AK5 0.47	6K8G 0.53	30P19/30P4	ECH35 1.60	PC88 0.70	UABCB0
6AMB8 0.70	6L6GC 0.68	30PL1 0.88	ECH42 0.80	PC97 0.42	0.47
6AN8 0.82	6L7(M) 0.59	30PL1 1.20	ECH81 0.40	PC900 0.30	0.47
6AQ5 0.53	6N7GT 0.70	30PL13 1.20	ECH83 0.52	PCC84 0.40	UAF42 0.75
6AR5 0.89	6Q7G 0.50	30PL14 1.29	ECH84 0.50	PCC85 0.58	UBC41 0.60
6AT6 0.53	6Q7GT 0.60	35L6GT	ECL80 0.50	PCC88 0.65	UBC81 0.60
6AU6 0.40	6R7G 0.78		ECL82 0.45	PCC89 0.50	UBF80 0.47
6AV6 0.53	6SA7 0.55	35W4 0.80	ECL83 0.82	PCC1890.60	UBF89 0.47
6AW8A 0.90	6SG7 0.52	35Z4GT 0.82	ECL86 0.47	PCF80 0.47	UC92 0.60
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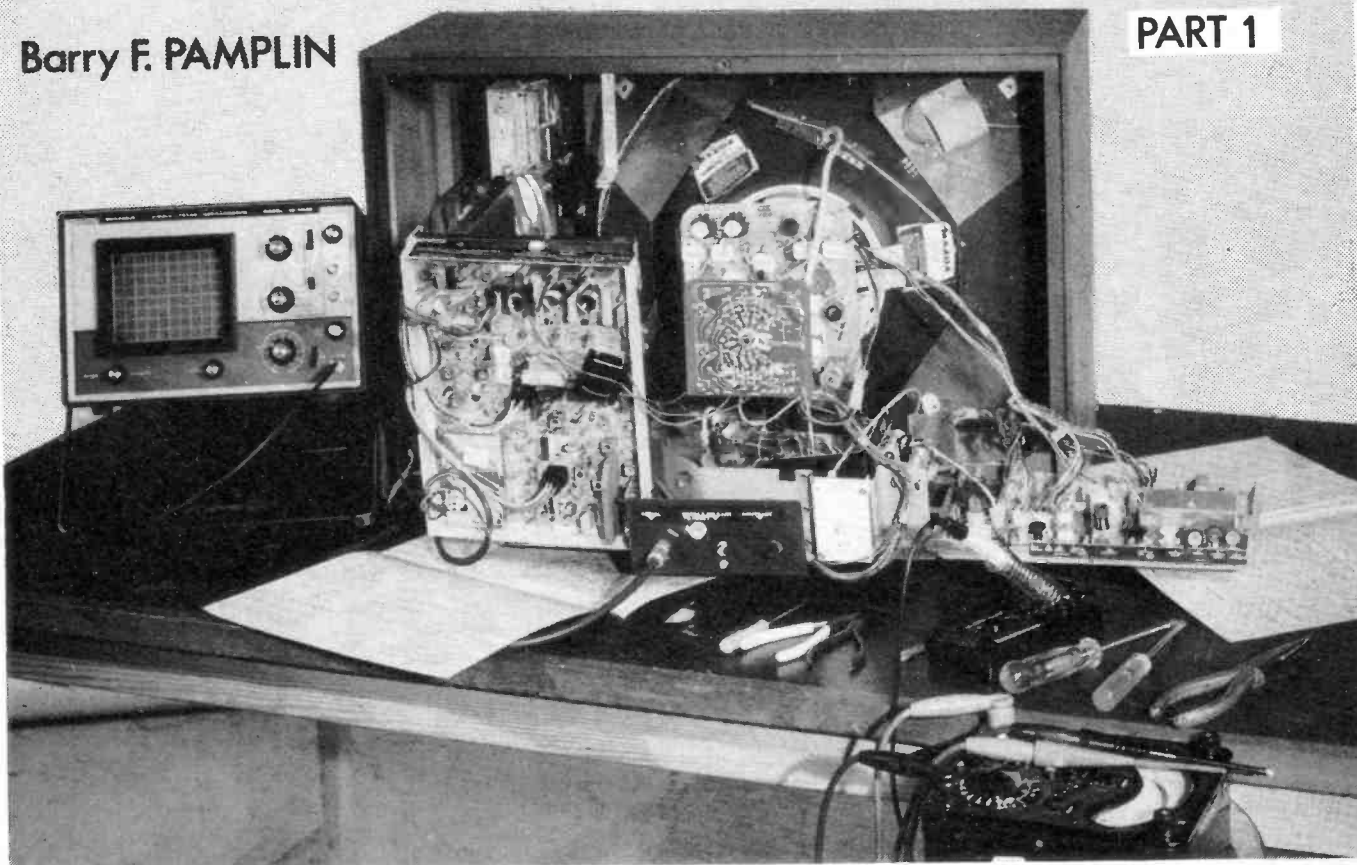
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Servicing the THORN 8000 8000A 8500 chassis

Barry F. PAMPLIN

PART 1



JUNE 1971 saw the production of the first British colour chassis aimed at breaking through the £200 barrier – the Thorn 8000 series chassis. With a 17in. A44-271X shadowmask tube and an all solid-state circuit the chassis has, along with its successors the 8000A, 8500 and 8800, proved to be very popular with the viewing public and more reliable than many engineers at first predicted.

Chassis Differences

The differences between the 8000 and 8000A chassis are minimal – the repositioning of some of the h.t. feed resistors from the power board to the mains dropper unit, and minor changes to the power board circuitry. The 8500 chassis, released in July 1972, uses a 19in. tube: the higher scan drive requirements led to a redesigned line output stage and focus circuit and the use of a choke instead of a dropper resistor in series with the live mains input line. This latter modification provides an h.t. rail of about 190V in place of the 170V used on the 8000 series. More recently there has been a redesigned i.f./decoder/video panel (PC651), and the introduction of the 22in. tube 8800 chassis which incorporates pincushion distortion correction and a varicap tuner unit: these later variants are not covered in the present articles.

The circuit is arranged in the form of seven replaceable modules. Accessibility is good, with the exception of the power board on the 8000 version. Originally buried beneath the flare of the tube, it was moved into the open on the 8500.

Outline

The front end consists of a conventional quarter-wave pushbutton tuner covering channels 21-68. There is a grounded-base r.f. amplifier and self-oscillating mixer. A.F.C. is used to prevent drift. Two different types of pushbutton tuner have been used, type 12558 which can be recognised by the presence of a small printed circuit panel at the rear, and type 221 with no such panel. These two units are interchangeable except for the fact that the knobs from one type will not fit the other.

The vision i.f. circuit consists of three broadly tuned stages with a.g.c. applied to the first two, feeding an i.c. low-level synchronous detector (Texas SN76530P or Motorola MC1330PQ). The intercarrier sound channel consists of another i.c. (Texas SN76666, Motorola MC1358PQ, RCA CA3065 or Sprague ULN2165A). The sound output stage is an MJE340 transistor operating in the class A mode with negative feedback. This transistor is

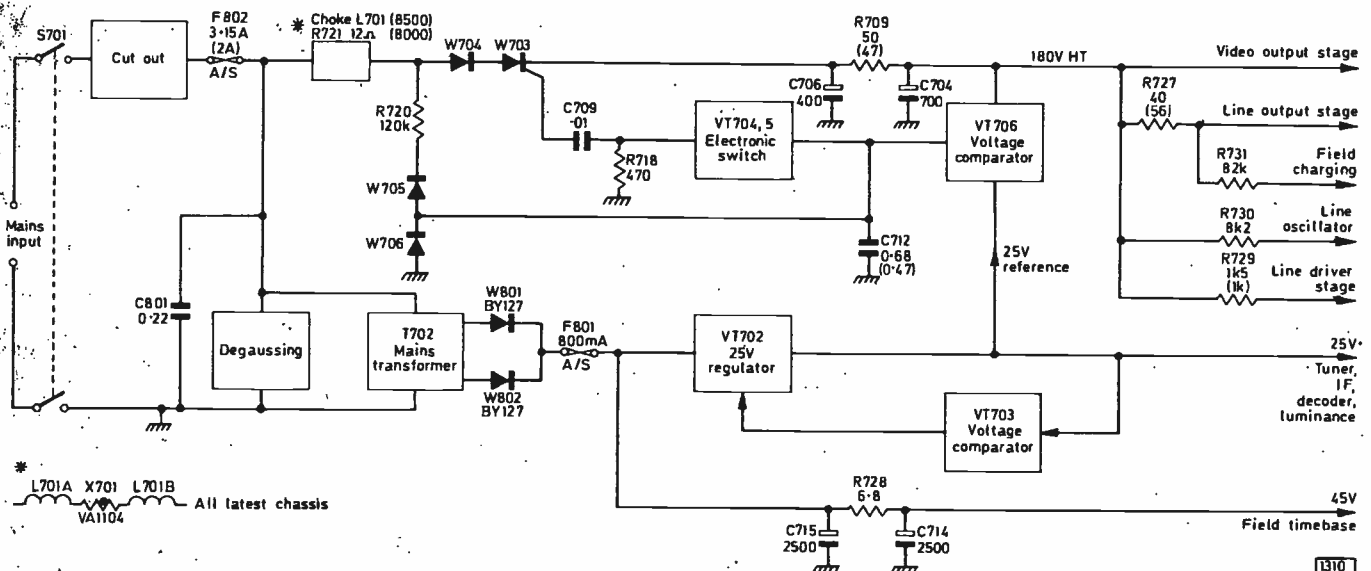


Fig. 1: Overall arrangement of the power supply board. Values in brackets apply to the 8000 and 8000A chassis, though in later 8000A chassis the ramp capacitor C712 which controls the electronic switch is 0.68 μ F as in the 8500 chassis.

also used to provide a quick path to chassis to ensure that the mains fuse blows under certain fault conditions – more of that later!

The decoder circuitry is fairly conventional (in Thorn terms), using the squared ident signal for R–Y switching and, somewhat unusually, a field effect transistor as a d.c. amplifier in the reference oscillator control loop.

The line and field timebase circuits are also fairly conventional. As mentioned above, the 8500 chassis uses a different line output arrangement based on a 1700V transistor (type BDX32) – the 8000 uses a BU105/02.

Power Unit

Having described the chassis briefly we will now get down to the power unit which is the subject of this first article. Two types of unit are used. The 90V6-644 used on the 8000 and the 90V6-644-101 used on the 8000A and the 8500. To distinguish one type from the other, look at R730 adjacent to the 10-way socket. If R730 is mounted vertically the panel is for the 8000 series, if it is mounted horizontally the panel is the later type for the 8000A/8500 chassis. *These panels are not interchangeable.* If the later type is used in place of the earlier type no damage will occur – the same cannot be said for using the earlier type instead of the later!

Associated with the different power panels are three different types of mains dropper. The original 8000 used a two-section dropper, type 90E5-005, consisting of a 12 Ω section and a 47 Ω section. The 8000A used a four-section dropper (90E5-006) consisting of a 12 Ω section, a 47 Ω section (as before) plus a 1k Ω section and a 56 Ω section. It will be clear from this that the four section unit may be used in place of the two section one but not the other way round. The 8500 uses a three-section dropper (50 Ω +40 Ω +1.5k Ω) since a choke (L701) is used in place of the original 12 Ω section. This dropper is suitable only for the 8500 series of course.

Overall Arrangement

The overall arrangement of the power board is shown in block schematic form in Fig. 1. From a mains input of 240V 50Hz, three outputs are provided. An h.t. line (referred to as 180V but in fact nearer 170V on the

8000/8000A and 190V on the 8500) which is obtained from a phase-controlled thyristor (W703). This feeds the video output transistors, the line output transistor, the field charging circuit and the line oscillator and driver.

An unstabilised 45V supply for the field timebase is obtained from a step-down transformer (T702), a pair of full-wave rectifiers (W801/2) and a smoothing circuit (C715/R728/C714). This supply is also used to feed the series stabiliser VT702 which provides a regulated 25V supply for the tuner, i.f. strip, decoder and luminance circuits. It is also used as a reference voltage for the thyristor-controlled h.t. line – an arrangement which makes the occurrence of a short-circuit stabiliser transistor a somewhat expensive affair!

Fig. 1 also shows the effect of the changes in the dropper resistors referred to earlier. In the original 8000 series the resistors feeding h.t. to the line output stage (R727) and line driver (R729) were mounted on the power board. On the later 8000A and 8500 chassis they are mounted on the mains dropper resistor assembly.

Protective Devices

The protection devices used in the circuit are also shown in Fig. 1. A 2A thermal cut-out and a fuse F802 (2A on the 8000/8000A, 3.15A on the 8500, both delay types) are used in the live mains lead while an 800mA delay fuse (F801) is incorporated in the 45V circuit. Whatever the theory may be, in practice – in the writer's experience – the thermal trip opens up only when the line output transistor has decided to shuffle off this mortal coil, the 2A (3.15A) fuse F802 blows only when the thyristor (together with a handful of other bits – more later) goes short-circuit, while the 800mA fuse F801 frequently blows for no obvious reason – unless of course it doesn't like the peak current rushing through it to charge up 2,500 empty microfarads restricted only by the impedance of the BY127s and the transformer secondary! It is not unknown for a defective cut-out to open of its own accord.

25V Stabiliser

The 25V stabiliser circuit is shown in Fig. 2 – the 45V supply has already been described. VT702, connected as an emitter-follower, acts as a series regulator with its emitter

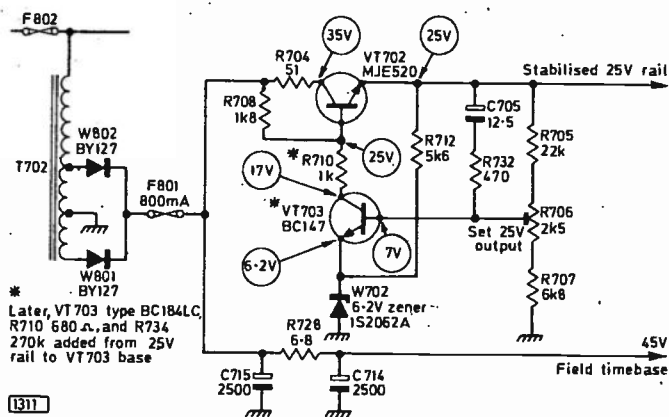


Fig. 2 The 45V supply and the 25V series stabiliser (VT702). C705 and R732 remove ripple by feedback action.

voltage following its base voltage – if the base voltage increases, the emitter voltage increases some 0.5V behind. R706 sets the stabiliser output voltage by altering the base voltage of VT703. Since the emitter of VT703 is tied to 6.2V by the zener diode W702, its collector voltage will alter following variations of its base voltage. Say the 25V line rises. The voltage on the base of VT703 will also increase, and its collector voltage will fall. This fall is coupled to the base of VT702 whose emitter voltage follows thereby counteracting the original increase. C705 and R732 couple the 100Hz ripple present at the output back into the control loop, thus providing effective smoothing.

HT Supply

The control circuitry for the 180V rail is shown in Fig. 3. Although apparently complicated, the operation of the circuit can be easily mastered if taken in small doses.

The mains input is fed via a dropper resistor section or choke to diode W704. This component originally owed its presence to the fact that when designing a set to break through the £200 barrier it is important to keep component costs as low as possible. Without the diode, thyristor W703 has to be able to withstand reverse voltages of the order of 400/500V. Such thyristors exist, but are more expensive than those that don't have such stoutness. Thus it's a case of it being cheaper to use two components rather than one! In some more recent production sets a different thyristor is used, W704* being omitted. More recently still a BY127 returns to the W704 position, and it pays to make sure that the diode is there.

The thyristor is generally faced with only the positive-going portions of the mains supply therefore, and these it conducts to the reservoir capacitor C706 in accordance with the signal at its gate. If more output is required, the gate signal switches it on earlier in each cycle – and vice versa. For those unfamiliar with thyristors it should be explained that once the gate has turned the device on it will remain conducting until the current through it falls to nearly zero – i.e. when its anode and cathode voltages are the same.

So far as the thyristor control circuit is concerned the key component is C712. When the voltage across this capacitor reaches 8V its upper plate is connected via VT704/5 to R714 and the thyristor is fired. The action of VT704/5 we will leave for a moment. Let us consider how C712 charges. It is connected to the stabilised 25V rail via VT706 and resistors R722/723. Thus it commences to charge as soon as the 25V rail has been established. The

rate at which it charges depends upon the base voltage of VT706, which is fed from a potential divider across the 180V rail and chassis. At switch on, the only current available to charge C712 is leakage through VT706. This gives the 8000 series its characteristic delay between switching on and the start up of the line timebase.

C712 must clearly be discharged to some fixed level every cycle, and this is the function of diodes W705 and W706. These conduct on only the negative half cycles of the mains input, pulling the top plate of C712 down to about -0.7V (the drop across W706).

Having sorted out the wood from the trees we can now return to the details of VT704/5. The base of VT704 is held at about 7V by the potential divider R716/R717. Thus when the voltage on C712 reaches 8V the transistor becomes forward biased and starts to conduct. The collector current flowing through R719/R718 causes the base of the npn transistor VT705 to become positive with respect to its emitter with the result that it too turns on. The effect of VT705 drawing current through R716 lowers VT704's base voltage so that this device turns on even harder. This regenerative action results in both transistors turning hard on and C712 being connected across R718. This voltage is fed to the gate of the thyristor via R714 and C709, switching it on.

Components C708 and R711 prevent the thyristor turning on spuriously, i.e. without a proper trigger pulse, especially at higher temperatures. R713/R715/C710 serve to bypass any transients which might tend to switch the thyristor on without a gate signal. C710 has proved to be unnecessary in the 8500 chassis since the transients are stopped by the ballast choke: though fitted to early boards, it should be removed when encountered (*this does not apply to the 8000 and 8000A chassis*).

Real Life Troubles

So much for the theory of the power board. What actually happens in real life? Without a shadow of doubt the two components that give most trouble are the 12Ω ballast resistor and the thyristor. Especially on the early 8000 models, the 12Ω resistor went open-circuit with alarming frequency. Whether the voltage drop per turn was too high or the ceramic formers were below par is not clear. When the modified resistor for the 8000A became available things got a bit better, but only when the resistor was replaced by a choke on the 8500 did the problem disappear. From a practical point of view the trouble was non-existent if you had a proper replacement to hand, and almost insuperable if you didn't. The classic approach of shunting the broken section with a dropper section was fraught with danger because of the small clearance between the resistor and the plastic cabinet. There was also the small problem of locating a source of 12Ω 50W sections! RS now make a complete dropper (stock number 154-955).

With the appearance of the 8500 chassis it was confidently hoped that dropper troubles would be over. No such luck. Referring to Fig. 1, the connection between R709 and R727 consists of a link of bare wire on the dropper – positioned so that it will readily short out R727 with the consequent demise of the line output transistor!

So much for dropper troubles. The next villain is the thyristor. This can misbehave in three ways. It can go short-circuit, open-circuit or start acting like an ordinary diode (there are other possibilities which are too rare to warrant mention). If it goes short-circuit the cause is often W704 going short-circuit thus subjecting it to high reverse

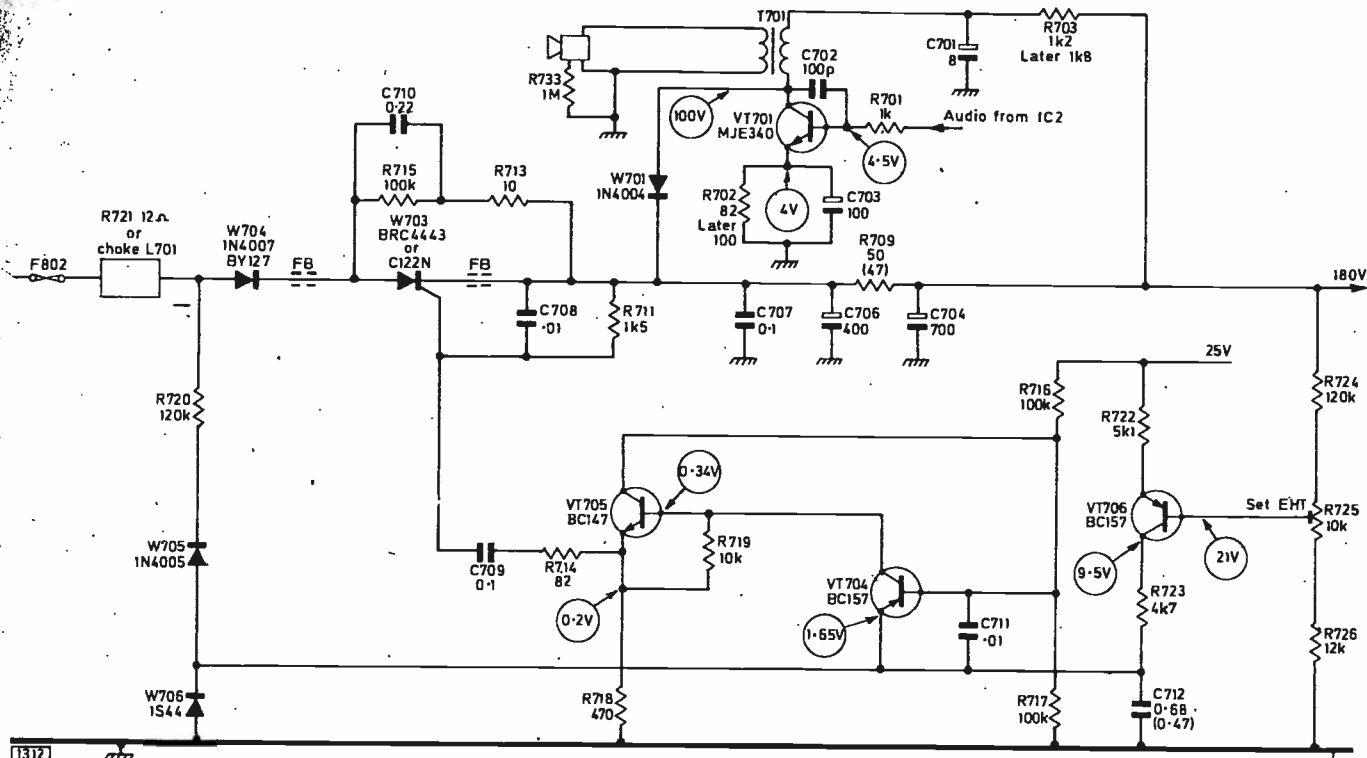


Fig. 3: Ahe stabilised h.t. supply circuit. Thyristor W703 provides the regulator action. The point at which it conducts during the positive excursion of the mains input waveform is determined by the ramp capacitor C712 whose charging is controlled by VT706. When the voltage across C712 reaches 8V the electronic switch VT704/VT705 operates and fires the thyristor. During the negative half-cycles of the mains input W705 and W706 conduct, discharging C712, and VT704/VT705 switch off.

potentials as mentioned before. When it goes short-circuit it will always take with it the sound output transistor VT701 and diode W701 (see Fig. 3). It is the author's contention, yet to be agreed by any higher authority, that the sole purpose of W701 is to ensure a low-impedance path to chassis via VT701 when the thyristor goes short-circuit and W701's cathode goes negative with respect to chassis. It certainly works, but what a system!

If the thyristor goes open-circuit there is no 180V rail but no damage otherwise. A thyristor acting like a diode will give an h.t. rail of around 280V, with dire consequences for the line output transistor and associated components.

Since the 25V rail is used as a reference point for the 180V supply it follows that a collector-emitter short in the 25V stabiliser transistor VT702 will cause the 180V rail to shoot up - in fact to around 280V. Shorts in VT706 and W705 have a similar effect, and in all these cases it is usually the line output transistor that suffers - and the customer's bank balance when one considers the price of a BDX32. Shorts across the collector-emitter junctions of the switching transistors VT704/705 cause the thyristor to stay off and result in no 180V supply.

Routine Fault Finding

For routine fault finding on the power board the following procedure is suggested.

Check for 45V at F801. If not present check W801/802, the mains transformer, fuses, thermal trip, and the on/off switch. Check for 25V on the emitter of VT702. If necessary adjust to 25V using R706. If no voltage is present here, check VT702/703 and associated components.

If the 25V supply is present but there is no 180V supply check W704, W703, VT704/705 and VT706 for being open-circuit - also check the 12Ω ballast resistor.

If the 180V line is high and uncontrollable the thyristor is the most likely culprit.

Instability of the 180V line is not a common problem, but when it does arise it produces a number of puzzling effects. A series of broad white lines across the screen is one example, another is the whole raster changing size rapidly. In all such cases the thyristor is the first suspect, with the transistors VT704/5/6 next on the list.

Modifications

During the life of the power board a few modifications have been introduced apart from those already mentioned. The three worth mentioning are all concerned with the behaviour of the unit with variations in supply impedance, and can be recommended in all cases where the power unit seems to be temperamental. R720 was changed from 150kΩ to 120kΩ, R723 was changed from 12kΩ to 5.6kΩ and finally to 4.7kΩ, C712 was changed from 0.47μF to 0.68μF.

Setting Up

There are two preset controls on the board. R706 sets up the 25V rail while R725 sets up the 180V rail. The setting up procedure is as follows.

Turn R725 fully anti-clockwise. Connect a meter capable of measuring 25V d.c. ±2 per cent between chassis and the emitter of VT702 and adjust R706 for 25V. The official procedure for setting R725 requires a special diode probe but in practice, and assuming no other fault exists on the receiver, it may be set to obtain the narrowest acceptable picture using the test card - for maximum reliability the h.t. rail should be set as low as possible.

CONTINUED NEXT MONTH

CEEFAX / ORACLE

reception techniques

Steve A. MONEY T. Eng. (CEI)

Part 7

APART from the normal display of text in the form of alphanumeric characters the specification of the teletext system also provides for a simple graphics facility, permitting the presentation of pictures, graphs or diagrams on the displayed page of information. This graphics mode can be used to display simple weather maps and other charts, or to produce large alphanumeric or other symbols. In this article the techniques involved in decoding and displaying this graphics information will be described.

Graphics format

For the production of the graphics display each of the character spaces is divided up into six segments as shown in Fig. 39. In effect this produces a dot matrix similar to that used for reproducing the text symbols but, in this case, being only a 2×3 array, it is much coarser.

Each of the six segments in the array can be either lit or dark. Since there are six segments it is possible to have 2^6 (64) different patterns which may be displayed in the character space. Each of these patterns is defined by a separate code word in the same way that the individual characters of the alphanumeric symbol set are.

Since there are only six segments it is practicable to allocate one bit of the data word to each segment of the array. In Fig. 39 the number shown in each of the segments indicates which data bit is used to control the state of that

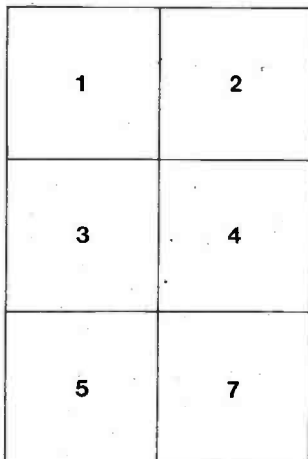


Fig. 39: The graphics symbol format. Each square can be separately addressed; the number indicates which bit of the data word controls that particular segment.

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particular segment. Thus if bit 1 of the received data word is at the 1 level then the upper left hand segment of the array will be lit. If this data bit is at the zero level then the segment remains dark.

Only six of the bits in the received data word are used to define the graphics pattern, bit 6 being omitted. Instead, bit 7 is used to control the lit or dark state of the sixth segment of the array. This has been done in order to provide an easy way of mixing graphics patterns and alphabetic characters in the same row of the display, as we shall see later.

The desired picture, or diagram, can be built up on the screen by simply selecting the appropriate graphics array patterns for each of the character spaces in the area covered by the diagram.

Shift control

There are only 128 possible combinations of the bits in the 7-bit data word which defines the pattern to be shown in each of the character spaces. Of these 96 will be required for the alphanumeric characters and signs. This leaves 32 spare codes which are not enough to cover the required 64 graphics patterns. To overcome this problem a "shift" mode of operation is used.

This shift arrangement is similar to that used on a typewriter, where, in order to keep the required number of keys on the keyboard down to a manageable level, each key is made to control two alternative symbols. On conventional machines each key operates its own type bar which will have to carry two different print symbols. For letters one symbol will be a capital, or upper case letter and the other will be its lower-case equivalent. The numbers are paired off with various punctuation signs with the number acting as the lower-case symbol.

Normally the typewriter mechanism is arranged so that, when a key is pressed, the lower-case symbol, on the type bar associated with that key, strikes the ink ribbon and a lower-case letter is printed on the paper.

To obtain capital letters an additional key, known as the Shift key, is held down whilst the character key is struck. Operating the shift key causes the mechanism to be moved so that the capital letter on the type bar will strike the ribbon and produce a capital letter on the paper. Whilst the shift key is held down all the symbols printed will be capitals but when the shift key is released the machine reverts to its normal lower-case mode.

BIT 7				0	0	1	1	1	1						
BIT 6				1	1	0	0	1	1						
BIT 5				0	1	0	1	0	1						
BIT 4	BIT 3	BIT 2	BIT 1	Al	Gr	Al	Gr	Al	Gr	Al	Gr	Al	Gr	Al	Gr
0	0	0	0			0		@	@	P	P			p	
0	0	0	1	!		1		A	A	Q	Q	a		q	
0	0	1	0	"		2		B	B	R	R	b		r	
0	0	1	1	£		3		C	C	S	S	c		s	
0	1	0	0	§		4		D	D	T	T	d		t	
0	1	0	1	%		5		E	E	U	U	e		u	
0	1	1	0	&		6		F	F	V	V	f		v	
0	1	1	1	'		7		G	G	W	W	g		w	
1	0	0	0	(8		H	H	X	X	h		x	
1	0	0	1)		9		I	I	Y	Y	i		y	
1	0	1	0	*		:		J	J	Z	Z	j		z	
1	0	1	1	+		;		K	K	[[k		{	
1	1	0	0	,		<		L	L	\	\	l			
1	1	0	1	-		=		M	M]]	m		}	
1	1	1	0	.		>		N	N	^	^	n		~	
1	1	1	1	/		?		O	O	_	_	o			

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Fig. 40: The graphics symbol codes, together with the corresponding alphanumeric symbols for each code.

In an electrically controlled typewriter it is usual to employ two control commands to operate the shift of the mechanism between upper and lower-case modes of operation. One command is used to set the machine into the upper-case, or capital letter, mode whilst the other is used to return the operation to the normal lower-case mode. The teletext system uses a similar two-command arrangement where one of the commands selects the graphics mode whilst the other is used to return the system to alphanumeric operation.

In the typewriter one key controls two different symbols and in the same way the received teletext data word may represent either a graphics or alphanumeric symbol according to the mode selected by the last shift command. Fig. 40 shows the series of codes used to define the graphics patterns, together with the corresponding alphanumeric symbols for each code.

Control codes

The shift commands are sent out in the data stream as if they were normal character codes. Last month when we looked at the character codes it was seen that the first 32 codes in the table are not used for defining symbols but are reserved for use as control signals. In fact the whole group of 16 codes in the second column of the table are used to control the shift operation.

The complete series of shift commands and their functions are shown in Fig. 41. Eight codes are used for selecting the graphics mode whilst the other eight are for the alphanumeric mode. Using eight orders for each mode permits the selection of any one of seven different colours in which the symbols may be displayed. The first code in each group is not used and will be displayed on the screen as a blank space.

CONTROL IDENT.		SHIFT					BLUE	GREEN	RED	FUNCTION
B7	B6	B5	B4	B3	B2	B1				
0	0	1	0	0	0	0	NOT USED			
0	0	1	0	0	0	1	GRAPHICS RED			
0	0	1	0	0	1	0	GRAPHICS GREEN			
0	0	1	0	0	1	1	GRAPHICS YELLOW			
0	0	1	0	1	0	0	GRAPHICS BLUE			
0	0	1	0	1	0	1	GRAPHICS MAGENTA			
0	0	1	0	1	1	0	GRAPHICS CYAN			
0	0	1	0	1	1	1	GRAPHICS WHITE			
0	0	1	1	0	0	0	NOT USED			
0	0	1	1	0	0	1	ALPHA RED			
0	0	1	1	0	1	0	ALPHA GREEN			
0	0	1	1	0	1	1	ALPHA YELLOW			
0	0	1	1	1	0	0	ALPHA BLUE			
0	0	1	1	1	0	1	ALPHA MAGENTA			
0	0	1	1	1	1	0	ALPHA CYAN			
0	0	1	1	1	1	1	ALPHA WHITE			

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Fig. 41: The shift command codes, allowing either graphics or alphanumerics to be displayed in any of seven colours.

If we examine the pattern of bits in these shift code words it will be seen that bits 7, 6 and 5 always have the combination 001. This combination can be detected and used to tell the decoder that the word is a shift order and not a normal character word. Looking at bit 4 it will be seen that it is a 0 for a shift to graphics and a 1 for the shift to alphanumeric. Thus bit 4 acts as a shift control signal. Bits 1, 2 and 3 switch the R, G and B video drive signals to produce seven colours as required. For each of the colours the pattern of these three bits is the same in both graphics and alphanumeric shift commands.

When it is desired to change the display mode, one of the shift command words is inserted as the data word for the symbol space before the point in the display where the shift action is to occur. Because the character generator may not recognise this code and could produce an unwanted symbol the space is displayed as a blank.

To reduce the number of shift commands transmitted it is assumed that every row of the display starts in the alphanumeric and white symbol condition since this is likely to be the most frequently used display mode.

Alpha with Graphics

If alpha symbols are mixed with graphics in the same row it would normally be necessary to leave a blank space each time the mode changed to allow for the insertion of the shift code word.

Earlier we saw that bit 6 was not used to define the pattern of the graphics symbols but it will be noted from Fig. 40 that for all of the graphics symbols bit 6 in the code word is always a 1. For the capital letters in the alphanumeric mode bit 6 is 0 and there are no graphics symbols associated with this group of character codes.

We can therefore arrange for the capital letters to be shown when in either graphics or alphanumeric modes. Thus in the graphics mode when bit 6 is detected as 0 the display is switched so that the alphanumeric character generator provides the symbol pattern to display letters without the need to change the mode of operation from graphics.

Using this technique enables graphics and alphanumeric symbols to be packed closely together in the same row since no blanks are needed for shift commands. Of course for numbers and lower-case letters the system has to be shifted back into the alphanumeric mode in the normal way.

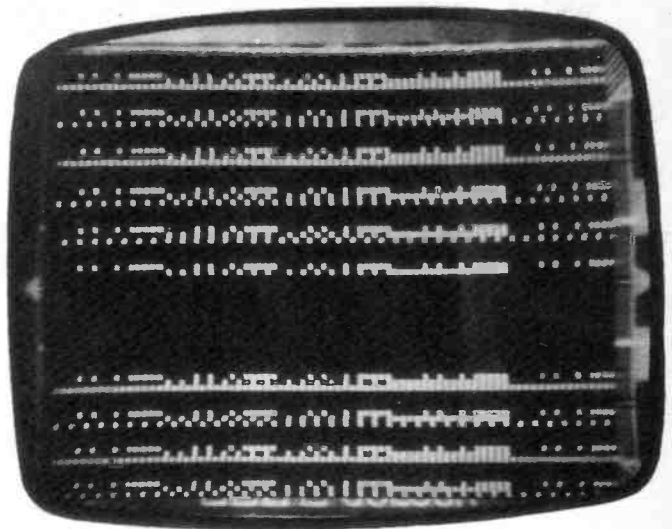
In a simple decoder with no graphics generation logic the graphics codes will either be interpreted as letters or simply blanked out.

Graphics generation

Having seen how the graphics signals are coded we can now go on to see how the display itself is generated.

Of course the graphics generator system could use a Read Only Memory device, programmed with the appropriate set of display patterns for the graphics symbols, and the generator circuit would then be similar to that used for producing alphanumeric symbols. In practice, because of the much simpler pattern of the graphics symbols and the fact that each segment is controlled by its own bit in the code pattern, it becomes possible to design a relatively simple generator circuit using normal logic elements.

The precise arrangement of the logic will depend on the layout chosen for the overall page display and also the type of alphanumeric character generator used.



This test display shows the complete symbol set available.



Symbols and alphanumeric used to produce a weather map.



The signs of the zodiac are built up from graphic symbols.

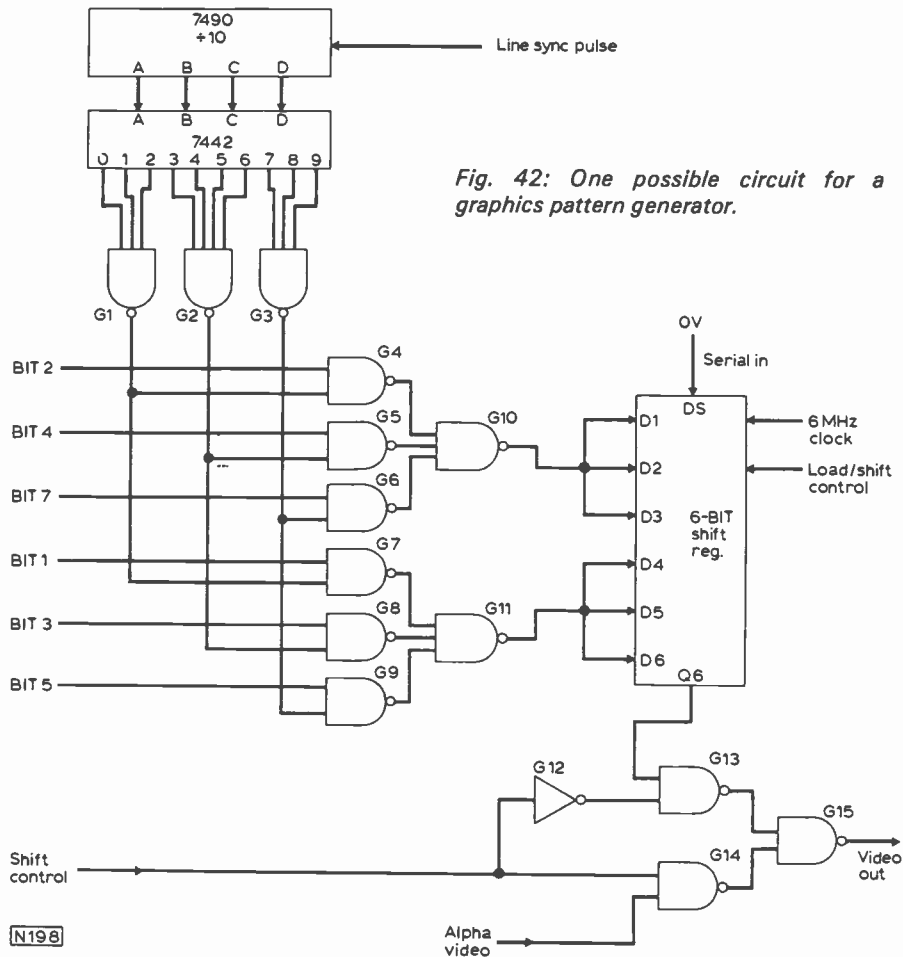


Fig. 42: One possible circuit for a graphics pattern generator.

In each field of the television picture there will be 287.5 active picture lines which could be used to display the teletext data. Since there are 24 rows of symbols in the page the maximum number of lines we can use for each row of symbols will be eleven from each field. In most decoders it is likely that ten lines per row of symbols will be chosen since it is much easier to produce a divide-by-ten counter for counting off the lines as the display is built up. For letters the character size is determined solely by the format of the character generator so that if eleven lines are used instead of ten there will simply be an extra line of spacing between the rows of letters.

In the case of graphics symbols the choice of ten or eleven lines per row will affect the layout of the three segments in each column of the graphics display pattern. Unfortunately neither ten, nor eleven is exactly divisible by three so the segments will either have to be of different heights or else gaps must be left between them. A possible arrangement is to use ten lines per row and to make the middle segment of the pattern four lines high whilst the top and bottom segments remain three lines high.

A typical logic arrangement to produce the graphics patterns is shown in Fig. 42. This circuit assumes that the alphanumeric character generator has a 5×7 dot format.

A 7490 counter is used to divide the line scans into groups of ten. Usually this counter will be a part of the main display control logic and may also be used to provide a line count signal for the character generator.

From the 7490 the four outputs are fed through a 7442 one-of-ten decoder, which produces an output on a separate pin as each line is scanned. The ten outputs from the 7442 can now be grouped into two sets of three lines and one of four lines to represent the three vertical

segments of the symbol being generated. The three NAND gates G1, G2 and G3 are used to perform this function.

For the next step the vertical segment outputs from gates G1, G2 and G3 must be gated with the six controlling bits of the received data word and this action is carried out in the six NAND gates G4 to G9. Of these gates G4, G5 and G6 deal with the three segments in the right-hand side of the symbol whilst the other gates deal with the left-hand segments. Suppose bit 2 of the character code were at the 1 level. During the first three scan lines of the symbol the output of gate G4 will now go to 0 to give a signal corresponding to segment 2 of the symbol pattern.

From gates G4, G5 and G6 the three segment outputs for the right-hand column are mixed together in gate G10. This latter gate acts effectively as an OR gate since its input signals are all inverted. As a result a 1 will appear at the output of G10 whenever one of the right-hand column segments is to be lit. Gate G11 deals with the signals for the left-hand side of the symbol in the same way.

To produce the serial video output signal a shift register is used in the same way as for the alphanumeric display generator. It is assumed that the character space is six elements wide so the register has six stages. The first three are driven by the signal from G11 since the left-hand segment must be the first to be shifted out of the register. Gate G10 feeds the last three stages of the register to give the right-hand segments.

During each line scan the sequence of data words for all 40 characters or symbols in the row are presented to the graphics generator in turn. For the first three line scans of the row of characters the generator will be producing segments 1 and 2 of each symbol according to the state of bits 1 and 2 as the symbol is scanned. For the next four

next month in Television

● WHY DIGITAL?

Digital multimeters are gaining favour. Why, and how do they function? E. Trundle answers these points in the first part of a new series reviewing the test equipment currently available. In this part, five digital multimeters will be considered from the TV serviceman's viewpoint. Later instalments will deal with oscilloscopes, pattern generators and miscellaneous items.

● SERVICING TV RECEIVERS

One of the most commonly encountered dual-standard chassis is that used in the Bush TV161 and subsequent models. It's five years since we last covered these sets, and many more stock faults have had time to make themselves known. Les Lawry-Johns reports.

● PREVENTING CALL-BACKS

A serviceman's reputation is all-important, and nothing detracts from it more than call-backs after a repair has been carried out. There are many steps that can be taken to make a call-back less likely, whilst on older sets with an accelerating rate of faults advice to the customer will let him know what to expect.

● NOISE-GATED SYNC SEPARATORS

Good line sync is essential in a colour set where line flyback pulses are used to control various operations in the decoder. For this reason many colour sets feature a noise-gated sync separator. Methods of discriminating between noise and sync pulses and making the sync separator immune to noise pulses will be described.

● GEC COLOUR HYBRIDS

More on servicing these very common colour sets. This information has been gathered from experience in a rental company owning a large number of these receivers.

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lines segments 3 and 4 will be generated and in the remaining scan lines the two bottom segments given by bits 5 and 7 are generated. As each character space is reached the pattern is loaded into the shift register and then shifted out by the 6MHz clock to produce the video output signal.

The video signal from the graphics generator is fed via a changeover gate, comprising gates G12 to G15, before going to the video circuits. This changeover is switched by the shift control signal which turns on either gate G13 for graphics or G14 to allow the alphanumeric signal to pass through. Gate G15 simply acts as an OR gate.

Shift logic

The logic used to provide the shift control signal is shown in Fig. 43. First bits 6 and 7 of the data word are inverted by gates G1 and G2 and these inverted signals are gated with bit 5 in gate G3 to detect the 001 combination of bits 7, 6 and 5 indicating a shift command. After inversion by G4 this detected signal is used as the clock input for a D-type flip-flop. The D input is fed by bit 4. Now when a shift command is detected by gate G3 the flip-flop will be set to the state of bit 4. The Q output of the flip-flop will go to 1 for graphics and to 0 for alphanumerics. At the end of each line scan the line sync pulse is used to reset the flip-flop into the alphanumerics mode ready for the next line scan.

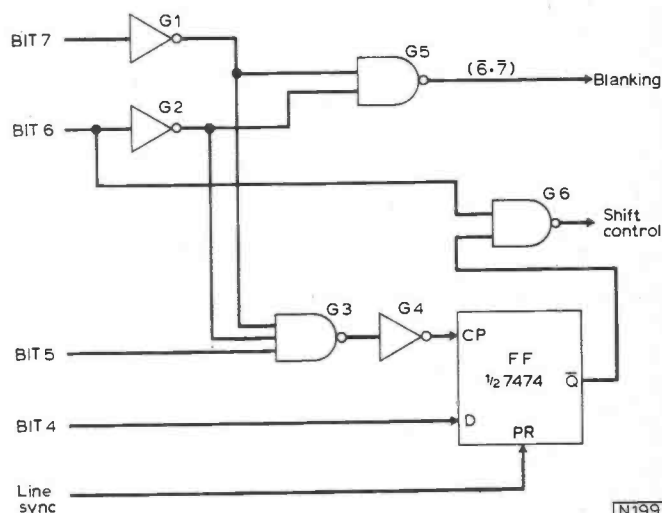


Fig. 43: A shift control logic circuit.

Gate G6 provides the alpha with graphics facility. When either bit 6 or the flip-flop signal goes to 0 the output of G6 will go to 1 to select the alpha display mode. Thus bit 6 will override the shift command when it is at 0 but the flip-flop will return the display to the graphics mode as soon as bit 6 returns to the 1 level.

To blank the display when command codes are received the inverted signals of bits 6 and 7 are gated together to produce a blanking signal which may be used to interrupt the video signal. Thus all words with either 000 or 001 as the combination for bits 7, 6 and 5 will be blanked.

There are naturally several alternative ways in which the graphics generator can be designed. For instance it is possible to use a common output shift register and carry out the changeover switching at its inputs.

Next month we shall look at the control logic for the display itself.

Simple U.H.F. Aerial Amplifier

Hugh COCKS

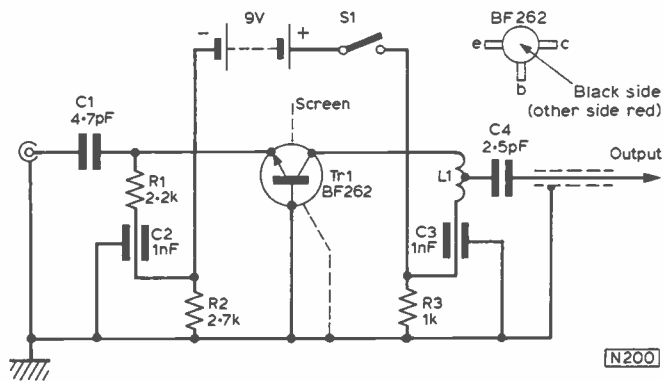


Fig. 1: Circuit diagram of the simple u.h.f. preamplifier.

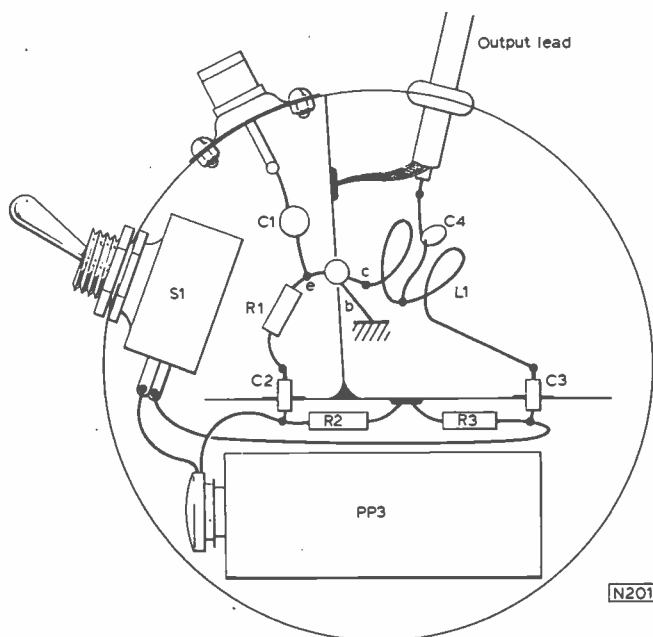


Fig. 2: Component layout of the prototype preamplifier, constructed in a 1 oz. tobacco tin. The output lead must be not less than 0.3m (12in) long (see text).

A wideband (or grouped) u.h.f. preamplifier can often significantly improve the signal to noise ratio on all channels within an aerial group, helpful for those unfortunate enough to live in a low-signal area, or for anyone keen to receive an alternative distant ITV station.

Using this simple preamplifier, I found that the Rowridge transmitter could be received at 80 miles on a u.h.f. indoor aerial, albeit somewhat noisily. Without the preamplifier, the signal was visible merely as weak line syncs. It should be possible to build the unit for about £1.50 including the battery.

Circuit description

The circuit of the amplifier is shown in Fig. 1. Incoming signals are fed via C1 to the emitter of Tr1. Emitter bias is provided by R1, decoupled by feedthrough capacitor C2. The base of Tr1 is connected directly to chassis, and is biased by the potential divider R2, R3. L1 forms the collector load, which is decoupled by C3.

The output is taken from a tap on L1 via C4 and a length of coaxial cable. This cable should be at least 0.3m (12 in) long in order to sufficiently damp the output to prevent any likelihood of instability.

The BF262 npn transistor used here is widely available, having found fame in the ELC1043 varicap tuner where two are used in r.f. stages.

Construction

The prototype unit was built in a one-ounce tobacco tin, which is large enough to accommodate a PP3 battery and on/off switch. Any metal container of adequate size will of course suffice.

No subchassis is necessary as the light metal of the tobacco tin can be soldered with ease using a 25W iron, although a 10W iron should be used when connecting the transistor into circuit. The passive components are fitted first and the transistor last. The feedthrough capacitors C2 and C3 are mounted on a tinplate screen soldered to the base of the tin. This screen also secures the battery firmly in place. To prevent any possibility of short circuits, the side of the battery facing the capacitors should be covered with insulating tape.

When all the components have been mounted, a second metal screen, shaped to clear the transistor, is fitted so as to separate the input and output circuits. Great care must be taken as the transistor is already in place and the tobacco tin will heat up quite quickly when the screen is soldered.

The braid of the coaxial output cable is soldered to this second screen. This, together with a grommet in the wall of the unit, mechanically secures the cable.

In common with all u.h.f. amplifiers, it is of the utmost importance that all connections and leads are as short as possible to avoid any tendency to instability. The only exception to this rule is the output coaxial lead, as mentioned above.

Coil details

For Group A, the coil consists of three turns of low-loss cable inner conductor, spaced over 6mm (¼in) and 6mm in diameter. The tap feeding C4 is made at the centre. For Groups B and C, the coil is two turns spaced over 6mm, still centre-tapped. Final peaking of the tuning is accomplished by slightly closing or opening the coil turns. Luckily, the tuning was not affected when the lid was put in place on the prototype as so often happens with amplifiers of this type.

continued on page 147

MILLER'S MISCELLANY CHAS. E. MILLER

Not Beyond Economic Repair

A SHORT time ago I sent a good quality portable radio of a well known make to the manufacturer's service depot requesting an estimate for the replacement of an i.f. transformer. To my surprise it was returned within the week, curtly described on the invoice as being "beyond economic repair". Pressed for a reason, the service depot alleged that the case was dirty and that the printed panel was covered with what they described as "corrosive dust" (!). So an expensive, eighteen-month old radio is condemned to the scrapheap as far as the makers are concerned.

I wonder what they would make of a colour television set which came in for repair earlier this year? It was a GEC Model 2028 – the original dual-standard chassis. Because the line output transformer had failed, the set had been allowed to stand idle for many months in a shed used as a workshop cum store. A sack of grass seed had been placed on top of the set, and this had attracted rats. The lovable little creatures had bitten through the sack, thus emptying its contents into the set which was backless. This provided them with a cosy nest in which they must have spent the winter, supplementing their diet by chewing most of the leads interconnecting the various panels.

The set was eventually dumped on the lawn in my back garden: it presented a truly daunting sight. The grass seed was still piled up in it, level with the tops of the i.f. cans, and it wasn't until the worst of this had been tipped out (on to the lawn of course!) that the havoc could be fully appreciated. To be honest, I thought the set would never work again. Fortunately, on hand was a most determined gentleman, "Tug", who is prevented by ill-health from working regularly and thus enjoys passing his time helping me out. With a small paint brush he painstakingly removed the seed – a job which also entailed removing all the screening cans since they were full to the brim! Under the seed was a strata of rat-droppings which resisted for a long time all efforts to shift it with Servisol.

When the print was at last reasonably clean I was still far from hopeful. Gazing glumly at the maze of chewed-up wiring, I predicted that sorting this out would prove impossible. It might have, too, save for a colossal stroke of luck: an exactly similar set came into the workshop for a simple valve replacement job. We sat the two sets side by side on a bench, and Tug went to work again. Hours of toil later, the seedless GEC 2028 was ready to be switched on. Glory be! We got pictures! The set ran for a couple of hours, then went mad and incinerated the pincushion distortion correction transducer T501 on the timebase board. A large, sooty hole appeared in the printed circuit. We cleaned this up and joined up the broken bits of print;

to discover that the set worked with no detectable difference in performance without the missing T501.

After a settling down period in the workshop, during which a little trouble was experienced with transistors in the bistable circuit, the set was put into service and has performed well (touch wood!) for the last six months. This was due very largely to the efforts of one who would be the first to call himself semi-skilled – but surely more of an engineer than the average valve jockey?

1984 Nears

When I renewed my television licence recently it was sent to me from the new Licence Centre in Bristol. It carried at the bottom a serial number with the staggering total of 27 digits. Since only the odd seven digits would be sufficient to give every man, woman and child in the UK a distinctive number, enough information could be carried by the remaining twenty to file everything from date of birth to length of toe nails. And it's only eight years distant, folks!

Why Study?

In a cogent editorial in a recent issue of our sister publication *Practical Wireless* the Editor, Lionel Howes, referred to the wages of Wireless Technicians, Prototype Wiremen, and Laboratory Technicians, none of whom could expect to earn more than £49 a week and probably as little as £42. One aspect of science however seems to provide a reasonable reward for little technical ability, vide an advertisement in the *Daily Mail*. The Science Museum were asking for a male cloakroom attendant, average weekly pay £43 for 42 hours – and it's probably more by now. Any overtime at double time rate, and generous paid holidays. Now all you over paid service engineers, doesn't that make those nights at the "tech" seem well worth while?

Check Your Numbers

"The first thing to learn in our trade", a demolition contractor is supposed to have told his apprentice, "is to make sure you have the right address!" This also applies to our trade. On one occasion many years ago a chap who worked for me went to remove an aerial from one house to another. The customer had said that the aerial lead would be left disconnected so that it could be drawn back through the window should no one be in when the call was made. What seemed to be the correct address was found, with a likely looking length of loose coaxial cable. When this was yanked however a perfectly innocent 17in. Ekco table model was catapulted on to a stone floor. By some miracle it survived this, and such were my assistant's powers of persuasion that not only did he get himself exonerated from all blame but he also managed to get the owner to let us take over the servicing of his set!

LOPT Troubles

Just lately I've had a crop of line output transformer failures in Bush/Murphy sets between two and six years old. At least one other local firm is also experiencing this. The older sets exhibit the signs of a weak e.h.t. rectifier, the picture blowing out as the brightness control is advanced. There is no remedy other than replacement of the line output transformer, and with prices as they are plus the dreaded VAT it seems to me that a lot of customers are

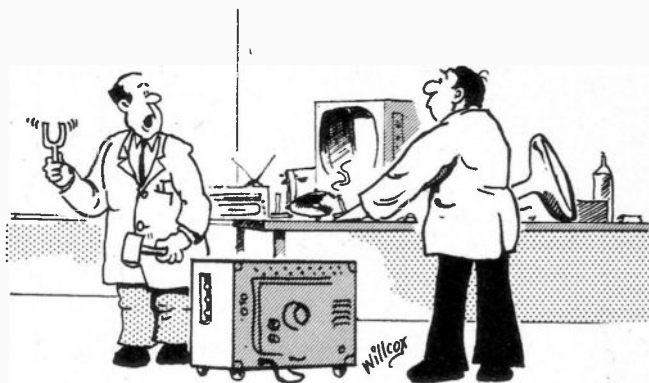
going to scrap their sets rather than pay up to £20 for repairs.

With the later single-standard models the faults seem about equally divided between the above mentioned trouble and flashover caused by the DY802 e.h.t. rectifier heater winding's insulation breaking down. Luckily the latter is easily cured by replacing the winding. The flashover usually seems to occur in this way, but I did have one case last week where it was from the c.r.t. anode lead to the PY88 top cap, due to the lead not having been pulled taut behind the insulation on top of the scan coils. The warning notice to this effect is obviously justified.

The Gentle Art of Graffiti

When television sets were large, square boxes with horizontal chassis, many were the hours we used to sit peering at the innards via a trapdoor in the bottom of the cabinet. To relieve the tedium certain engineers took to doodling on the woodwork, a harmless enough pastime. Later the practice escalated to altering the wording printed on the backs of sets. Regentone/RGD sets of the period used to have a large white label with the legend "when dispatched from the factory this set was tuned to _____", followed by the name of a BBC station, such as Holme Moss. This was ripe for attention. The paxolin aerial panel also carried a small socket, labelled "earth". One of our number discovered that some very interesting results could be produced by erasing the bottom bar of the E and the complete H. And so it came to pass that two unsuspecting engineers found themselves delivering a set which had been well and truly got at.

When we reached the doorstep and were about to ring the bell, we became aware of a rhythmic chinking sound from within. It sounded for all the world like a Victorian miser counting his gold. The bell caused a sudden break in this activity, followed by the rattle of coins being poured into a cash box. The front door eventually swung back to reveal a middle-aged couple who looked both nervous and suspicious. The sight of the television set seemed to assure them that we weren't about to rob them of their life savings, and we were allowed in. We placed the set on its table and



"It's an amazing breakthrough in sonic remote control - doesn't need any batteries you see!"

switched it on. It performed well enough, so the man ushered us through to the front room to pay for the repairs. He started to count out about two pounds in threepenny bits and tanners, but got only about half way when his wife burst in.

"Wait a minute!" she told him, "that's not our set!"

"Not your set?" I faltered, nonplussed. "Of course it is".

"Oh no it's not!" she retorted accusingly. "I've had a look at it and it says on the back "this set was tuned to Vladivostok. Our set wasn't tuned to Vladivostok, it was tuned to the BBC".

I looked in vain to my accomplice for support. He simply looked at the wall, shoulders heaving. Worse was to come.

"And anyway" the woman went on, "what does this other writing mean? F...A...R...T?"

There was a strangled cry from beside me. It's at times like this that you know who your friends really are. My brain worked overtime searching for a convincing lie. It came up with:

"I know... it's your set, but it's had the wrong back put on it."

Incredibly, she believed me. We left with the cash, promising to return at an unspecified date to fit the correct back. Hey!... I wonder if she's still waiting...?

BOOKS ON CCTV

From correspondence and enquiries arising from our recently concluded series on Closed Circuit Television, we know that a number of our readers are involved or interested in various aspects of CCTV. Whilst there seems to be little published material on the industrial uses of CCTV, there are quite a few books aimed at the educational and training fields. Some recently published titles which may be of interest are listed below, together with a summary of their contents.

TV CAMERA OPERATION, by Gerald Millerson, 160 pages, price £1.75. Camera features and controls, viewfinders and mountings. Lenses - focusing, depth of field, perspective, turrets, zoom lenses. Picture shots and composition. Camera movements. The studio environment.

TV LIGHTING METHODS, by Gerald Millerson, 150 pages, price £2.25. The character and aims of lighting. Light sources and fittings. Controlling light. Lighting for various subjects, in the studio and on location.

BASIC TV STAGING, by Gerald Millerson, 173 pages, price £1.75. The purpose of staging. Set construction.

Scenic erection and support. Constructional devices. Decoration and lighting.

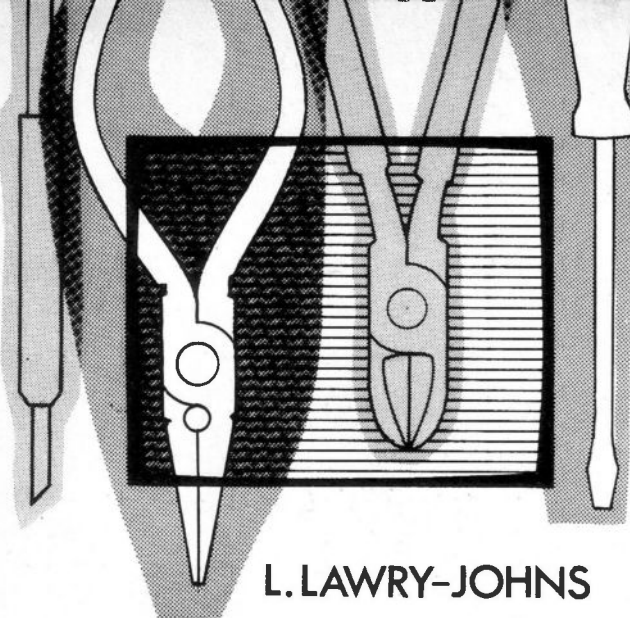
TV SOUND OPERATIONS, by Glyn Alkin, 176 pages, price £2.25. The nature of sound. Microphones - types and mountings. Sound control and acoustics. Speech and drama. Sound effects. Music of all types. Tape recording and editing.

THE USE OF MICROPHONES, by Alec Nisbett, 167 pages, price £1.75. Sound and acoustics. Microphone types and characteristics. Speech balance. Relating sound and picture. Music balance. Instrumental, vocal and orchestral music. Controlling sound.

All the above books are published by Focal Press Limited, in their Media Manuals series.

TELEPRODUCTION SHORTCUTS: A Manual for Low-Budget Television Production in a Small Studio, by Bob Westmoreland, 262 pages. Published by University of Oklahoma Press (UK Agents: Bailey Bros. and Swinfen Ltd.) at £7.70. A wealth of practical hints and tips based on the author's experiences in establishing and running a schools CCTV system in Ponca City, Oklahoma, USA.

The vidicon camera. Video and videotape. Audio. Lighting. Visuals. Studio design. Location and mobile units. Production techniques.



SERVICING TELEVISION RECEIVERS

INDESIT MODEL T24EGB

L. LAWRY-JOHNS

continued

No Sound

We have had several of these sets in for lack of sound although the audio amplifier/output stages are working – as indicated by a hum test at the volume control. This situation is calculated to make anyone feel uneasy as it could well indicate a defective intercarrier sound chip (TBA120A). This combined 6MHz amplifier and quadrature detector is in common use and it is not unusual to find it at fault. It is a fact however that we have not so far had to replace one in this type of set. The fault is usually due to a dry-joint at or around the chip. Careful probing will reveal the defective joint or a general run round with the iron will put matters right. On one occasion there was no supply to pin 11 of the chip because of a leaky electrolytic (C1317).

The more usual cause of no or intermittent sound is a faulty PCL86 audio valve. There is often a loud crack or screech which can be produced by tapping the suspect valve. No trouble here then, but do check the cathode resistor R308 whenever the valve has to be replaced.

The Vision Strip

Now let's take a quick look at the vision stages. We say quick because we haven't had much trouble here except to locate and replace the occasional dud transistor.

The transistors that are likely to give trouble can be anticipated. One is the final i.f. transistor TR1203 (BF197). When this is faulty there will often be no voltage across its emitter resistor R1214 (should be 1.2V) although the base and collector voltages are present. The failure of this transistor leaves the raster present on the screen and fully controllable but with no picture or sound of course (perhaps a little sound may get through which can be misleading).

The other transistor that causes trouble is the video output transistor TR205. This usually goes open-circuit. As a result its collector voltage will be high – set by the potential divider R229, R231. The voltage across R229 will be less than normal since the transistor is not conducting. Therefore the brightness control will have to be fully advanced before the screen will be illuminated – if it lights up at all since the grid can be brought up to only about 100V.

If there is no raster then, don't immediately order a new line output transformer! Check the tube base voltages, having checked the e.h.t. with a quick wave of the neon

over the line output transformer to confirm that this is full of energy and radiating happily.

If the c.r.t. cathode voltage (pin 7) is well over 110V check the voltage across the video output transistor's emitter resistor R227. This should be roughly 3.5V. If there is no voltage here, check the transistor's base voltage to ensure that the contrast control is intact and is dividing the collector voltage (4V) of the driver stage (TR201) to provide TR205 with base voltage. If there is voltage at the base of TR205 it is reasonable to suspect that the transistor is faulty. It is a BF178, a type which is readily available though others can be used if they have suitable ratings and are intended for video use.

Field Timebase

The field timebase consists of a straightforward PCL805 circuit. It requires little comment except perhaps to point out that the field output transformer has a feedback winding. The valve itself is responsible for most fault conditions, but we can anticipate that time will show up one or two other probable defects such as lack of height – even loss at top and bottom – due to either R517 or R505 changing value or the height control itself developing a dud spot, or severe bottom compression due to C512 drying up.

Line Timebase

The line timebase is where most trouble will be experienced. To date we have found that the principal causes of the no picture condition can be fairly equally divided between valve and line output transformer failure. Sometimes there is little doubt as to which of these has occurred because of the obvious breakdown of insulation on the transformer. This is not always the case however. The PL504 may show signs of moderate overheating which is not due to lack of line drive – this would cause more obvious overheating and in any case can be checked with a meter at R425. In this case one suspects the line output transformer but nevertheless carries out the usual checks

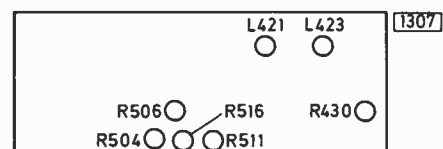


Fig. 3: Rear chassis view of preset controls.

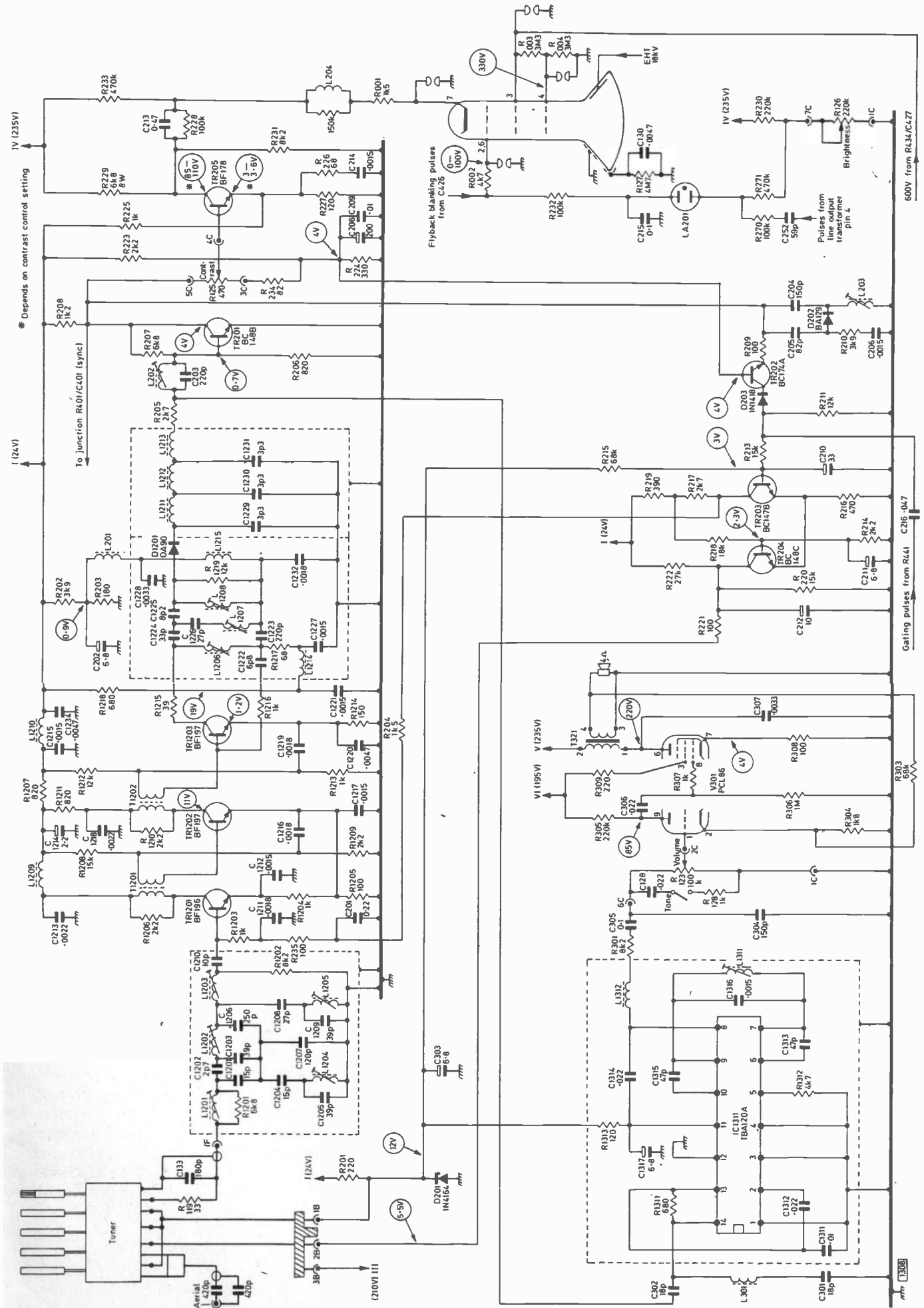


Fig. 4: Circuit of the vision and sound sections of the Indesit Model T24EGB. Voltages measured without signal, using a 50kΩ/V meter.

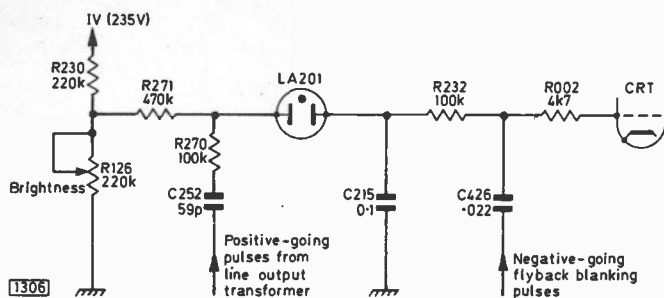


Fig. 5: The c.r.t. grid circuit is somewhat unusual in using a neon bulb (LA201), which is mounted on the main printed board, to provide switch-off spot suppression. The neon does not conduct until the line output stage comes into operation, when the positive pulses applied to it via C252 and R270 cause it to strike. The brightness potential is then applied to the c.r.t. grid and C215 charges. At switch-off LA201 ceases to conduct and the charge left on C215 results in the e.h.t. being rapidly discharged. The neon hasn't given trouble to date: if it failed to strike we would expect a plain, bright raster.

on the valves and components, including disconnection of the line scan coils.

This latter check is not done by pulling out the interconnection plug because when this is disconnected the h.t. supply to the stage is cut off, a safety precaution since otherwise the c.r.t. could have full e.h.t. but no deflection, resulting in a severe burn at the centre of the screen. The link between 50 and 60 cuts off the h.t. to render such an act harmless. It is quite easy to disconnect the line coils only however, thus leaving full vertical deflection.

In practice the scan coils are rarely at fault and one is left with the sad conclusion that the overload is being caused by shorted turns in one of the output transformer windings. One winding may be found to be quite warm when touched, but make sure that this is not due to a defective e.h.t. rectifier – by removing the e.h.t. cap from the side of the tube. Several of the transformer lead-out wires are soldered direct to the panel. The solder must be

removed in part at least by desoldering braid or some kind of vacuum pump (which is incorporated in some types of iron).

The boost capacitor C424 doesn't cause much confusion as it's returned to chassis via a winding on the transformer and R436 (2.7kΩ) which shows its distress in no uncertain way when the capacitor shorts.

Attention is drawn to the two 4.7MΩ resistors R427 and R428 which can go high in value to cause lack of width.

Whilst most line oscillator troubles are due to the PCF802, on the odd occasion a positive voltage may be found at pin 2 due to leakage through C415. This kills the oscillator and causes the output stage to overheat.

Line drift not due to PCF802 troubles could well be due to R414, R415, R431 or R432 changing value or to D402 and D403 being unbalanced.

Tuner Unit

The tuner unit appears to be a standard type but in fact contains three transistors, an r.f. amplifier, a mixer-oscillator and an i.f. preamplifier. It's mechanically tuned and the majority of troubles are likely to be of mechanical origin.

AGC Circuit

A.G.C. is applied to the base of the r.f. amplifier transistor from the delayed a.g.c. stage TR204. The a.g.c. to the first i.f. stage (TR1201) on the main panel comes direct from the a.g.c. amplifier TR203.

Possible Faults

Whilst we haven't experienced the following faults yet on these models it is quite likely that C427 will short at some time to deprive the c.r.t. of its first anode voltage (pin 3) and thus give a no raster condition, and that R435 will go high value to give rise to vertical rulings (striations) down the left half of the screen.

'Bye for now.

BOOK REVIEWS

QUESTIONS AND ANSWERS ON COLOUR TELEVISION, 2nd Edition, by J. A. Reddihough and David Knight. Published by Newnes/Butterworths. 134 pages, 4½ × 6½ in.

The first edition of this book was published in 1969 and was the first attempt to provide a fairly comprehensive account of colour television reception based mainly on the techniques used in the commercial sets of the period. Its main fault consisted of a few over simplifications due to the limited amount of technical information available at the time – most of the information on the PAL system generally available then was in German for example. This second edition has been revised to take into account subsequent developments and to fill out some of the technical points – for example a more detailed account is given of how the chrominance delay line circuit works. At 75p the book is good value, providing a detailed guide to how colour receives work and basic setting up procedures. Fault conditions are also touched upon. The new edition takes in RGB drive, in-line gun colour c.r.t.s such as the Trinitron and PI tube, decoder i.c.s, 110° convergence and raster correction, and basic thyristor line

output stage operation. How rapidly the scene changes however is brought out by the fact that the PI tube is described as being a 90° type: already a 110° version has been announced, though this does not seem to be in use yet in sets on the market. As with the first edition, the overriding aim has been to provide information in a practical manner so that anyone who can follow a circuit diagram can see what is involved in decoding a colour transmission and producing a picture on the colour c.r.t.

GUIDE TO WORLD-WIDE TELEVISION TEST CARDS, by Keith Hamer and Garry Smith. Published by HS Publications at £1.30 including postage. Soft cover, 56 pages, 6 × 8½ in.

The hobby of long-distance television reception (DX-TV) has been gaining increasing numbers of followers in all parts of the world in recent times. When you receive an SpE, Tropospheric, MS or other variety of distant signal the most important thing is to be able to identify its origin. Invaluable therefore is this Guide to World-wide Television Test Cards, which has been compiled by two well known enthusiasts. In addition to 264 test card, network and station identification photographs, there is a useful supplement on world-wide broadcasting authorities and networks and a list of transmission standards. The book can be obtained from HS Publications at 7 Epping Close, Mackworth Estate, Derby DE3 4HR.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

OCTOBER seemed to be rather dead until the time came to start thinking about writing this column. MS reception was only slightly above average, while SpE reception was equally quiet apart from a small opening on the 9th. Early in the month the only Tropospheric openings were relatively minor affairs confined to medium-distance signals – particularly on the 8-10th with ducting into Switzerland and South West Germany (at his Leeds home Kevin Jackson noted strong signals from Switzerland at u.h.f. on the 8th). But the last three days here have turned into a Tropospheric bedlam! A very slow-moving, high-pressure system settled over Central Europe and the result was a quite fantastic upsurge of signals in all bands. By the 27th I had received here in Romsey, Hampshire (75ft a.s.l.) twenty-one new stations in all bands.

Most remarkable I feel was the reception of several Swedish transmitters at v.h.f. and u.h.f., with the signals ranging from just visible to almost noise free. The strongest SR signal was on channel E55, but this has not yet been identified.

In fact the log recently resembles that of a summer's day during a typical Sporadic E opening. Today I received Denmark, East Germany, West Germany, Norway and Sweden. The weather situation looks as if it will remain unchanged for a couple more days so the conclusion of this opening will have to be reported next month, when we shall also have heard how other enthusiasts fared.

There have been problems in identifying individual transmitters since due to networking similar cards are radiated from many outlets. Generally I tend to assume that the transmitter being received is the nearest or most powerful one in the direction from which the signals are coming, though this isn't a hard and fast rule and one has to bear in mind other possibilities due to the effect of signal ducting.

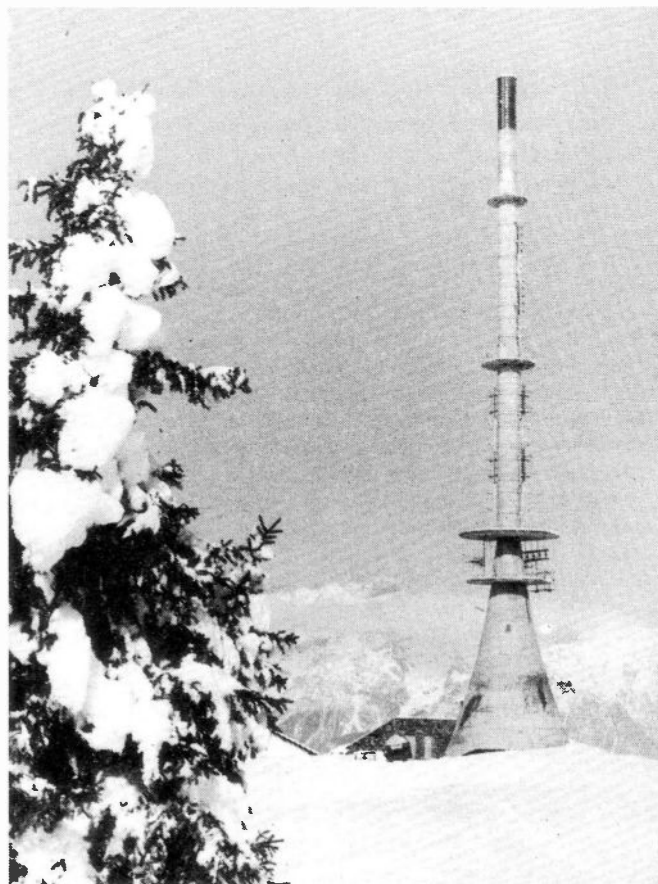
These recent activities make the other few events of the month rather insignificant. Garry Smith has again been successful with Band III MS however, including TSS (USSR) on ch. R6. Another new transmitter received here via Band III MS was the TVP-1 (Poland) Olsztyn ch. R6 outlet. To summarise then, a quiet month which has ended with a dramatic flourish. In the circumstances there seems little point in listing the usual log.

A letter just in from James Burton-Stewart reports suspected reception of Lille-3 on ch. E29, carrying the French TF1 and TF3 programmes.

Satellite News

The engineering division of Sveriges Radio ab (Sweden) has written to us on the subject of the experimental satellite transmissions to Europe within the TV broadcast frequency spectrum. These were to have taken place in the Autumn of 1976 but have been cancelled due to "objections from several countries in Europe regarding frequency clearance". I'm hoping to find out the intended frequency that was to have been used for this now defunct project since it may point to future experiments.

It is reported in the latest *EBU Technical Review* that talks on the future of satellite broadcasting have been taking place in Brussels. The band that would be used is Band VI (12 GHz) and



A Christmas scene – the ORF transmitter at Hauser-Kaibling, which radiates ORF-1 on ch. E11 with a power of 10kW, and ORF-2 on ch. E40 at 80kW. The mast is 63m high and the site is 1858m asl.

it seems that the vision modulation will almost certainly be f.m. While on the subject of satellite TV transmissions, the ATS-F project providing educational programmes to India is reported to be going well since its commencement in August. Typical receiver installations use a three metre diameter mesh dish aerial which feeds the receiver via a 60cm converter.

A major agreement for the supply of a complete satellite system has been under discussion between the Central African state of Zaire and a major French electronics company. Detailed contracts have still to be negotiated however.

Foreign News

Poland: Over 6.1 million sets are now in use and a shortage of colour receivers is reported at present. TVP-1 covers some 95%



The Jakutschaja, Siberia ASSR caption received from TSS.



Station identification of RTV Bahrain in the Arabian Gulf. See "From our Correspondents".

of the population and TVP-2 some 45%. The aim for colour capability was that the whole network would be able to handle colour by the end of this year, with 50% colour programming; 100% colour programming is anticipated by the end of 1978.

Belgium: A second French language RTB service to complement RTB-1 is expected to be started within two years. It is understood that the second service is being introduced due to competition from networks in adjacent countries. Many cable companies relay the foreign transmissions and because of the terrain many domestic installations are able to pick up these transmissions with the aid of high-gain aerials and preamplifiers.

France: The French government is to issue regulations prohibiting "the importation of foreign signals", and also of advertising on the various cable TV systems. The main concern seems to be with the very popular TMC (Tele Monte Carlo) and CLT (Luxembourg) programmes.

Italy: Michele Dolci reports that an RAI-3 network is proposed for Northern Italy. The first transmitters will be Milano (ch. E33) and Mt. Penice (ch. E55). The only indication of the start of operations is "soon".

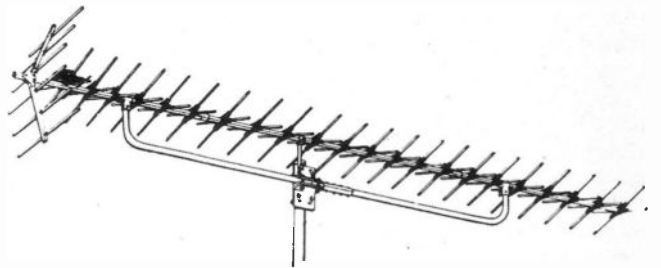
USSR: Peter F. Vaarkamp tells us that the new Vilnius TV tower is now open. It's 326 metres high. TV coverage has now been extended to Tadshikistan via a new receiving station: for the Orbita satellite network. The transmitter is located at some 2,200 metres in the Pamir Mountains.

Czechoslovakia: Does anyone know the channel used by Krasov TV? It's apparently the most powerful CST transmitter, with a 312 metre mast, and came into operation on December 23, 1974.

Australia: Robert Copeman and Nicholas Earley have both written to tell us of the latest changes being made as a result of the introduction of f.m. radio transmissions. The problem is that the TV channels 3, 4 and 5 lie within the 85-108MHz spectrum in which the f.m. service is being introduced. This means that the frequencies used by several TV transmitters are having to be changed, while other transmitters not immediately affected are suffering from various degrees of co-channel interference. For the record, f.m. stations at present in operation are: Sydney 2MBS-FM 92.1MHz (400W) and ABC-FM 92.9MHz (50kW); Melbourne 3MBS-FM 92.5MHz (3.6kW); Adelaide ABC-FM 92.1MHz (50kW); Canberra ABC-FM 101.9MHz (50kW).

From the U.S.

The WTFDA *VHF/UHF Digest* continues to arrive and reading through it I wonder what DX is like there, with so many stations in operation and on programme for such long hours. The September issue reported that veteran DXer Bob Seybold of Dunkirk, New York, had received KVUE-TV ch. A24 and KHTV ch. A39 – a distance of some 1,200 miles! Bob mentions that during a super opening with SpE and Trop reception "close to 200 stations were seen on one great day. The opening started in the morning but improved after 1800 and continued great until 0330 the following day (August 9th) when I quit for a spell.



The Antiference XG21 high gain u.h.f., providing a forward gain of almost 21dB.

Resuming at 0700, I found that the signals were of fantastic strengths, with Trop openings at u.h.f. up to 1,200 miles – some 7-800 mile signals were snow-free". In the same issue Glen Hausser (Oklahoma) reports receiving seven high-band (that's our Band III) signals via SpE!

The WTFDA has published a TV station guide to the North American continent, providing a map and information on channels, offset frequencies, city, state, call letters, networks, e.r.p.s, transmitting mast heights etc. The attractive book is available at \$5 post paid from the WTFDA, Box 163, Deerfield, Illinois, 60015, USA.

European DX-TV Club

There has been no organisation publishing a club bulletin in English since the demise of the Europese Testbeeldjagers. Now, G. van der Linden of Noorderhavenkade 21b, Rotterdam 3004, Holland is proposing to establish an international edition of the European Testcard Photo Club (it's published in Dutch at present). If there is sufficient support the project will go ahead.

**LONG-DISTANCE
TELEVISION**

Those interested should write to the address given above. The annual membership fee would be Dfl 30, but don't send money for the present since initially only the likely response is being investigated. We hope the club will be supported!

TV Station List

It's time for subscribers to renew payment to receive the twentieth *List of European Television Stations*. Not surprisingly, the price has increased – to 400 Belgian francs. It's obtainable from the European Broadcasting Union, Technical Centre, Avenue Albert Lancaster 32, B-1180, Bruxelles, Belgium. We highly recommend this list, which is very accurate and comprehensive and now the size of a telephone directory!

From our Correspondents . . .

Mike Allmark (Leeds) has reported on his results during the past SpE season. In all he received some 17 countries, and a drawing he sent confirms reception of TVR (Rumania) on the 18th. Mike has been using a "ZL Special" aerial, details of which are shown in Fig. 1. Basically, it's a twin-dipole assembly with 1/8th wavelength spacing, driven 135° out of phase. The response is similar to that of a three-element array, but with a greater vertical angle. Mike's array is made of 300Ω ribbon feeder taped to dowelling. The information is given in case others should wish to experiment. It does seem a useful aerial, with a 60° beamwidth (–3dB points) and a forward gain of 6-7dB.

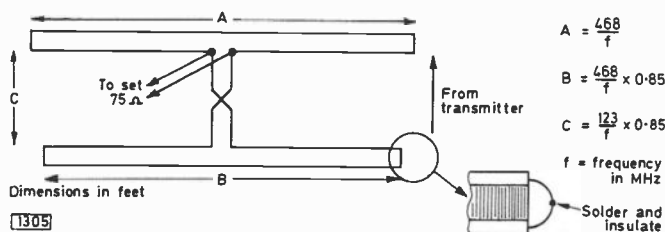


Fig. 1: The "ZL Special" aerial used by Mike Allmark. The dimensions for channel E3 are: "A" 2.6m (102in); "B" 2.2m (87in); "C" 0.58m (23in). The length of the feeder "C" is critical, since it governs the phasing between elements, and therefore the overall directivity of the array.

Our photographic expert Graham Harrison reports seeing on ch. E3 a test card which resembles the RETMA card but with the contrast/gray scales blacked out. I suspect this was either Port Said ch. E3 or Iraklion (Crete) ch. A2. Did anyone else see it? The date was August 20th.

Hetesi Laszlo (Hungary) tells us that the Nagykanizsa ch. R1 MT-1 transmitter has been using the colour blockboard – which DFF have been using recently. MT has discontinued the use of the RETMA card. One of Hetesi's friends recently experienced really exotic reception, including RTV Bahrain – a photograph showing the stylised flowers in primary colours and a large Arabic 4 (i.e. ch. E4) to the right-hand side is shown this month.

Meteor Shower Dates for 1976

Thanks to the BAA, Meteor Section, we list the dates for regular MS in 1976.

Quadrantids: January 1-6, peaking 4th at 1000. "Very favourable indeed."

April Lyrids: April 19-24, peaking 21st at 1800. "Rather favourable."

May Aquarids: May 1-8, peaking 5th. "Fairly favourable."

June Lyrids: June 10-21, peaking 16th. "Unfavourable."

Capricornids: July 10-August 15, peaking July 25-26th. "Very favourable."

Delta Aquarids: July 15-August 15, peaking July 27-28th. "Very favourable."

Capricornids: July 15-August 25, peaking August 2nd.

Aquarids: July 15-August 25, peaking August 26th.

Perseids: July 25-August 18, peaking August 12th at 0600. "Unfavourable."

Cygnids: August 19-22, peaking August 20-21. "Rather favourable."

Orionids: October 16-26, peaking October 21st. "Fairly favourable."

Taurids: October 20-November 30, peaking November 8th. "Partly favourable."

Cepheids: November 7-11, peaking November 9th. "Very unfavourable."

Leonids: November 15-19, peaking November 17th at 0700. "Rather unfavourable."

Geminids: December 7-15, peaking 14th at 0300.

Ursids: December 17-24, peaking December 22nd. "Very favourable indeed."

In addition the Southern Hemisphere MS dates are as follows:

Corona Australids: March 14-18, peaking 16th.

Ophiuchids: June 17-26, peaking 20th.

Pisces Australids: July 15-August 20, peaking July 31st.

Phoenicids: December 4-5.

Further Thoughts on Moonbounce

In the April 1975 column we speculated on the chances of TV signals being received after being bounced off the moon. We left the issue open in the hope that someone might receive something or that other information would be forthcoming. Dave Bunyan has been looking into the past history and experiences of this unusual mode of propagation, and has come up with the following information: it's impossible! Dave explains that with a 500kHz bandwidth signal the path loss can be overcome at about +12dB over the noise by using an aerial and amplifier each with a gain of 25dB. When the bandwidth is increased to 1MHz however the signal from a 5MW US transmitter after being moon bounced would, received with the equipment just mentioned, result in a signal level of –30dB under the noise – with no Tropospheric enhancement of the path. Dave further suggests that the moon should be only a few degrees above the horizon in order to utilise the maximum (low angle) radiation from a domestic transmitter and to maximise ground reflection at the reception end – such reflection can give 12dB at angles less than 12°. Much of this information was obtained from *The VHF Handbook* by Orr and Johnson, published in 1956.

In a subsequent letter Dave further endorsed his view that moonbounce is "no-go". The moon is spherical rather than circular, with an approximate radius of 1,100 miles. Thus a reflected signal can have a path variation of up to 1,100 miles – the difference between a centre and an outside limb reflection. This would stretch signal pulses by about 5ms, which although not affecting CW telegraphy – normally used by radio amateurs for moonbounce – would play havoc with sync pulses and picture content. For example, if we started with a line 1 sync pulse we would receive the last echo of that pulse some 5ms (or 80 interlaced lines) later. The result would be rather a mess! In any case the angle the moon occupies in the sky is less than 1°, and a dish with a 30ft diameter has a beamwidth of approximately 4°. If we now start thinking about the polarisation of the incoming signals, they will be returning not in the conventional vertical or horizontal mode but circular – we have to think about left- and right-hand helical threaded aeriels . . . !

Conclusion: it's going to be difficult!



MAINTAINING THE PHILIPS N1500 VCR

Michael GLADWELL

It is well over a year since the Philips N1500 videocassette recorder was first introduced on the domestic market in the UK. Thus a good number of these machines are now out of the guarantee period, and many more will follow. Increases in labour and materials costs and VAT rises in recent times have meant that an after-guarantee service contract can be very expensive. The machine must nevertheless receive regular maintenance, and the purpose of this article is to outline what is required.

There are two main aspects of regular maintenance, lubrication and cleaning. We will look at lubrication first.

Lubrication

As the layout (Fig. 1) shows, there are three motors. These are the threading motor, the video head drum motor and the capstan (tape drive) motor. Only the tape drive and video drum motors require attention. Every 1000 running hours the upper and lower bearings should be lubricated with a light oil (e.g. Mobil DTE N medium type). A hypodermic syringe is a useful tool for this operation.

The bottom pivots of the capstan flywheel and the tape transport motor should also be lubricated with this type of oil. This should be done every 500 hours. The pinch wheel shaft requires a polish and a smear of light oil, again every 500 hours, but it is most important that oil does not come into contact with the pinch wheel itself.

The upper and lower clutch assembly is best left alone: since the tools and jigs required to reset the clutches after

assembly are expensive, it is advisable to leave the lubrication of this unit to the local service agent. This assembly is probably the most reliable mechanical part of the machine however, so it should not require attention as regularly as the parts mentioned above.

The video head drum shaft requires cleaning and a drop of light oil every 1000 hours or so. This can be done when the drum is removed for inspection.

The piano-key mechanism, cassette holder mechanism and other slow-moving parts can be cleaned occasionally and lubricated with a fine smear of light grease.

VCR lubrication can be approached in the same way that you would tackle that of a good quality audio tape recorder. The majority of faults we have encountered so far with these VCRs have been of mechanical origin, so it is well worthwhile paying careful attention to the machine's moving parts.

Cleaning

The layout of the heads and the tape path is shown in Fig. 2. This will assist in making clear what cleaning is required in this area. The machine is shown here in the unthreaded position, i.e., OFF. As most owners and readers will know, the helical-scan technique is used in this machine: on completion of the threading up action (red light period ON) the tape is partially wound round the video head drum. In operation the tape floats round the video head drum on a minute cushion of air. It is essential

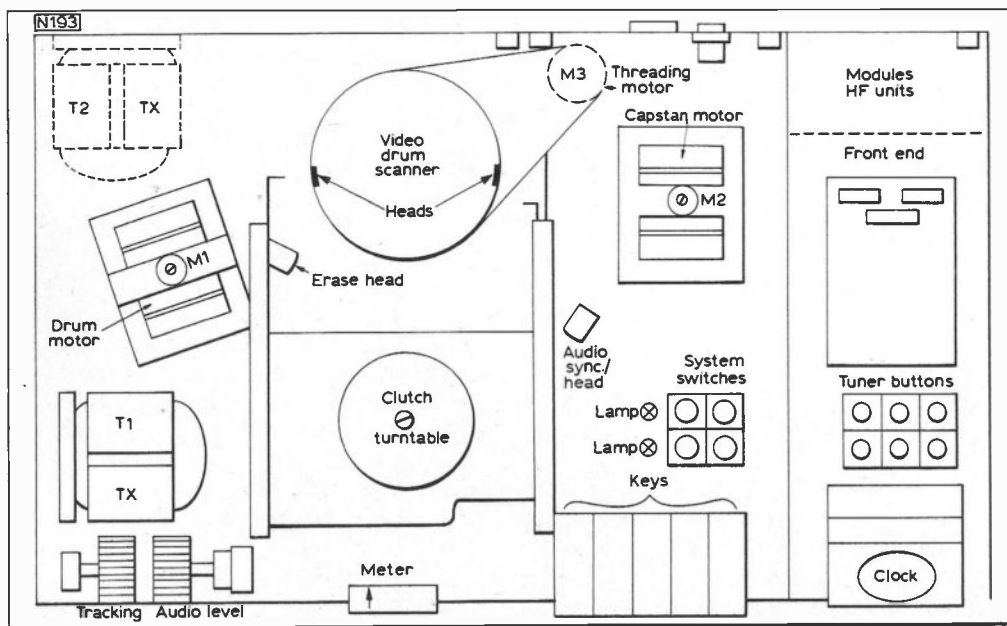
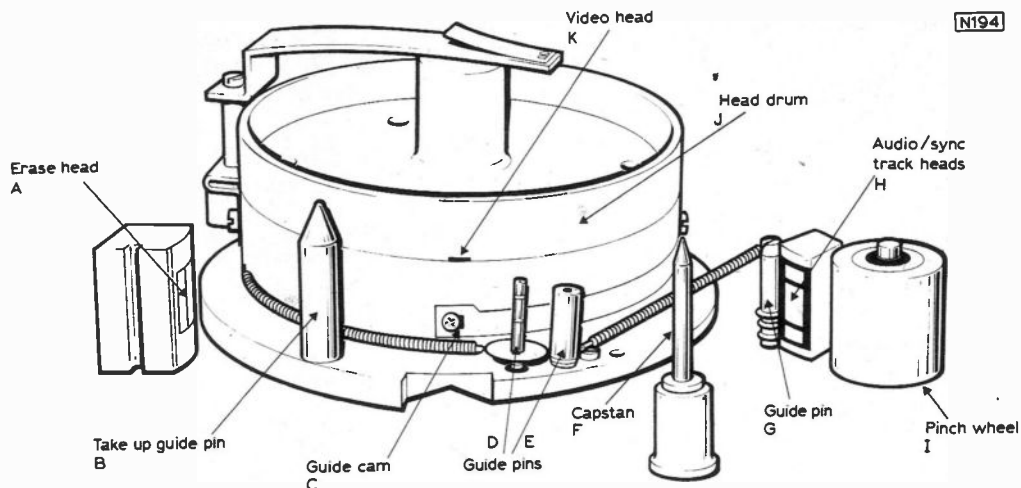


Fig. 1: View of VCR with top cover removed, showing layout of major mechanical features. Components shown dotted are mounted below the chassis.

Fig. 2: Layout of heads and tape path. Only one guide cam (C) and one video head (K) are shown. Another video head and two more guide cams appear on the other side of the drum.



therefore that the tape path is clean throughout. Cleaning should be done with chamois leathers and industrial alcohol.

It is probably best if the owner first removes the machine's top cover and observes the tape path during the threading and running operations. To do this, remove the cassette lid cover screws, the lid and next the four small star-headed screws then exposed. Slacken the four larger star-headed screws on the sides of the top cover, remove the mains input and the coaxial plugs and gently lift the cover upwards and towards you – don't pull it away completely as the video/audio level meter is still attached to the cover. Remove the spring clip on the meter and the cover will then come away.

Make sure that the meter is in a safe position, then reinsert the mains plug, depress the Eject key and insert a cassette. Switch the VCR to the ON position and observe the threading action: press the Start key, and the videotape path and the critical cleaning areas can be studied. Switch the VCR off, withdraw the cassette and commence the cleaning operation.

Moisten a chamois leather with alcohol and clean parts A, B, C, D, E, G and H shown in Fig. 2. Clean off the surplus alcohol, then polish with a dry chamois leather. At all costs avoid touching the video heads (K) during this operation. Rough handling can result in the heads being damaged – and a replacement video head drum can be very expensive.

The next step is to start the machine up again. Wait until the threading action has been completed, then remove the mains plug. This will enable the guide cams on the side and rear of the threading ring to be cleaned.

Replace the mains plug, switch on and depress the Start (playback) key. Clean the pinch roller and capstan (F and I in Fig. 2) with a moistened chamois leather. Do not dry off with a clean chamois leather however as deposits of leather tend to be left on the roller.

Head drum

The final stage is to clean the head drum (J). A moistened chamois leather will suffice for cleaning this: use gentle upward strokes in line with the ribs on the drum. Again, take great care not to touch the heads themselves.

After many cleaning operations it will be found that the video heads (K) and a small area around them have become black and dirty due to these areas having been avoided in previous cleaning operations – the effects on the picture are noise and an excessive number of chrominance drop-outs.

The areas can be cleaned off by using a very fine haired artists' paint brush (preferably squirrel or similar). Soak the brush well in alcohol and wash the dirt away very gently.

This completes cleaning of the videotape path areas. Before using the machine with a cassette however allow the alcohol to dry off completely by running the machine for several minutes in the playback position.

Dusting

Dust can cause many problems with videotape, so it is probably wise to complete the cleaning programme by vacuum dusting the rest of the top chassis areas before final reassembly, always remembering to unplug the machine first of course. Finally, reassemble the VCR, making sure that the insulating sleeve on the meter clip fits under the exposed meter contacts.

Recommended cleaning times for the above are as follows: items A–I after 20 running hours, item J after 200 running hours, item K only when absolutely necessary.

It is a good idea to make or obtain a well fitting cloth cover for the VCR to protect it when not in use. This will keep the machine dry and exclude harmful dust and dirt.

Operational hints

A VCR that has been maintained correctly should give very good results. If line jitter or picture instability are experienced despite regular servicing, the likely cause of the trouble is the television set being used with the machine. This is particularly so if, as nearly all sets do, the receiver uses flywheel line sync. A simple modification will remedy this however: shortening the time-constant of the flywheel line sync filter so that it is roughly a third of the initial value will give much improved picture stability. In the IIT CVC5-CVC8 chassis for example, reduce the filter capacitor C288 from 0.0047 μ F to 800pF and change the values of the components in the anti-hunt network as follows: increase the value of R395 from 15k Ω to 47k Ω and reduce the value of C290 from 0.47 μ F to 0.1 μ F.

Overmodulation can sometimes occur in strong signal areas, due to the aerial preamplifier in the VCR tuner unit. A simple remedy is to fit an attenuator giving about 6dB attenuation in series with the aerial input to the machine.

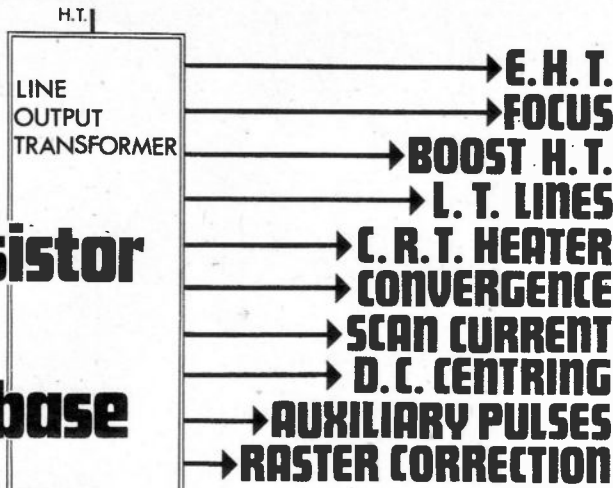
The mains phasing of the television set and the VCR must be correct, otherwise there will be problems due to potential differences throughout the system.

If the above points and the maintenance schedule given are carefully followed the machine should give excellent results for a good many years. ■

The Transistor Line Timebase

SYNCH PULSES
FLYWHEEL OSCILLATOR LOOP
LINE DRIVER STAGE

E. J. Hoare



PART 2

THE purpose of the line driver stage is to control the line output transistor so that it switches on and off at the correct instants in the scanning cycle. The line output transistor's base current must be more than 1A peak for it to turn on hard enough to become completely bottomed and thus keep collector dissipation at minimum. When the output transistor is non-conducting, its base voltage must be held at about -4V to ensure that it remains completely cut off, even when its collector voltage rises to 1.5kV during the flyback.

A typical driver stage circuit is shown in Fig. 12(a). It will be seen that transformer coupling is used in order to provide a low-impedance drive to the line output transistor. The transformer's primary winding is driven by a high-voltage transistor which is supplied from the set's h.t. line and acts as a switch, being controlled by the squarewave train from the line oscillator described last month.

The action of this circuit is not quite so straightforward as it might appear however. The stage has to provide an approximately squarewave output to drive the line output transistor, and quite a large step-down ratio is required to get the correct voltage/current conditions at its base. The base of the driver transistor is fed with a squarewave: when the waveform goes positive, the transistor is turned on hard, i.e. it's bottomed, placing a large h.t. voltage across the primary of the driver transformer. Since the transistor is bottomed when conducting there is very little collector dissipation. Thus a transistor such as a BF337 which has a collector voltage rating of 250V, a collector current rating of 150mA and can dissipate up to a watt with only a very small heatsink can be used.

When the drive waveform falls, the driver transistor is completely turned off. This must occur very quickly, again to reduce collector dissipation. The collector voltage will now rise towards h.t., but there will tend to be an overshoot due to oscillation between the winding and its associated stray capacitance - in a similar manner to the flyback oscillation in the line output stage described earlier. To suppress this oscillation the damping network C2, R2 is connected across the primary winding, with the result that the transistor's collector waveform is of approximately squarewave form as shown in Fig. 12(b).

The decoupling resistor R1 with its associated capacitor C1 drops the h.t. to give a mean value of about 100V. This

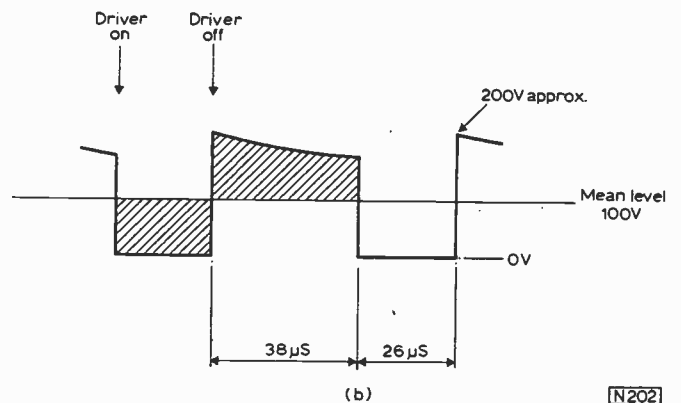
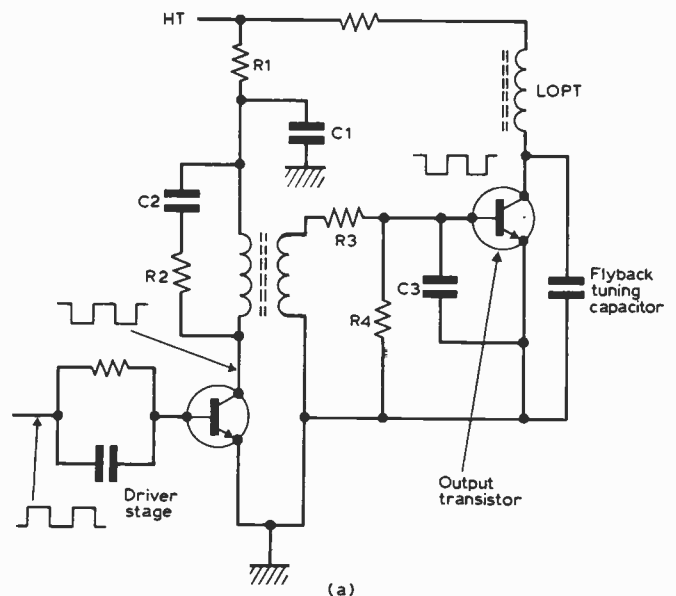


Fig. 12: Driving the line output transistor

(a) Line output drive circuit

(b) Collector voltage waveform of the driver transistor. The two shaded areas must be of equal area.

ensures that the maximum positive excursion of the collector voltage will be well below the limit of 250V since due to the inductive loading in the collector circuit the two hatched areas shown in Fig. 12(b) must be of equal area. The peak voltage will thus be of the order of 200V (including a small overshoot), leaving an adequate safety margin.

The very fast switching of the driver transistor can cause problems. These show up as vertical lines of interference on the picture, corresponding to the instants at which the transistor is switched on and off again. A steep waveform such as a squarewave contains many high-order harmonics of its fundamental frequency (15,625Hz in this case) and some of these lie in the v.h.f. and u.h.f. bands. A voltage swing of 200V at these frequencies radiates a considerable amount of energy which gets picked up by the aerial and tuner body, amplified throughout the r.f. and i.f. circuits of the receiver and modulated on to the signal. As a result, the picture can have brightness modulation due to these switching transients.

The cure is to pay attention to the wiring layout to reduce the areas of loops carrying switched currents, to place a damped r.f. choke close to the collector of the driver transistor, to put a similar choke in its base circuit, and to decouple such points with small decoupling capacitors of a few tens of picofarads value. Nothing must be done however that slows down the rate of switching to a point where the driver transistor's collector dissipation rises significantly, or causes the switch-on rate of the line output transistor to fall to a level where its collector dissipation also rises. The rate of switch-off of the line output transistor is governed by a different factor altogether.

Base Charge Effects

Transistors used as switches are either turned completely off or completely on (bottomed). When a transistor is bottomed its collector will be at almost the same voltage as its emitter and its base will be charged. The transistor cannot be turned off again until this charge has been removed. If no special precautions are taken, an ordinary squarewave pulse which falls to the emitter potential being applied to the base, the transistor will switch off slowly, the process not being complete until the base charge has leaked away. During this time the collector voltage will be rising, and the transistor will have to dissipate an appreciable amount of energy. In the case of the line output transistor the collector voltage rises to 1.2kV or more (flyback) and if it turns off slowly the junction may easily overheat and be destroyed.

This problem is overcome by putting a carefully controlled amount of inductance in the line output transistor's base circuit so that the capacitive charge on the base can be transferred to the inductance. A separate inductance is not shown in Fig. 12(a) since in practice in most recent circuits the leakage inductance of the driver transformer is used for this purpose – it can be regarded as being in series with the secondary winding. The correct inductance value is given in the published data for the particular transistor being used, and the transformer is designed to have a leakage of this value. A typical figure is 20 μ H. Small but important.

The leakage inductance L and capacitive charge C form a temporary resonant circuit. This is damped by R4 to ensure that during the flyback no oscillation can occur which might turn the transistor on again, upset the circuit's

operation and perhaps destroy the transistor as well.

Resistor R3 is usually about an ohm or so in value but as the peak base current exceeds 1A it drops sufficient voltage to make V_{be} variations between different output transistors unimportant – in other words it ensures that the peak base current in all receivers will be approximately the same. Capacitor C3 prevents spurious oscillations under no drive conditions and also bypasses any voltage transients resulting from c.r.t. flashover.

Drive Waveform

We must consider a bit further the effect of the line output transistor's stored base charge since this governs the choice of drive waveform mark/space ratio. The process of removing the stored charge and transferring it to the series inductance takes an appreciable amount of time. The result is that there is a delay of about 10 μ s between the time at which the drive waveform at the collector of the driver transistor falls to zero and the time at which the output stage actually turns off.

The line output transformer flyback time is usually about 12 μ s, and a margin of safety, say about 4 μ s, must be allowed before the output transistor is turned on again – if it were turned on too early, i.e. during the flyback time, the high collector voltage would result in excessive dissipation and the transistor would almost certainly be destroyed. In any case the extra energy loss would upset the operation of the circuit. Fig. 13 should help to clarify the question of drive voltage timing, since the need to start the turn off cycle so soon – before the end of the forward scan – may come as a surprise to some readers.

As we have seen, the base of the line output transistor must be held at about -4V during the flyback to ensure that it remains completely cut off. Despite all these precautions, the transistor's total collector dissipation is quite high, typically of the order of 4W, though due to variations in turn-off time between different transistors of the same type, top limit out-of-sync conditions and h.t. line voltage differences the maximum dissipation may exceed 10W. Thus generous cooling by means of a large heatsink is essential.

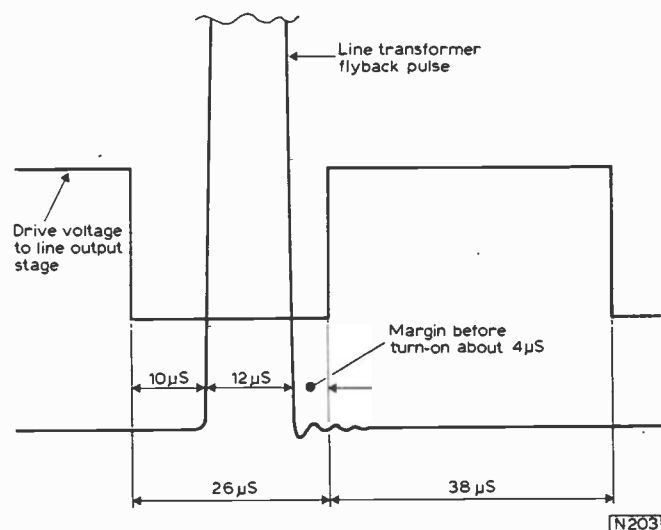


Fig. 13: Relative timing of the drive and flyback voltages, illustrating the margins needed to ensure safe operation.

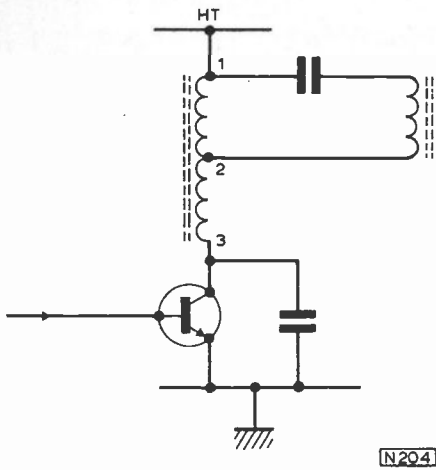


Fig. 14: A simplified line output transformer circuit.

The base charge effects we have been discussing also occur in the line driver transistor, though to a much smaller extent because the collector current is much less. To avoid aggravating the drive timing problem still more however the charge on the base of the driver transistor is usually removed rather than being ignored. This can be done quite easily. No inductance is required, but the base voltage is made to fall to about $-2V$ in the cut-off condition. This is effected by using partial a.c. coupling, as shown in Fig. 12(a). Care is necessary to ensure that the V_{be} limit of about $-5V$ common to almost all low-power transistors is not exceeded.

It is worth noting that most driver stages of the BF337 type need a base current of $10-20mA$ to ensure that they are bottomed. Thus an emitter-follower or similar stage providing current gain is usually included in order to avoid loading the oscillator circuit. If the base current is less, the transistor may not be completely bottomed when conducting and the product of its collector voltage and current may result in enough heat to make a generous heatsink essential. It is usually cheaper to provide adequate base current.

Line Output Transformer Operating Conditions

In Part 1 we discussed the basic mode of line output transformer operation, whereby a constant voltage applied across an inductance (the output transformer primary winding) results in the generation of a sawtooth current. This voltage is the h.t. line voltage, which is connected and disconnected by means of a switch, in this case a high-power, high-voltage transistor. We have also now established how correct switching is achieved. Fig 14 shows the basic line output transformer circuit, without e.h.t. overwinding or any other ancillary features. The next point to consider is how the deflection coils are tapped into the autotransformer winding.

If we know the scan coil inductance L and the peak-to-peak sawtooth scanning current I required for full picture width on a c.r.t. we know that the voltage applied across the coils must be $V = L(di/dt) = LI/T$ where T is the forward scan time which is approximately $52\mu s$. Thus in a typical monochrome receiver where L might be $2.8mH$ and I $2.4A$, $V = (2.8/1000) \times (2.4/[52/10^6]) = 129V$. Under these conditions the ratio of peak flyback voltage to scan voltage will be about 8, i.e. $V_{flyback} = 8 \times V_{scan}$. This ratio depends primarily on the choice of flyback time and to a lesser extent on transformer efficiency. So during the flyback the voltage across the coils will rise to about 8×129 , i.e. $1032V$ peak.

A typical line output transistor of the BU205 type has an absolute maximum collector voltage rating of $1.5kV$. To ensure that this is never exceeded under the worst operating conditions — with the line oscillator out of sync and all tolerances on the adverse side — we choose a nominal operating condition of $1.2kV$. This means that the maximum permissible transformer ratio between the collector and the scan coil tapping will be $1200/1032 = 1.16$, i.e. the turns ratio of winding 1-3 to winding 1-2 shown in Fig. 14 is 1.16.

From this we can establish what value of h.t. is required, since the full h.t. appearing across winding 1-3 = $1.16 \times$ the voltage across winding 1-2 = $1.16 \times 129 = 150V$. What we have done here is to use the maximum permissible transformer turns ratio in order to reduce the peak current in the line output transistor and thus obtain optimum reliability. In doing so we find that there is only one value of h.t. line voltage that will suffice. Too high a voltage will result in excessive scanning current and picture width together with a peak transistor collector voltage which is too high for reliable operation. A reduction in voltage will result in the opposite effects.

Thus in any all solid-state television receiver the h.t. line voltage is governed primarily by the sensitivity of the scanning coils, the choice of flyback time and the maximum permissible transistor peak collector voltage. This is an important point which sheds light on what sometimes appears to be a rather obscure issue — why so many television receivers have h.t. line voltages in the region of $150V$.

Complications

What we have been discussing so far has been an idealised state of affairs — in order to keep the issues as simple as possible. In practice matters are rather more complicated. For example, the autotransformer is not perfect and usually has an inductance only about five times the deflection coil inductance when referred to the same point. Next, a resistor of about $27-56\Omega$ is normally connected in series with the transformer in order to reduce picture breathing (see later) and in some cases to limit the peak current after a c.r.t. flashover. This resistor produces a voltage drop.

Another important point is that the scanning current cannot be a pure sawtooth: it must be rounded off at both ends in order to get a linear picture on an almost flat screen. Fig. 15 illustrates how equal deflection angles at the

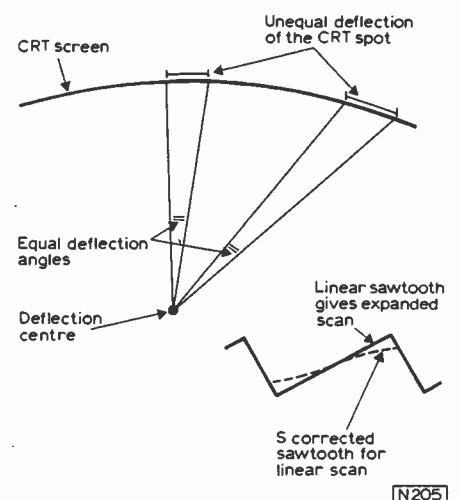


Fig. 15: The need for S correction of the line scan current.

centre and edges of the screen, caused by equal scan current changes, do *not* cause equal displacements of the electron beam as it traverses the c.r.t. screen. Thus the sawtooth line scan current must be rounded off as shown by the broken line. This is achieved by connecting a capacitor of about $0.47\mu\text{F}$ in series with the scan coils to integrate the scan current waveform slightly.

Next, the resistance of the deflection coils and losses in the transformer add up to the equivalent of a resistor in series with the inductance of the deflection coils. This results in the current waveform becoming rounded off towards the end of the scan, causing picture compression on the right-hand side of the screen. To correct this curvature of the waveform, in practical circuits a linearity coil is connected in series with the scan-correction capacitor.

Linearity Coil

The linearity control consists of a coil wound on a ferrite core, with an accompanying permanent magnet. During the first half of the scan the magnetic field produced in the coil by the scan current cancels the field of the magnet. Thus the coil is inductive and reduces the rate of change of the scanning current. This reduces the width of the display at the left-hand side of the screen. As the scan current falls to zero and then starts to become increasingly positive however the magnet's field progressively saturates the coil's core. This reduces the inductance so that the scan current waveform becomes steeper, the picture width at the right-hand side of the screen increasing. The effect of this control on the operation of the transformer is to require a greater voltage across the scan coil circuit.

So far we have not mentioned the problem of e.h.t. generation. This is achieved by adding to the transformer a coil with a large number of turns and thus a step-up ratio. For use with a voltage tripler assembly the peak flyback voltage of 1.2kV at the collector of the line output transistor can be stepped up to 8kV ; alternatively for use with a diode e.h.t. rectifier a step-up to $20\text{--}25\text{kV}$ can be provided. The power represented by the e.h.t. voltage multiplied by the average value of the c.r.t. beam current has to be supplied by the line output stage, and as a result the mean current of the transistor is increased. The stage is being used as a d.c. to d.c. converter.

Similarly, rectification of flyback pulses at taps on the transformer winding by simple diode/capacitor combinations provides many l.t. and h.t. supplies in a typical receiver. This is another d.c. to d.c. conversion.

We can now draw a complete line output transformer circuit diagram which is nearer to what one finds in practice, see Fig. 16. Note that a separate winding has been added as a secondary to feed a heater voltage to the c.r.t. and to supply a waveform with a negative-going flyback pulse to an l.t. rectifier circuit. The diode conducts during the whole of the forward scan stroke (this is called scan rectification) instead of during the flyback pulse only as in the case of the e.h.t. circuit. The reason for this is to provide a low-impedance source of l.t. current so that the l.t. voltage changes much less with changes in the load requirement.

Harmonic Tuning

In the early days of line output transformers one of the most difficult problems to overcome was that of ringing.

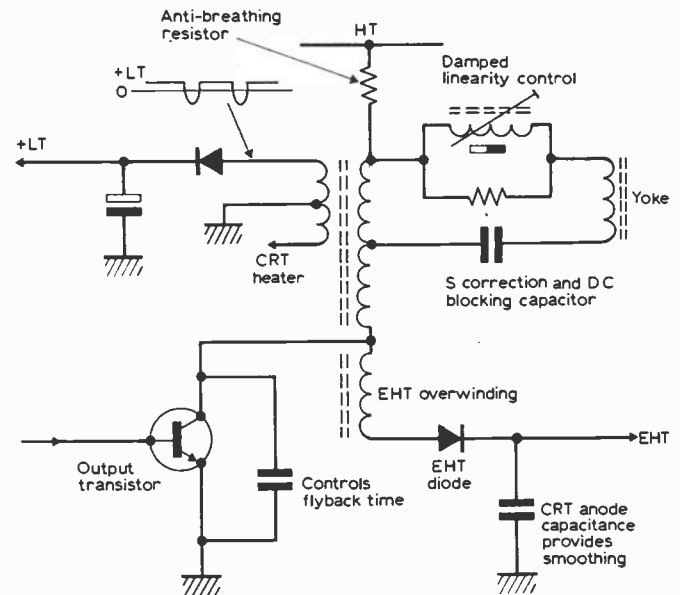


Fig. 16: A more complete line output transformer circuit, showing the various added features discussed in the text.

This effect is caused by the flyback pulse shock exciting resonant circuits in the transformer windings and causing a high-frequency ripple to appear on the scan current at the beginning of the scan. Superimposed on this it was common to find a lower-frequency ripple extending along the whole of the scan current waveform.

These ripples caused the c.r.t. spot to speed up and slow down alternately as it scanned the screen. The result was a series of light and dark vertical lines often known as striations or curtains. Furthermore if the scanning voltage found its way on to the signal voltage applied to the c.r.t. a *brightness* modulation occurred which reinforced the *velocity* modulation of the spot, making matters still worse. The cause of all this was quite simple in principle but in practice difficult to cure.

In any transformer some of the magnetic flux generated by one winding fails to cut the turns of the other winding. As a result there is some leakage flux between the windings, and this can be regarded as being an inductance in series with the second winding. Every turn of a winding has some distributed capacitance, and this forms a resonant circuit with the leakage inductance. The fast-changing current during the flyback stroke shock excites this circuit, with the result that energy is transferred to and fro between the capacitance and inductance, forming a damped oscillation. This unwanted current gets coupled into the scanning circuit by normal transformer action, and is thus superimposed on the wanted sawtooth current waveform.

An example of this action is represented by a line linearity control. This is connected in series with the deflection coils, and its inductance resonates with its stray capacitance to produce ringing. The cure is to damp it with a resistor – commonly about 1.5Ω in value – so that the ringing stops before the start of the visible part of the picture. Followers of our servicing articles and problems solved pages will be well aware of what happens when the resistor goes high value or open-circuit – oscillations which appear as striations on the left-hand side of the screen, reducing in severity as the spot approaches the centre of the screen.

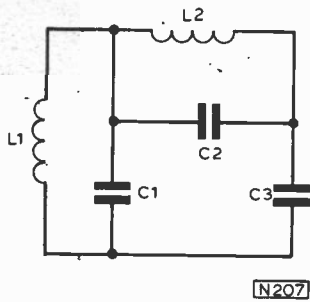


Fig. 17: The principal resonant circuits in a line output transformer

- L1 = Effective transformer circuit inductance
- C1 = Total capacitance, including strays, across L1
- L2 = Overwind leakage inductance
- C2 = Overwind self capacitance
- C3 = Capacitance of high voltage circuit to chassis.

Most other leakage inductances are kept sufficiently small by good transformer winding techniques to be fairly innocuous, but there is still one troublesome villain. The e.h.t. overwinding has a large number of turns and plenty of high-voltage insulation. It is fairly bulky therefore and has a high self-capacitance together with a relatively large leakage inductance due to a poor coupling factor to the transformer's primary winding. The result is a large amount of stored energy which can cause severe ringing all the way across the picture. It cannot be damped by means of a resistor because of the high voltage across the winding — up to 25kV — and the large amount of energy which would have to be dissipated.

Equivalent Circuit

Fig. 17 shows the equivalent circuit of this leakage inductance and its associated stray capacitances, together with the transformer primary inductance and its own capacitance. To begin with we are concerned only with what happens during the flyback stroke, and if we assume that an e.h.t. diode rectifier is being used it will be conducting during this period and can thus be regarded as a short-circuit.

So, during the flyback L1 resonates with C1 at a frequency α which is the fundamental flyback resonant frequency — such that one half cycle takes $12\mu\text{s}$, i.e. approximately 42kHz. C2, L2 and the rest of the circuit in parallel resonate at a frequency γ , while C2 and L2 alone resonate at a frequency δ .

Now consider the scanning cycle. The transformer primary winding is connected across the low-impedance h.t. supply which acts effectively as a short-circuit. Thus L2 resonates with C2 and C3 in parallel at a frequency β .

During the flyback some fairly complex damped oscillations occur: α , γ and δ . α is the wanted flyback oscillation, but γ and δ are spurious oscillations. As soon as the transistor conducts after the end of the flyback the energy in the γ and δ circuits is transferred to the β circuit, and it is this oscillation that can occur throughout the whole scan. It can be seen most easily on a plain dark grey raster.

The mathematics of this process is rather complex and beyond the scope of the present discussion. To summarise matters, it can be said that if the flyback ring frequency γ is made equal to 2.8 times the flyback oscillation frequency

α , no energy is left in the overwinding leakage inductance at the end of the flyback and no ring at frequency β can occur during the forward scan. If $\gamma/\alpha = 2.8$ and $\alpha = 42\text{kHz}$, then $\gamma = 118\text{kHz}$.

So one of the tricks of the trade is to design the high-voltage winding in such a way that $\gamma = 118\text{kHz}$. The choice of turns per layer and insulation thickness, together with the coupling factor to the primary winding, can be manipulated to achieve the desired effect. But this is not the end of the story, since there are some interesting side effects.

The flyback ring frequency is approximately the third harmonic of the flyback oscillation frequency — only approximately, because the flyback itself is not a pure sine wave but is slightly distorted. Fig. 18(a) shows what happens when the ring frequency is added to the flyback oscillation.

On the primary winding, the waveforms are in antiphase: they subtract therefore and the overall peak voltage is reduced — to the benefit of the line output transistor. On the overwinding however the voltages add, so that a larger voltage pulse is produced for a given number of turns. This means that the overwinding can be made smaller and is easier to manufacture.

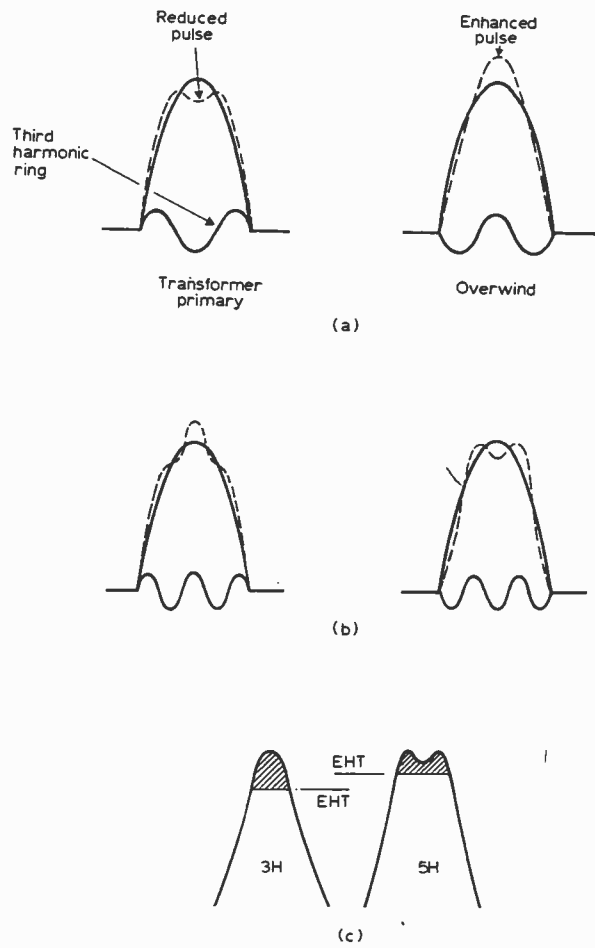


Fig. 18: The effect of harmonic tuning in a line output transformer

(a) Third harmonic tuning.

(b) Fifth harmonic tuning.

(c) Fifth harmonic tuning gives a smaller drop in e.h.t. for a given c.r.t. beam current loading (equal shaded areas).

Clearly we want (in this particular example) to make the voltage on the primary winding as small as possible, and this is achieved by using a carefully chosen value of the frequency ratio β/α . This is of the order of 2.3, so β becomes $2.3 \times 42 = 97\text{kHz}$. Conversely we want to make the voltage on the overwinding as large as possible. This requires a frequency ratio of δ/α of about 6, so δ becomes $6 \times 42 = 252\text{kHz}$.

In practice we are having to manipulate a large number of variables, each of which is a tricky business to adjust because they are all interdependent. With experience and patience however a good result which not only reduces the ringing during the scan but also produces beneficial effects in terms of the flyback voltage pulse can be achieved.

What we have just been describing is called third harmonic tuning and is a technique appropriate to say a monochrome receiver fitted with a 20kV overwinding and using a simple stick diode rectifier. A rather different situation arises in the case of a colour receiver line output transformer used in conjunction with a voltage tripler to produce an e.h.t. of 25kV. The flyback pulse fed to the tripler is only 8kV and is easy to generate. The winding does not have to have a very large number of turns and the insulation problems are relatively simple. What is important however is to produce an e.h.t. supply with a low source impedance so that the voltage does not fall too much at high mean beam currents which in a colour set rise to about 1.5mA. A voltage decrease would increase the deflection sensitivity with the result that the picture would expand in size for a constant value of scanning current.

In this situation fifth harmonic tuning is used. The effects are shown in Fig. 18(b). The basic theory is the same as before, and once again the leakage inductance of the overwinding is left discharged at the end of the flyback so that no ringing can occur during the scan. In this case however the ratio $\gamma/\alpha = 4.7$ - hence the term fifth harmonic tuning.

The result is that the peak voltage across the primary winding is increased - though only slightly - while the voltage pulse across the overwinding is reduced in amplitude and made broader at the top. Extra turns could of course be added to the overwinding to compensate for the amplitude loss. The vital point however is this broadening of the pulse. It means that for a given energy transfer to the c.r.t., i.e. increased beam current, the broad pulse will be reduced in amplitude less than a narrow one would - see Fig. 18(c). Thus the e.h.t. will not fall so much and there will be less change of picture width. Change of picture width with change of c.r.t. beam current (picture content changes) is known as breathing.

Breathing

The usual technique of compensating for breathing is to add a resistor of 27-56 Ω value in series with the primary winding of the line output transformer. When the c.r.t. beam current increases, the mean line output stage current increases. As a result, the voltage drop across the series resistor increases. The effective reduction in line output stage h.t. voltage reduces the scanning current and the e.h.t., but the net effect is to reduce the change in picture size. The addition of this resistor in series with the h.t. supply can be said to be a process of matching the source impedance of the h.t. supply to that of the e.h.t. supply so that the effect of one cancels the effect of the other.

TO BE CONTINUED

SIMPLE UHF AERIAL AMPLIFIER

continued from page 131

★ Components list

Capacitors:

C1 4.7pF silver mica
C2, C3 1000pF feedthrough ceramics
C4 2.5pF silver mica

Resistors: (all $\pm 10\%$, $\frac{1}{4}\text{W}$)

R1 2.2k Ω R2 2.7k Ω R3 1k Ω

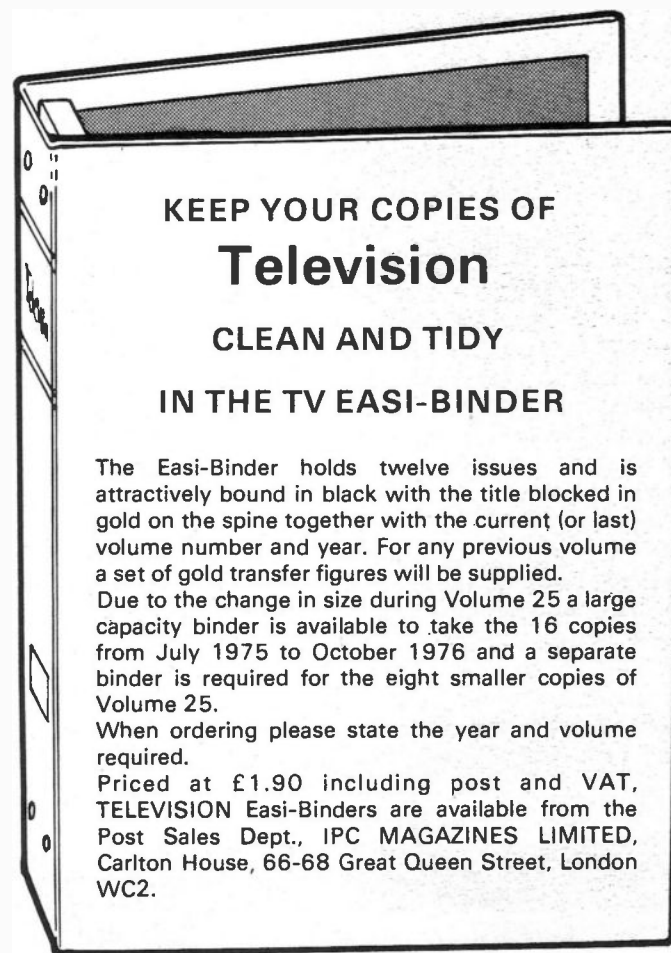
Miscellaneous:

Tr1 BF262. L1 see text. S1 s.p.s.t. toggle. PP3 9V battery with connector. Coaxial plug and socket. Coaxial cable. Grommet. 1oz. tobacco tin plus tinplate for screens.

Operation

The amplifier should draw a current of just over 3mA and be completely stable over the u.h.f. band. In areas of high signal strength it will cross modulate, but in normal areas no trouble should be experienced.

Finally, my thanks to Roger Bunney for his suggestions and advice on the construction of this amplifier. ■



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Solid-State Mono Chassis Faults

John Coombes

UNTIL the introduction recently of the new Thorn 1600 chassis there had been only two large-screen monochrome solid-state TV chassis produced in the UK, the Philips 320 chassis and the RRI A816 chassis. The former is used in the Philips Models G17T320/01, G20T322/01 and G24T324/01. The latter is used in the Bush Models TV309 and TV311 and the Murphy Models V2029 and V2427. Apart from the use of varicap tuners, the two chassis have little in common.

PHILIPS 320 CHASSIS

Most of the faults in this chassis relate to the power supply circuit which is shown in Fig. 1. It consists of a fairly conventional thyristor stabilised arrangement which is fed from a full-wave bridge rectifier. Note that as a result of the use of this bridge rectifier the chassis is live whichever way the mains plug is connected.

Power supply thyristor: As with similar circuits in other chassis, the thyristor gives trouble. Early versions were fitted with a BT100A/500R thyristor which has a black body. This often blew the mains fuse FS1621. In later models a BT100/02 thyristor is used. This has a grey encapsulation and does not need the heatsink used with the earlier type. At the same time the mains fuse was up-rated from 1.25A to 1.6A (anti-surge). When investigating fuse blowing check that these modifications have been made.

Other causes of fuse blowing: As with so many chassis, a common cause of the mains fuse being blown is that the mains filter capacitor C4622 (0.33 μ F) has gone short-circuit (not always measurable on a cold resistance test). This component must be replaced, not just chopped out. It is a safety component, serving to prevent spurious spikes on the mains supply ruining the bridge rectifier D5601.

This bridge rectifier has a tendency to go short-circuit, again blowing the mains fuse. Greater reliability can be achieved by using four separate BY126 rectifiers to form a bridge.

Another cause of spurious fuse blowing is c.r.t. flashover. Check that there is not a poor connection at the earthing screw terminal X1 on the c.r.t. base panel. Make sure that there is a good soldered joint between the print earth section and the bush of terminal X1.

H.T. voltage: It is important that the voltage at TP15 is 165V. This is set by R5630. The correct procedure is to turn R5630 to maximum resistance (minimum h.t.), connect a voltmeter from TP15 to chassis, and adjust R5630 for a reading of 163V. Then tune the receiver to a test transmission with a stationary picture, turn the brightness control to minimum and, after allowing at least thirty seconds for the circuit to stabilise, again adjust R5630 for 163V. If HT1 is found to be above 165V, check

diodes D5607 and D5608 and make sure that R5640 is not open-circuit.

Field jitter: As on many colour receivers, the BR101 diac D5604 in the power supply circuit can cause field jitter. The BT100/02 thyristor can also be responsible for this trouble.

Tuning voltage stabiliser: A TAA550 i.c. (IC2112) is used to stabilise the supply to the tuning potentiometers. This supply passes to the tuning controls via a tuning range preset potentiometer (R2114). If the TAA550 is faulty the result is tuning drift or loss of picture due to complete loss of tuning.

Beware when adjusting the tuning range control R2114. If you don't use an insulated trimming tool it is possible to ruin the intercarrier sound i.c. (IC2301) as a result of a short-circuit.

Line oscillator: The line oscillator consists of a TBA720Q i.c. It is important in this part of the circuit to measure only those voltages quoted in the service manual: if test leads are applied to the line hold preset trimmer (C2412) or to pins 12 or 13 of this i.c. the pick up of radiated energy can result in the BU105 line output transistor being destroyed.

E.H.T. arcing: This is very often due to a cracked e.h.t. rectifier holder. The holder splits, with the e.h.t. arcing to the nearest available point.

Blank raster: A blank raster with no vision content is very often due to the BF337 video output transistor (TR2248) which goes open-circuit at its base-emitter junction.

Sound, no raster: Apart from faults in the line output stage this has been traced to the c.r.t. control grid decoupling capacitor C3103 (0.33 μ F) being short-circuit.

BASIC DIODE AND TRANSISTOR CHECKS

Germanium

Reverse biased junction: very high resistance.
Forward biased junction: low resistance (about 400 Ω).

Silicon

Reverse biased junction: very high resistance.
Forward biased junction: low resistance (about 1.5k Ω).

The resistance readings obtained will vary according to the test voltage used: the above readings were obtained with an Avo Model 8, on the ohms range.

Most multimeters have the positive test voltage on the black lead and the negative test voltage on the red lead when used on their resistance ranges.

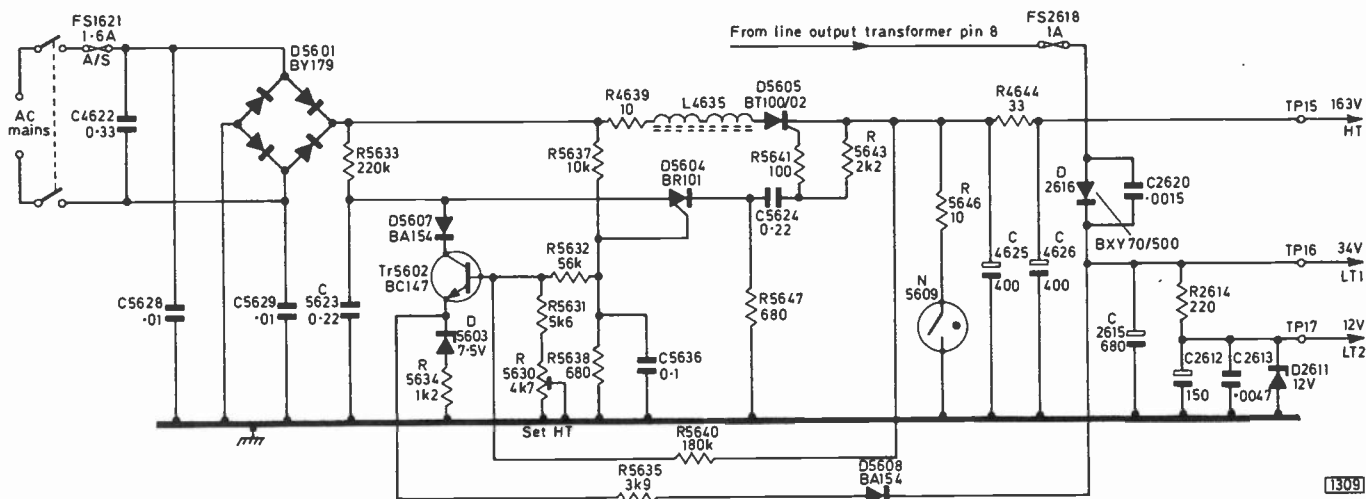


Fig. 1: Thyristor-stabilised power supply circuit used in the Philips 320 chassis. In the event of the h.t. voltage rising excessively the bimetal strip in N5609 closes, blowing the mains fuse FS1621.

Field output stage: As a rule the field timebase is very reliable. The output transistors TR2507 (BD131) and TR2508 (BD132) can and do give trouble however. The usual consequence is field collapse.

Intermittent sound: The audio output stage consists of a class A push-pull circuit. Intermittent sound has been traced to the coupling electrolytic C2326 (470 μ F) between the collector of the lower BD131 and the base circuit of the upper BD131 being leaky.

Vision gain: At different times we have found the vision gain to be low. This is usually due to the U2900 vision i.f. gain can which houses three transistors. The transistor which is generally faulty is the second BF194 (TR2908) which can go short- or open-circuit, causing a grainy picture or, where the signal is weak, just grain with no picture.

RRI A816 CHASSIS

The h.t. supply in this chassis is provided by a simple half-wave rectifier (BY127). The l.t. supply is obtained from a shunt regulator which is in series with the line output stage, i.e. between the emitter of the BU105/01 line output transistor and chassis. This arrangement also serves to provide indirect stabilisation of the h.t. supply (see page 118).

No e.h.t.: This fault will be combined with no c.r.t. heater voltage since (as with the Philips 320 as well) the c.r.t. heater is fed from a winding on the line output transformer. Since the BU105/01 line output transistor and the shunt regulator transistor 3VT20 (RCA type 16083) are connected in series either can cause this fault. Sometimes they are both faulty. If both are in order the most common cause of the fault is the line driver transistor 3VT17 (BD 150A).

No e.h.t. can also be due to absence of output from the line oscillator, which is in the SN76533N i.c. (3SIC2). If the oscillator does not start, check that the cold-start resistor 3R90 is 13k Ω – in some models it is 18k Ω . The i.c. itself can be faulty of course, and this does happen quite often. Note that a 12V zener diode should be connected across 3C44 (47 μ F) which decouples the power supply pin (2) of this i.c.: it is not present on some earlier models. Also, in some models a Plessey SL438 is used instead of the Texas SN76533N: with the Plessey i.c. 3R123 which is

in parallel with the line hold control should be 3.9k Ω while with the Texas i.c. it should be 2.7k Ω (in early models it's 1.5k Ω). This is to ensure adequate hold control range.

No sync: The sync separator is also in the SN76533N (or SL438) i.c. 3SIC2. Absence of sync is another fault caused by this i.c. being defective.

Reduced height with bottom cramping: An npn/pnp driver stage (3VT11 and 3VT12) drives the npn/pnp (3VT13 and 3VT14) field output stage. Either 3VT11 (BC207) in the driver stage or 3VT13 (BC287–BC139 in earlier production) in the output stage can cause this fault. If the transistors are all right, check the output coupling electrolytic capacitor 3C31 (1000 μ F). Cramping at the bottom can be caused by the field charging capacitor 3C29 (0.047 μ F) being open-circuit. This capacitor incidentally is returned to the linearity feedback network rather than to chassis.

Field collapse: This fault is very often due to 3VT8 (BC204) which is part of the field oscillator circuit (astable multivibrator). 3VT10 (BC207) also causes this fault – it is connected between the oscillator and the driver stage. If 3VT14 (BC323), the lower of the output pair of transistors, is found to be faulty make sure that 3C32 in the feedback loop is 1.5 μ F (it's 1 μ F in early models).

Tuner drift: The most common cause of this trouble is the tuning voltage stabiliser i.c. 3SIC1 (ZKT33D DPD). The electrolytic capacitor 3C13 (1 μ F) which decouples the tuning voltage feed can also be responsible.

Low gain with line pulling: This fault is generally due to 2SIC1 (SC9504P) which provides most of the i.f. amplification and takes care of the a.g.c. The tuner a.g.c. voltage is also provided by this i.c.

No field flyback blanking: Flyback blanking is carried out in the emitter circuit of the video output transistor 3VT7 (BF259 in early production, later changed to type E1697 to improve reliability). The line and field flyback blanking pulses are first amplified by 3VT6. The field flyback blanking pulses are fed to the base of this transistor via diode 3D1 (1N4148) which has been found to be the cause of no field flyback blanking.

AAC THEORY

A step by step approach

Ian SINCLAIR

Part 3

Frequently we have both capacitance and inductance present in a circuit. The easy case is when we have inductance, resistance and capacitance in series. The resistance in this circuit is usually the resistance of the wire of the coil plus any connecting wire. When we draw the phasor diagram for this (Fig. 1), we can see that the contributions of the reactances of the inductance and the capacitor are in opposite directions.

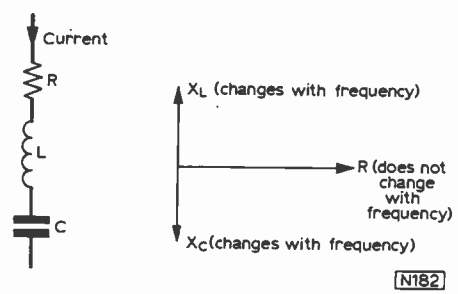


Fig. 1: A series RLC circuit and its basic phasor diagram, showing opposing phase of inductive and capacitive reactance.

The way in which the circuit will behave at any given frequency will depend on the sizes of the reactances.

Why should there be a change with frequency?

As the frequency of the signal applied to this network is increased, the inductive reactance increases and the capacitive reactance decreases.

If the inductive reactance is greater than the capacitive reactance at some frequency (Fig. 2(a)), then the circuit will behave as if it had inductance and resistance only, and the phase of

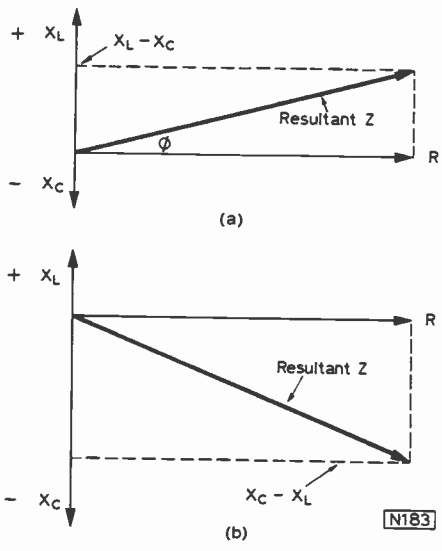


Fig. 2: (a) X_L is greater than X_C at this frequency. Circuit behaves as if it has only inductance (of a lower value) and resistance.

(b) X_C is greater than X_L at this frequency. Circuit behaves as if it has only capacitance (of a higher value) and resistance.

voltage across the circuit will lead the phase of current. At some other frequency where the capacitive reactance is greater than the inductive reactance (Fig. 2(b)), the circuit behaves like a capacitor, and current leads voltage in phase.

What happens when inductive reactance equals capacitive reactance?

The two reactances cancel out, and the circuit behaves as a resistor as far as current and voltage in the whole circuit is concerned.

This condition when inductive reactance equals capacitive reactance is called RESONANCE. In the circuit which we have just examined, we classify it as SERIES RESONANCE. For any circuit which has inductance and capacitance in series (and practically every circuit must) there will be a frequency for which series resonance exists. We can calculate this frequency if we know the values of the capacitance and inductance.

Inductive reactance is $2\pi f.L$ or approximately, $6.3 f.L$. Capacitive reactance is $1/(2\pi f.C)$ or $1/(6.3 f.C)$. At resonance, these two are equal so that: $1/6.3 f.C = 6.3 f.L$. Rearranging, we get: $f^2 = 1/(6.3 \times 6.3 \times L \times C)$. Approximately, $f^2 = 1/(40 \times L \times C)$. Frequency f will be in Hertz if L is in Henrys and C is in Farads, so that some conversion of units is needed to make the calculation.

What resonant frequency will be measured if a $125\mu\text{H}$ inductor is connected in series with a 200pF capacitor?

Remember that μ means 10^{-6} and p means 10^{-12}

$$f^2 = 1/(40 \times 10^6 \times 125 \times 10^{-12} \times 200) = 1/(40 \times 125 \times 200 \times 10^{-18}) = 1/(10^6 \times 10^{-18}) = 1/(10^{-12}) = 10^{12}$$

so that $f = 10^6$ or 1MHz

At resonance, inductive reactance cancels out capacitive reactance, leaving only resistance in circuit. Because of this, the total impedance at resonance is lower than at any other frequency, and the current through the circuit is large, limited only by the resistance of the wire and by the voltage available for driving current through the circuit. $I = V/R$.

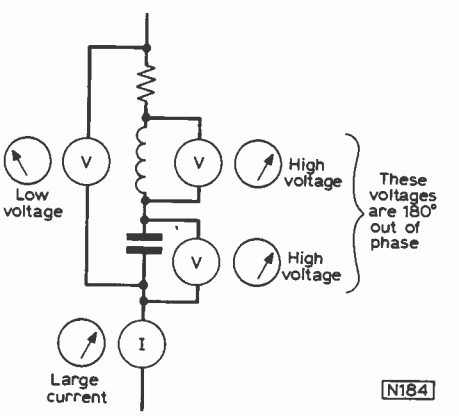


Fig. 3: Current and voltage readings in a series resonant circuit.

There will, however, still be voltages, $V = I.X$ across each reactance. If the reactance values are high, then these voltages will be high; they may very easily be larger than the voltage applied to the network (Fig. 3). Because of this, the series resonant circuit acts as a voltage multiplier for signals at resonant frequency, but not for signals at very different frequencies.

If an inductor has reactance 100Ω at some frequency and is in series with a capacitor whose reactance at that frequency is -100Ω , what current flows if the resistance of the wire in the inductor is 1Ω and if $1V$ is applied across the circuit? What voltage will be measurable across the inductor and across the capacitor?

1A flows; the voltage across the capacitor is $100V$ with I leading V , the voltage across L is approximately $100V$ with V leading I ; the approximation is caused by neglecting the 1Ω resistance.

We do not get something for nothing in this circuit, for there is no gain in the power ($V \times I$) of the signal, only a slight loss.

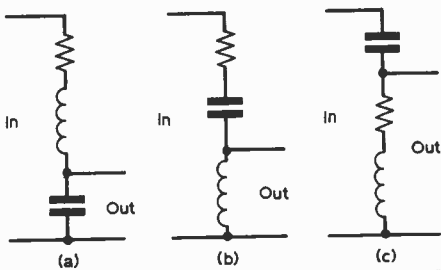


Fig. 4: Taking the signal from across one reactance, (a) is possible, (b) is not, since the resistance of the circuit is usually the resistance of the inductor. Therefore (b) must be redrawn as (c).

The voltage gain is at the expense of the large current flowing, and will drop sharply if any resistive load is placed across L or C unless the resistance is very high compared with the reactance.

If a signal is fed into a series resonant circuit, and an amplified signal is taken from one of the reactances, what is the phase difference between signal in and signal out?

90°. Voltage in is in phase with current in, since the whole circuit acts as a reactance. Voltage out is 90° out of phase with current since the voltage is taken from a reactance. See Fig. 4.

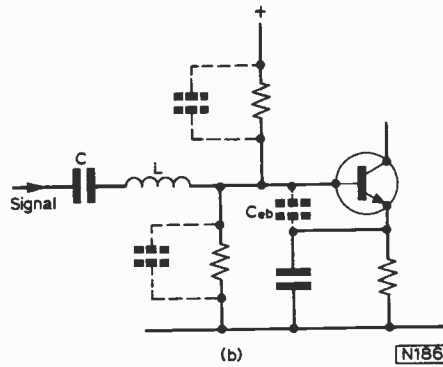
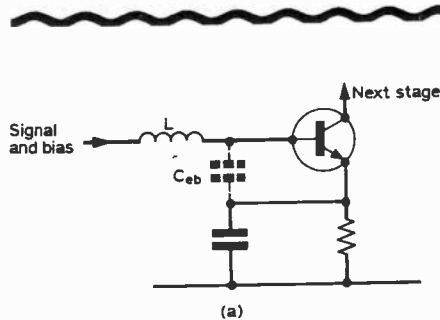


Fig. 5: In (a) the base-emitter junction capacitance forms a series resonant circuit with L . In (b) it is swamped by the other stray capacitances of the circuit.

In the circuit shown in Fig 5(a), the capacitance from base to emitter forms part of a series tuned circuit so that a large current flows in the base-emitter circuit at resonance. The tuning of this circuit can be protected against changes in the base-emitter capacitance by adding a capacitor in series (values adjusted to preserve resonance), so making a change in C_X , the total capacitance, only a fraction of the change in C_{EB} (see Fig. 5(b)).

Where is this type of circuit most often found?

In amplifiers working at the upper end of the frequency limits of the transistor. At frequencies below resonance, the reactance of the capacitor is greater than that of the inductor. Current through the network is smaller than it is at resonance and leads voltage in phase.

At frequencies above resonance, the reactance of the inductor is greater than that of the capacitor. Current is again smaller than at resonance and this time lags voltage. As frequency is varied from below resonance to above resonance, phase changes very rapidly, and current rises sharply to a maximum at resonance.

At frequencies far from resonance, is the voltage out from a reactance (a) closer in phase to the input? (b) still at 90° ? (c) further than 90° out of phase?

It is closer in phase - imagine one of the reactances removed completely, the phase of voltage out would then be identical to the phase of voltage in, for they would be connected to the same point.

If we plot a graph of the output voltage of our resonant circuit against the input voltage, we get a curve with a sharp peak at the resonant frequency as in Fig. 6(a). The more "perfect" the LC circuit (meaning the less resistance to waste power) the higher and sharper is this peak. If we add resistance in series with the inductor or in parallel with either inductor or capacitor we can modify the shape of this curve as shown in Fig. 6(b):

- (1) uses a small (1Ω) resistor in series or a large ($1M\Omega$) resistor in parallel.
 - (2) uses a larger (100Ω) resistor in series or a smaller ($10k\Omega$) one in parallel.
 - (3) uses a large ($1k\Omega$) resistor in series or a small ($1k\Omega$) in parallel. Note how the use of "large" and "small" has to be compared to the size of the normal component in the circuit.
- (1) is a very selective circuit with a high gain for a limited range of frequencies. (2) gives reasonable gain over a larger

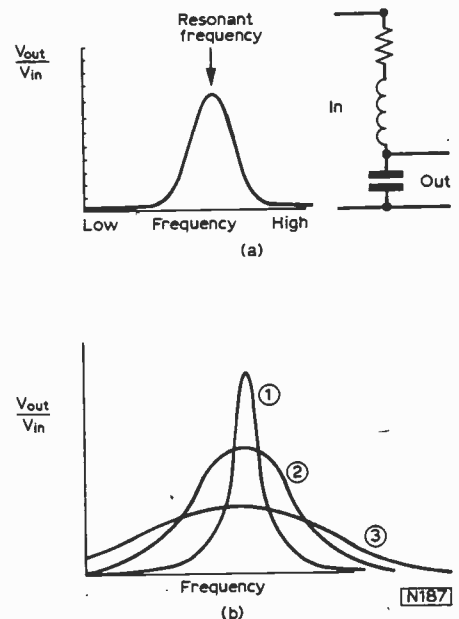


Fig. 6: (a) The basic selectivity curve of the series RLC circuit. In (b) changing circuit losses alter selectivity but not resonant frequency.

range of frequencies around the resonant frequency.

(3) gives low gain, but at a very wide range (large bandwidth) of frequencies.

Why are resistors connected across the resonant circuits in the i.f. stages of a TV set?

To keep the bandwidth wide, even at around 6MHz, and the amplification in particular needs a bandwidth of the expense of gain. The colour signal must be uniform (or reasonably so) over this range. Even more important, phase shifts must be kept small within this range of frequency so that sharply tuned circuits are out.

The shape of the resonant curve depends on the ratio of reactance to resistance in the circuit. The figure $(6.3 f.L/R$ or $1/(6.3 f.C)$ is often used to measure the sharpness of the resonant curve, and is given the symbol Q (not to be confused with Q meaning charge).

A high- Q circuit (values of 200 or so) has a large reactance value compared to its resistance and its resonance curve will have a high peak with a narrow bandwidth. A low- Q circuit (50 or less) will have larger resistance compared to its reactance, and gives a curve with a low peak and a wide bandwidth.

What sort of Q values will TV signal stages have?

Low.

To avoid having to write $2\pi f$ or $6.3f$ all the time in the equations, we give it the symbol ω (the Greek letter called omega).

$$\text{At resonance: } \omega L = 1/\omega C \\ \omega^2 = 1/L.C$$

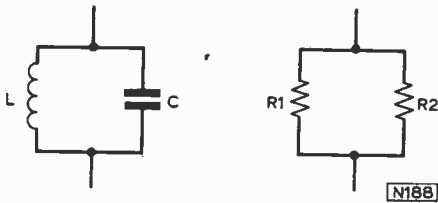


Fig. 7: Parallel reactances combine in the same way as parallel resistances.

Phase shift off resonance = angle whose tangent is $\omega L/R$ or $1/\omega C.R$. This is usually written as $\tan^{-1} \omega L/R$ or $\tan^{-1} 1/\omega C.R$

$$Q = \omega L/R \text{ or } 1/\omega C.R.$$

We have dealt so far with series resonance, in which inductance capacitance and resistance are all in series; at some frequency, called the resonant frequency, the two reactances cancel, leaving only the resistance. At resonance, a high current flows, and there is a large voltage across each reactance, 90° out of phase with the current and usually larger than the voltage applied to the network.

Resonance is possible also when the reactances are in parallel. The simple case is when the resistance is very small compared to the values of the reactances at the frequency of resonance, we can then treat the circuit as simply two reactances in parallel in the same way as we deal with two resistors in parallel, Fig. 7.

How do we add resistors in parallel?

$$1/R_{TOTAL} = 1/R1 + 1/R2 + 1/R3 \text{ etc.} \\ \text{CONDUCTANCE, } G, \text{ as } \\ \text{I/Resistance and write } \\ G_{TOTAL} = G1 \times G2 \times G3 \text{ etc.}$$

This method of adding values in parallel is also used for reactances. The quantity corresponding to conductance (1/Resistance) is SUSCEPTANCE ($-1/\text{Reactance}$) which is given the symbol B . There is one important difference here: when we find susceptance by taking the inverse of reactance, we change the sign as well.

$$\text{Susceptance of an inductor} = -1/\omega L$$

$$\text{Susceptance of a capacitor} = \omega C.$$

To find the total susceptance of these in parallel we simply add:

$$B_{TOTAL} = \omega C - 1/\omega L \\ = \frac{\omega^2 L.C - 1}{\omega L}$$

Reactance is the inverse of susceptance, $X = 1/B$.

In our example,

$$X_{TOTAL} = \frac{\omega L}{\omega^2 L.C - 1}$$

which is quite different from the form of the expression which we found for the series case.

In the series example, we found $\omega^2 = 1/L.C$, or $\omega^2 L.C = 1$ at resonance. What value of X_{TOTAL} do we find if we use this value for $\omega^2 L.C$ in the parallel case?

Infinite. X_{TOTAL} is infinitely large. Infinite values are not found in practice but we can certainly expect to find a very large value of reactance at resonance, unlike the series circuit which had zero reactance at resonance.

We can draw a phasor diagram for susceptances as easily as we can for reactances, but with the directions changed as in Fig. 8. Because susceptance is the inverse of reactance, we can modify Ohm's Law to read, $I = B.V$, and we can take our horizontal axis as reference VOLTAGE.

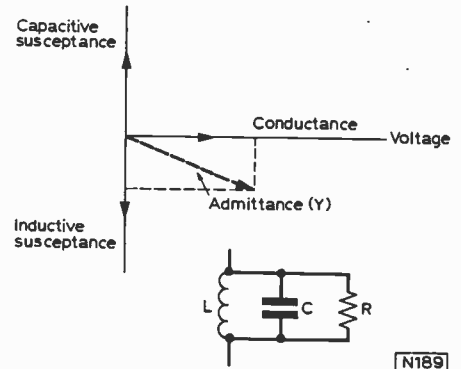


Fig. 8: A modified phasor diagram using Conductance, Susceptance and Admittance.

Inductive susceptance, B_L is now drawn downwards, being negative, and capacitive susceptance B_C is drawn upwards. When the two are equal, then the overall phase angle is zero, as in the series resonant circuit, and we have zero susceptance, which is infinite reactance as before.

Off resonance, what would the phase angle be?

$\pm 90^\circ$, depending on which susceptance is greater.

So far, we have not seen how resistance fits in. The easiest case to deal with is when any resistance in the circuit is in parallel, as we can then add all the component values in parallel. If we think of the type of tuned circuit often seen in TV i.f. stages, the resistance in parallel can be treated as a conductance G (remember $G = 1/R$), and plotted on the phasor diagram along the voltage direction, since there is no phase change caused by a resistor.

Off resonance, the resultant of conductance and the net susceptance can be drawn in the usual way to give ADMITTANCE, the inverse of impedance. At resonance, the susceptance is zero, and the admittance is equal to the conductance. In simple terms, the circuit behaves as if only the resistor were present, and there is no phase shift.

Why do we bother using a tuned circuit as load when it behaves as a resistor? Why not use a resistor in the first place?

This happens only at resonance; off resonance the impedance is much lower, so giving the required selectivity. When a resistor alone is used, the gain will be fairly constant over a wide range of frequencies. It will also be lower, because the resistor value must be kept low so as to overcome the shunting effects of stray capacitance in the circuit, which would otherwise cause a fall off in gain at high frequencies, together with an undesirable phase shift. In the resonant circuit this stray capacitance is part of the susceptance which is tuned out at resonance, leaving the resistor to behave in an ideal manner.

The parallel resonant circuit is not always so obligingly simple. Usually the resistance in the circuit is not in parallel with the other components but is in series with the inductance as in Fig. 9, since it is the resistance of the inductor windings.

To deal with this using phasor diagrams we first have to draw a diagram with the resistance and the reactance of the inductor only. When we find the impedance and phase angle, we invert the impedance to obtain the admittance of the inductor with its resistance, and we insert this, at the correct phase angle, in a second phase diagram showing susceptance and conductance. We can now put into this

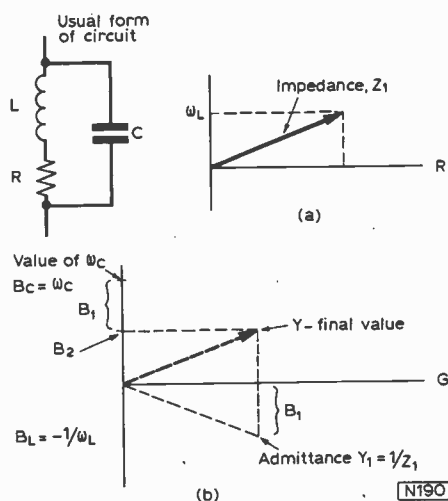


Fig. 9: In a practical parallel LC circuit with resistance in the inductor, find the impedance of R and L on diagram (a) then convert this to admittance and plot on diagram (b) to find overall admittance, and therefore impedance.

second diagram the value of susceptance of the capacitor, and find the total admittance in the usual way.

When this is done algebraically, the results look rather fearsome:

$$\text{Impedance} = \frac{R^2 + \omega^2 L^2}{\sqrt{\omega^2 C^2 R^2 + (\omega^2 LC - 1)^2}}$$

$$\text{Phase angle} = \tan^{-1} \frac{\omega[L(1 - \omega^2 LC) - CR^2]}{R}$$

How do these differ from the previous case when $\omega^2 LC = 1$?

Impedance is no longer infinite, as we would expect in this more practical case, but is at $1/\omega LC$ if we take maximum point of zero phase shift, but it occurs at a value slightly less than $1/\omega LC$ if $\tan^{-1}(-\omega.C.R)$. The true resonance is not zero, but the phase angle is not zero, but

Impedance is no longer infinite, as we would expect in this more practical case, but is

Fortunately, for many purposes, we can ignore the difference between the simple case and the correct case; but we should not forget that the simple case is an approximation, and that the phase shift in a parallel resonant circuit is never exactly zero when it is tuned to maximum impedance.

In what kind of circuits might this be of great importance?

Any feedback circuit, where the phase shift at maximum impedance could cause an upset in the feedback. It was for this reason that double-tuned circuits could not be used with early valves and transistors without special circuit precautions such as neutralisation.

At resonance, a voltage across a parallel resonant circuit sends very little current through it, though large currents circulate round the components of the resonant circuit. The parallel resonant circuit is also used for selective voltage magnification. If a parallel resonant circuit is used as the anode load of a valve or as the collector load of a transistor, then the output voltage of the stage will be low at frequencies off resonance, and high at the resonant frequency. This is a tuned amplifier - its graph of voltage gain against frequency will appear as in Fig. 10.

What determines the shape and width of the curve?

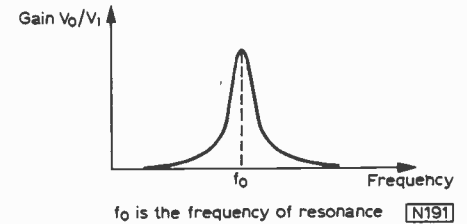
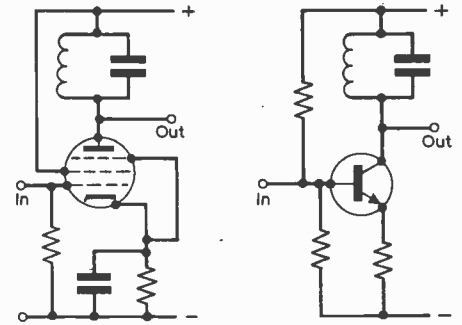


Fig. 10: Selective voltage magnification.

The Q of the tuned circuit, defined in the same way for the parallel circuit as it was for the series circuit.

It is possible to calculate what bandwidth can be obtained with a given Q value without drawing the curves. If we reckon the bandwidth to the 3db points, meaning the range of frequencies from one point where the response is 70% of maximum to the other 70% point (Fig. 11), the expression for bandwidth is simply: Bandwidth = $f_0/2Q$, where f_0 is the frequency of resonance.

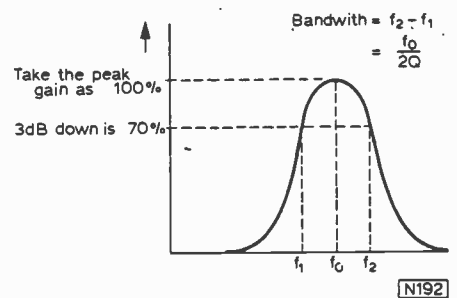


Fig. 11: Defining bandwidth.

If we measure f_0 in Hz, then the bandwidth is in Hz; if we use kHz for f_0 , the bandwidth is also in kHz, etc.

If a stage is tuned to 40MHz, and has a Q of 4, what is its 3db bandwidth?

Service Notebook

1

G.R. WILDING

Bush TV161 Series

The owner of a Bush Model TV161 complained that the picture had suddenly disappeared in a wild pattern of erratic lines. As a distinct smell of burning had then occurred he had switched off quickly. On switching on we obtained a good picture and good sound: in fact the receiver appeared to be working normally, with good field and line lock, and adequate contrast and brilliance. After a few minutes however there were sounds of sparking and the raster became a completely unstable display with reduced width lines: smoke was coming from a large carbon resistor near the PL504 line output valve. At first we thought that the cause of the trouble might be an internal arc-over in the valve, but it turned out that the resistor was the line linearity coil damping resistor ($4.7k\Omega$). Further inspection showed that one of the linearity coil connections had become unsoldered from the panel, so that the resistor, which of course is in series with the line scan coils, was carrying the entire line scan current. In order to make good contact when the coil was reconnected it was necessary to scrape away quite a bit of the panel surrounding the tag, since the sparking and heat had carbonised the panel. On completing this and replacing the badly discoloured resistor normal operation was restored. Clearly in addition to reducing the width the fault had upset the operation of the flywheel line sync circuit.

In another of these models the picture would intermittently collapse to only about an inch or so in height. A new PCL805 failed to cure the trouble, and the cause wasn't intermittent reduction in the voltage at the triode anode of this valve. In fact the fault turned out to be a defective cathode decoupling electrolytic ($3C35, 500\mu F$) which decouples both cathodes of this valve. Loss of capacitance in the field output pentode's cathode decoupler usually results in cramping at the bottom of the raster, but as in this circuit there is a common cathode resistor the effect of $3C35$ losing capacitance is severe loss of height as well. The capacitor is readily identifiable: it is mounted vertically with respect to the panel, close to the PCL85. Due to its size it can easily be knocked and become unsoldered, so watch out!

Since the l.t. supply for the transistor stages is obtained from a rectifier fed by a winding on the line output transformer, failure of the line output stage to provide adequate output will result in loss of sound as well as absence of the raster. If the PL504 line output valve is o.k., first suspects are the boost capacitor $3C18 (0.1\mu F)$ and the valve's screen grid feed resistor $3R22 (2k\Omega)$.

Weak Colour Lock; Field Collapse

The decoder reference oscillator frequency control in a hybrid GEC Model C2040B had to be very carefully set otherwise colour sync was lost on channel change. As the two OA91 diodes in the burst detector circuit have a reputation for giving this kind of trouble in these receivers we replaced them both and while we were at it replaced the two OA90 diodes in the burst gate circuit. This produced a considerable improvement, but the standard of colour lock was still below par. We next replaced the two $0.005\mu F$ capacitors which feed the antiphase burst signals to the burst detector diodes, and retuned the detector transformer. After doing this, first class colour lock was obtained.

While giving the set a good bench test, and while awaiting the test card since the vertical linearity wasn't too good, the field spasmodically varied to an alarming extent and finally collapsed.

Tapping the PL508 field output pentode failed to produce any movement of the horizontal line so we replaced it, though with little hope that this would provide a cure. The valve failed to get really warm however, so it seemed likely that there was no screen grid voltage. This proved to be the case. There is a separate h.t. line (HT4) for the screen grid of the PL508 in this chassis, and it turned out that the smoothing resistor R65 ($5.6k\Omega$) was open-circuit. Had the primary winding of the field output transformer gone open-circuit the resulting greatly increased flow of screen grid current would have resulted in the valve being as hot as usual, while had the cathode bias resistor gone open-circuit the associated decoupling capacitor would probably have broken down and acted as a medium- or low-value resistor to give some vertical output.

Set Dead

The valve heaters in a Ferguson set fitted with the Thorn 950 Mk. II chassis could be seen glowing but there was neither sound, speaker hum, raster or line whistle. Clearly there was no h.t. On investigation the fusible resistor R138 in the h.t. line was found to be open-circuit. We switched off, resoldered the resistor and checked for a short-circuit from this point to chassis. The ohmmeter needle gave the usual swing as the electrolytics charged, then dropped to infinity indicating that there was no short-circuit. On switching on, the sound began to develop but within a few seconds faded away while the PY81 boost diode began to get red hot. A replacement PY81 acted in the same way, to be accompanied by a wisp of smoke from the vicinity of the line output transformer. The suspect was not the line output transformer itself however but the $220pF 8kV$ capacitor C131 which provides third harmonic tuning and is connected from the PY81 cathode circuit to chassis. This capacitor — which is not in the earlier Mark I version of the chassis — frequently breaks down, especially after the h.t. is applied. To get at the capacitor it is usually necessary to remove the line output transformer (two securing screws). We discovered that the capacitor was blackened, but on being tested out of circuit with the ohmmeter there was no indication of a short or even of leakage. Normal results were restored on fitting a replacement.

Poor Results

Poor brilliance, a defocused picture and a gap of 3in at each side of the screen suggested that the PL509 line output valve in a set fitted with the Pye 691 chassis had very low emission. Changing the PL509 and the PY500 efficiency diode had no effect however and the trouble was found to be due to the h.t. voltage being low. Although approaching 300V appeared at the dual electrolytic reservoir and HT1 smoothing capacitor can after switch on, the voltage dropped to only about half that value once the valves had warmed up and started to pass current. A line output valve with insufficient drive will pass excessive current of course, reducing the h.t. line voltage. But this wasn't the case since the PL509 was only warm while when both the PL509 and PY500 were removed the h.t. rail voltage still stayed at less than 180V.

There was no measurable short-circuit or leak across the supply, and no sign of resistors or other components overheating. The h.t. rectifier's surge limiter resistor was intact, and although the VA1104 thermistor in series with this resistor had a fairly high resistance this was only to be expected since it never reached

its normal operating temperature – if the thermistor's high resistance had been the cause of the low h.t. it would have been running very hot. Despite the absence of a hum bar, there was only one possible cause of the trouble – that the 200 μ F reservoir capacitor was low in value. The simplest check is to connect a smaller electrolytic in parallel and note the effect. If the value of the original has fallen markedly even a 50 μ F capacitor will result in a big increase in voltage. If the original electrolytic is o.k. however paralleling an additional 50 μ F across it will have negligible effect, though putting a little extra strain on the h.t. rectifier – the greater the value of the reservoir capacitor, the greater the initial surge current.

It was found that a shunt 50 μ F capacitor restored the picture to almost full size. On fitting a replacement 200 μ F plus 300 μ F electrolytic a perfect picture was obtained.

Reduced Width Plus Bottom Cramping

Greatly reduced width plus cramping at the bottom of the raster were the faults on a colour set fitted with the Thorn 3000 chassis. Since both the field and line output stages are fed from the chopper stabilised h.t. rail (58-65V) our first move was to check this. As suspected, it was well below the minimum correct value. There was the full, normal voltage at the collector of the chopper transistor, so clearly the h.t. rectifier and its reservoir capacitor were in order. The 140 μ F electrolytic which smooths the regulated supply to the audio and field output circuits was also o.k., so as there were no signs of excessive current demand/component overheating we concluded that the drive to the chopper transistor was incorrect. Attention was directed therefore to the transistors which drive the chopper, and the feedback amplifier which controls the mark-space ratio of the chopper drive waveform produced by the monostable circuit.

The feedback amplifier (see Fig. 1) senses voltage changes in the

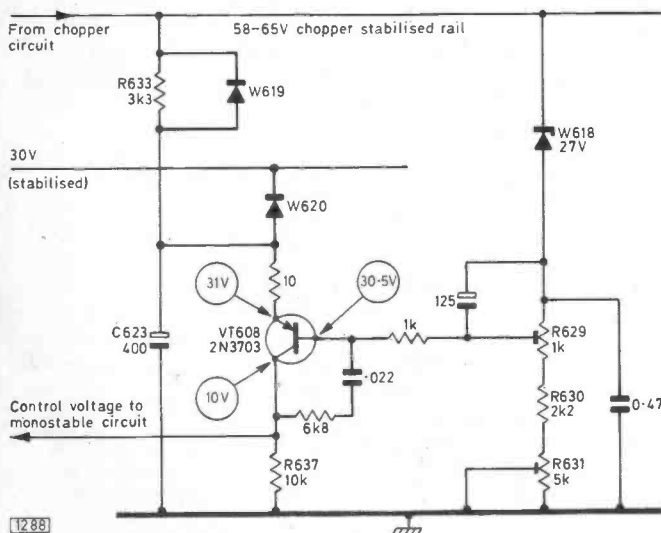


Fig. 1: The feedback amplifier used in the power supply circuit in the Thorn 3000/3500 chassis. The voltage developed across R637 determines the mark-space ratio of the monostable circuit's output waveform and thus the on/off time of the chopper transistor. At switch on C623 charges via R633: when the voltage across it reaches 30V W620 conducts, clamping the voltage at this level. This action ensures that the h.t. builds up slowly. When the set is switched off C623 discharges rapidly via W619.

chopper stabilised h.t. rail and develops at its collector a voltage which is used to adjust the mark-space ratio of the monostable circuit's output waveform. On checking the voltages we found that the collector of VT608 was at only about 4V instead of 10V – thus acting to keep the chopper output low. The cause was found to be near complete breakdown of the 27V zener (W618) in the voltage sensing network W618/R629/R630/R631. As a result VT608's base voltage was higher than normal, and since this is a pnp device the current through it was low, accounting for the low collector voltage. Replacing the zener resulted in correct voltages and a normal raster being obtained.

Loss of Sync

A set fitted with the Thorn 1580 hybrid portable chassis would lose both line and field sync after an hour's use. Our first suspicion was naturally the transistor sync separator stage. The sync was found to be perfect when the set was first switched on. The collector voltage was normal at just over 60V, but the base voltage was definitely less than the correct figure of -2.8V. When the sync finally disappeared our first move was to short-circuit the protection diode in series with the transistor's emitter. This produced no effect, so could clearly be eliminated. The transistor's collector voltage was found to have risen to over 100V, so obviously either the transistor was defective or there was a fault in its base circuit. Our next move was to connect a capacitor in parallel with the input coupling capacitor (C38, 0.22 μ F). This immediately restored perfect sync – but perfect sync remained when the test capacitor was removed! Nevertheless the original was obviously unreliable, and no further trouble has been experienced since its replacement. The particular capacitor is a ceramic type with four broad colour stripes to indicate its value.

Poor Colour Picture

An 18in Pye Model CT200 had the complaint of a badly coloured and varying picture with streaks. This was basically due to the luminance signal varying, for on turning the colour control to minimum it was observed that the contrast varied intermittently. The sound was perfect, thus ruling out intermittent gain variation in the tuner unit or the i.f. strip. In this chassis the video output signal from the TCA270 demodulator i.c. on the i.f. panel is fed via a screened lead to two points on the RGB board – to the luminance delay line circuit and via a 10pF capacitor to the chrominance bandpass circuit. Attention was first directed therefore to the delay line printed circuit connections and to the printed circuit connections to the following 4.43MHz chrominance subcarrier notch filter. All connections proved to be o.k., so we decided to replace the 68 μ F electrolytic C299 which couples the luminance signal from the notch filter circuit to pin 3 of the TBA560 luminance/chrominance i.c. This completely cured the trouble.

Frequency Changer Trouble

We were recently called to see an oldish dual-standard Bush receiver which would work perfectly well on u.h.f. when first switched on. The picture and sound would then gradually fade away however. The local ITV channel would go off first, followed by BBC-1 and BBC-2. The fault was clearly due to tuner trouble, the prime suspect being the PC86 self-oscillating mixer valve. Replacing this cured the fade out, while a new PC88 r.f. amplifier valve produced a very worthwhile increase in contrast.

A few days later we were confronted with an elderly v.h.f. only Murphy set which gave a good raster but neither sound nor vision. A tell-tale band of interference was travelling up the screen on BBC-1 however, clearly indicating that the frequency changer was not oscillating: interference covers such a wide bandwidth that it can get through to the i.f. strip without conversion to i.f.! A new PCF80 restored a good picture and sound.

Rank A823A Chassis

The A823A was the initial Bush/Murphy all solid-state colour chassis: there are some substantial modifications in the later version, the A823AV chassis. Amongst the changes are the use of completely different line generator circuits. In the later chassis a conventional sinewave oscillator controlled by a reactance stage is used: in the earlier version a varicap diode and reactance multiplier stage control the line oscillator.

A Model CTV194 fitted with the earlier chassis came our way recently with the complaint of intermittent line oscillation. Sometimes the set would work perfectly from switch on, sometimes the owner said he had to switch off and on again rapidly to produce a picture, while occasionally the picture would fade out after an hour or so of use. We have come across several instances of this fault before, all due to defective tuning capacitors in the line oscillator circuit. There are three of them, 5C17, 5C18 and 5C20. After replacing all three using high-grade types the intermittency was completely cured.

When working on this panel it is always worthwhile checking the various diodes, especially the flywheel sync discriminator diodes 5D2 and 5D3. Others to check are 5D1 in the collector circuit of the line sync discriminator driver stage, 5D5 the line oscillator transistor protection diode, 5D6 in the base circuit of the emitter-follower and 5D12 which couples the field sync pulses to the field oscillator.

Finally on this panel, loss of capacitance in 5C5 (400 μ F) which decouples the supply to the sync separator often shows up first as poor field lock, while loss of capacitance in 5C22 (also 400 μ F) which decouples the supply to the reactance multiplier and line oscillator stages 5VT4 and 5VT5 usually results in weak line hold.

No Signals

There was neither sound nor vision on a hybrid monochrome portable receiver fitted with the Thorn 1580 chassis – just a clean, normally controllable raster. The fault was likely to be almost anywhere in the i.f. strip, including the video driver stage since the intercarrier sound signal is tapped from the collector circuit of this transistor: complete absence of any noise or interference on the screen rather ruled out the tuner. On checking the i.f. transistor voltages we found that the collectors of the first two were at the l.t. rail voltage while the emitters were at chassis potential. Thus neither was passing current. The a.g.c. voltage is

applied to the base of the second i.f. transistor, while the first i.f. transistor obtains its base bias from the emitter of the second i.f. transistor. The fault was clearly in the a.g.c. circuit or the second i.f. transistor, and it turned out that the latter had an open-circuit base-emitter junction. A replacement restored normal working voltages plus sound and vision.

Width Variations

The problem with a KB colour set fitted with the CVC5 chassis was width variations. Valve replacement made no difference, so we checked the PL509 line output valve's cathode components and the high-value resistors in the width circuit. In many chassis these megohm-value resistors cause reduction in width due to increase in value, though we've never known them cause intermittent width changes. There's always a first time however! The next suspect was the 220pF 4.5kV pulse feedback capacitor from the line output transformer to the width circuit, but replacing this produced no improvement. After a short while however sparking came from the e.h.t. can, the raster vanished, and we were able to see the PY500A boost diode overheating before the h.t. fuse F5 blew. An ohmmeter check from the PY500A cathode (top cap) to chassis showed an almost complete short-circuit, due to the line output transformer tuning capacitor C308 (220pF, 12kV) breaking down. Fitting a replacement plus a new fuse restored normal operation with no trace of width variation. The capacitor had clearly been faulty prior to its final breakdown.

HT Sparking

Almost immediately after switching on, loud cracking noises came from the chassis of a dual-standard Bush monochrome set. No sparking could be seen, but the casing of the dual 300 μ F h.t. reservoir/smoothing electrolytic was found to be quite warm. There was no short circuit, and it appeared that the h.t. sparking must be occurring inside the can! On disconnecting the leads and transferring them to a replacement normal results were obtained.

Picture Slip

"Picture slip" on a monochrome set fitted with the ITT VC200 chassis was found to be due to the fact that field lock could be obtained only when the hold control was right at the end of its travel. A new PCL805 field timebase valve improved matters by shifting the hold control setting slightly away from one end, but there was still insufficient range to compensate for drift. None of the resistors in the timebase circuit were discoloured, those affecting the frequency being within tolerance on test. Capacitor replacements were next tried therefore. Changing the cross-couplers made no difference, but the fault cleared when the field sync pulse coupling capacitor C70 (0.0047 μ F) was replaced. This capacitor applies the field sync pulses to the cathode of the triode section of the valve.

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Due to escalating costs the company is no longer able to continue to provide a subscription service for its Practical Group magazines. Current subscriptions will be continued until they expire, but no new subscriptions can be accepted. We much regret the inconvenience this may cause to some readers. The best way to ensure that you get a copy of *Television* each month is to place a regular order with your local newsagent. The company has official agents in many countries overseas.

Servicing the **III** CVC5 CVC5/8 CVC7 CVC8 CVC9 Chassis

PART 3

E. TRUNDLE

No Sync

Loss of both syncs is likely to be caused by the sync separator transistor going short-circuit. This is T42 on the field panel. It is a high-voltage type and must be replaced with a similar type, e.g. BF117F or BF137F. Spasmodic field roll on change of camera etc. can be due to R330 (3.3M Ω); it is more commonly caused by D46 however.

Line Timebase

The line oscillator with its detector and reactance stage can be the source of several faults. If line hold troubles are encountered, earth pin 9 of the PCF802 valve and adjust L96 for vertical floating lines. If the line oscillator does not lock in when the shorting link is removed the trouble is in the phase detector. While the discriminator diodes D55 and D56 can be responsible, the polystyrene capacitors C281-C286 are more often faulty. We usually replace all six when this trouble is encountered. Any unbalance between R388 and R392 (51k Ω) or R393 and R394 (2.7M Ω) causes an asymmetrical pull-in range.

If the 400mA fuse F5 on the CVC5/CVC7 chassis or the fusible resistor R380 on CVC8/CVC9 chassis blows erratically and for no apparent reason the cause is often a lazy line oscillator failing to start up. C294 (0.0022 μ F), C295 (0.01 μ F) and C291 (0.001 μ F) were polystyrene types in early chassis and should be replaced on sight! Ceramic capacitors are unsuitable here. Polystyrene or polyester capacitors are sufficiently stable for replacement purposes, but avoid RS components' polystyrene types which are rated at only 125V. The other suspects for a sleepy oscillator are the .330pF ceramic capacitor C293 and the oscillator coil itself, L96. In the latter case, zero voltage at pin 1 of the PCF802 makes the diagnosis easy. Resoldering the fine coil wire to the leadout pins will do the trick. A dry-joint at R400 has also been known to cause the trouble.

The line drive feed to the PL509 follows a long and roundabout route. Lack of drive (often intermittent) is sometimes caused by solder blobs or hairline cracks along the way.

The 210pF tuning capacitor C308 (mounted on the line output transformer subpanel) often becomes short-circuit with some charring. The 400mA fuse (CVC5/7) or 56 Ω fusible (CVC8/9) soon puts the PY500 out of its misery. The boost reservoir capacitor C310 (0.47 μ F, 1kV) sometimes goes short-circuit with identical results.

The line output transformer itself is quite reliable, and

the occasional failure is usually obvious from burn-marks on the winding.

A mystifying symptom is a plain distorted raster with vague red and green curved vertical lines. The fault is as difficult to diagnose as the effect is to describe, and is due to R422 being dry-jointed or, more commonly, the four earth tags on the line output transformer being dry-jointed to their subpanel. This lifts one or more of C308, R414 or transformer pin 3, which depend on the transformer frame for an earth-return, off earth. The effect is often intermittent. A similar situation can develop on the earth tags of the steel cage around the line output compartment. Symptoms vary, but a series of loud cracks immediately after switching off is the most usual. A beefy soldering iron is called for here.

Apart from the usual symptoms, a burning R426 (470 Ω) is a sure sign of a faulty tripler. Renew the tripler and replace the resistor with a similar (1W composition) type. The 8kV lead from the line output transformer overwinding to the tripler can arc to the cage top due to disintegration of the plastic retaining strap. Shortening the lead is the best remedy.

Focus drift is usually due to the resistors associated with the focus v.d.r. R430 going high-resistance. These are R429 and R431, both 4.7M Ω . If oxide type resistors are used as replacements they will be found more reliable. Constant focus adjustment can lead to a copper deposit building up on the v.d.r. A moments thought will confirm that rotating the v.d.r. to find a different track area will not work. Clean off the deposit with emery cloth. Occasionally, focus troubles are caused by the tripler itself or by R276 (2.2M Ω on the c.r.t. base panel) going high-resistance. This resistor must be mounted clear of the board and not pushed over.

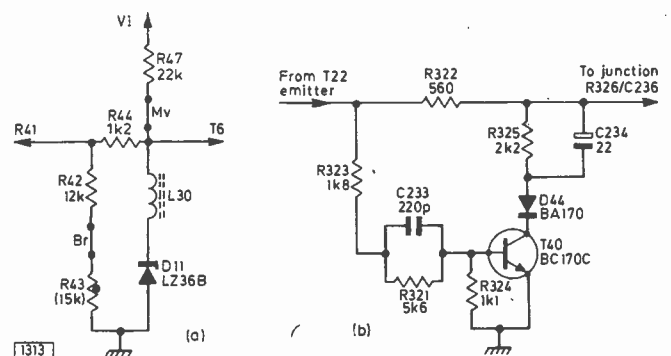


Fig. 5: Early versions of the CVC5 chassis used the tuning voltage stabiliser circuit shown at (a) and the noise gate shown at (b).

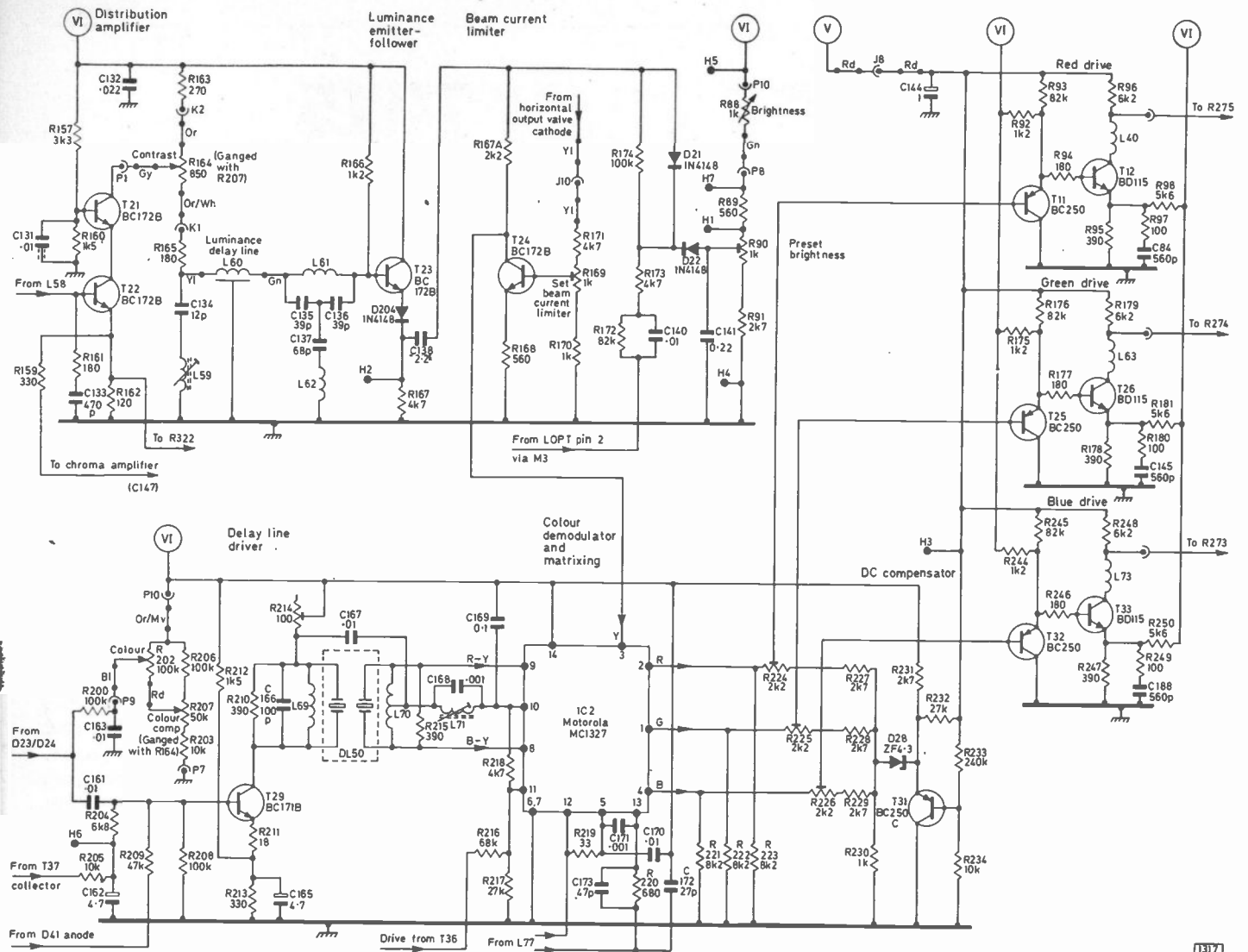


Fig. 6: Modified decoder and RGB circuitry employed when an MC1327P i.c. is used for colour demodulation and matrixing, and PAL switching. The subcarrier amplifier circuit is modified as follows: there is no tap on L77, and the feedback to the detector diodes D34/D35 is from a tap on L76 via C211 with C210 and R286 deleted.

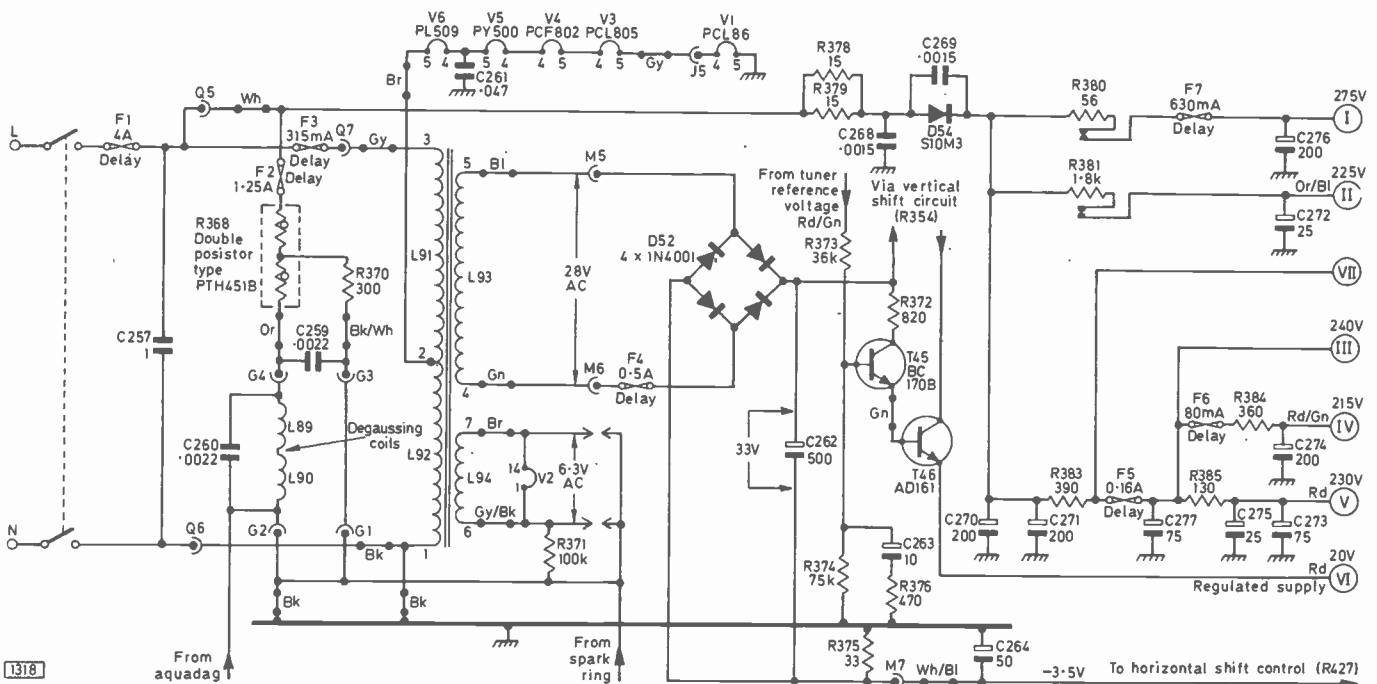


Fig. 7: Power supply and degaussing circuit used in the CVC8 chassis. In the CVC9 chassis F3 is replaced by a thermal cut-out and a pair of BY133 h.t. rectifiers may be used as in earlier sets with two BY103 h.t. rectifiers.

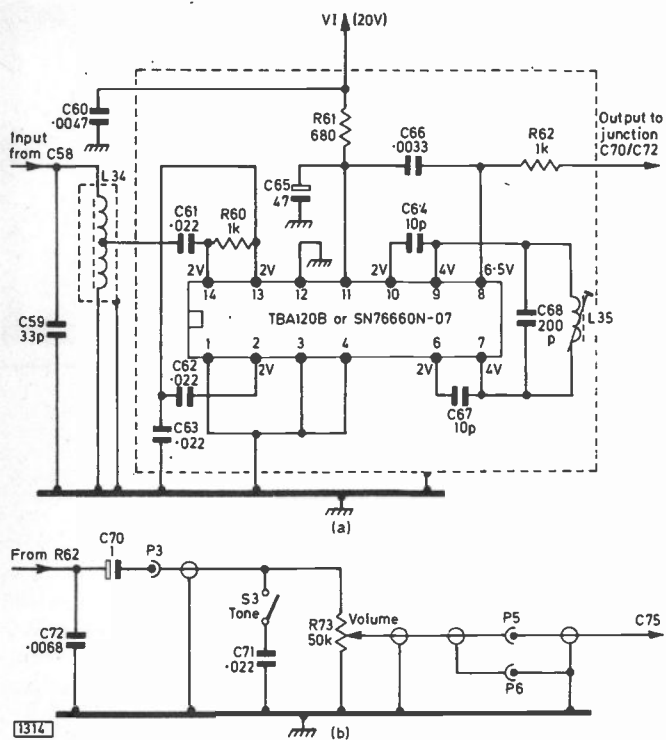


Fig. 8: (a) Intercarrier sound i.c. circuit used in later production. (b) Later a.f. coupling circuit.

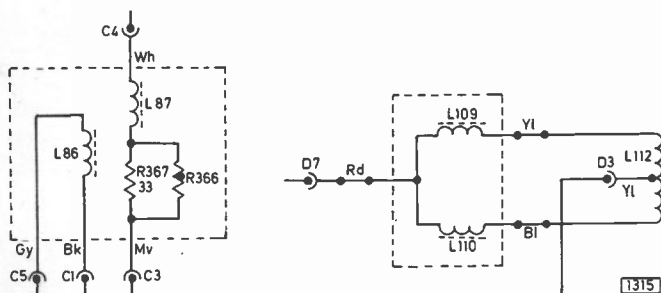


Fig. 9: Connections to Plessey deflection coils.

The line linearity coil damping resistor R428 is a generously rated wire-wound component and vertical striations on the left of the display due to its failure are much less common than on other makes of receiver. Other possible causes of this fault are C305 or the network R422, C306.

R424 has been known to become open-circuit causing great discomfort to the scan-correction capacitor C307. More commonly it becomes dry-jointed after prolonged use, leading to arcing and line jitter. A bad burn hole in the printed circuit board can result. The best course is to remove the charred section of the board altogether and fit a paxolin patch – it is hoped to enlarge on this method of board repair in a later article. Note that both R424 and R422 must be mounted clear of the board – a gap of 10mm is recommended.

Convergence Board Faults

Faults on the convergence board are rare. If red-green convergence down the vertical centre line cannot be achieved with the appropriate controls one of the diodes D47-D50 inclusive is usually responsible. If double encapsulated types are found, D47 and D48 may be replaced with two 1N4148 diodes and D49, D50 with two 1N4001 diodes. Difficulty with blue convergence, with

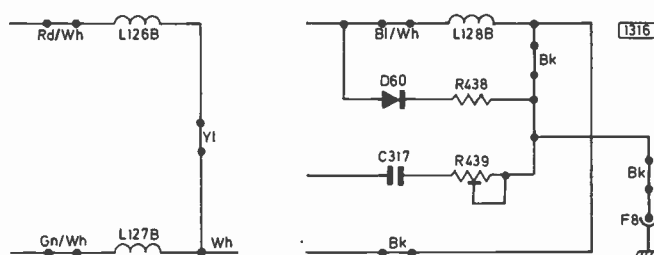


Fig. 10: Connections to Plessey convergence coils.

L117 having too little range, can be caused by C313.

Other troubles in this area are usually confined to hairline cracks on the c.r.t. first anode preset potentiometers (R263, R265 and R268, all 2.5M Ω). This leads to grey-scale drift.

Purity Faults

Purity troubles due to a faulty degaussing circuit are extremely rare though not unknown. If R368 is defective the fact will be revealed by its appearance. More often R370 gets severely damaged, the symptom being pretty patterns which move slowly up or down the display.

The CVC9 Chassis

At the time of writing, the CVC9 chassis has been introduced only recently. It is a development of the CVC8 incorporating modifications to meet BEAB requirements and also to allow greater flexibility in the choice of tuner control units. The touch-tuned version contains no less than ten fuses, which must be a record.

From the servicing viewpoint, replacement of any BEAB specified component must be made with an ITT-approved part, and these components must be fitted in the same way as the originals.

Apart from a sprinkling of fusible resistors, most of the circuit changes concern the circuitry around the tuner. The 32V stabiliser i.c. is fed via a lower value resistor than on earlier chassis (R47 is 18k Ω), and the resulting high bleed current is excessive for a TAA550 i.c. The ZTK33B (ITT) and SN76550-2Y (Texas) are suitable.

Two variants of the CVC9 will be encountered. The touch-tuned version has five illuminated touch-buttons in a spring-out drawer. Two i.c.s are used in the selector circuits, which are altogether less complex than the earlier (CVC7) arrangement. The tuner assembly for use with this arrangement is not interchangeable with the rest of the CVC5-CVC8 series, having a different component layout on the printed tuner mounting board.

The second type uses a conventional tuning bank (square buttons, as on the CVC8). The wiring of the control unit is different from the CVC8 however, and the units are not directly interchangeable.

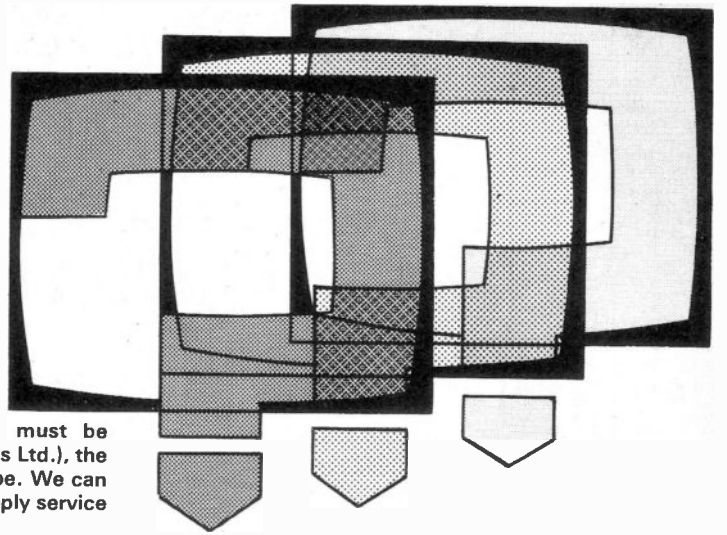
A further point to note is that the new breed of Mullard varicap tuners have higher resistance trimming potentiometers. To date we have had no problems when fitting the earlier type of varicap tuner unit to the CVC9.

Conclusion

In conclusion it should be pointed out that the foregoing is the distillation of over five years spent servicing many hundreds of these receivers. Unless you are very unlucky, the average specimen will contain very few faults. The chassis is very accessible in the main, and fault diagnosis relatively easy.

Your PROBLEMS solved

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PHILIPS G23T212

The problem with this set is multiple or split pictures which cannot be cured by adjusting the hold controls. The appropriate valves have been replaced without making any difference. Also, when the brightness control is advanced the picture and screen black out.

The blacking out – with ballooning we suspect – is due to poor e.h.t. regulation: fit a new DY87 e.h.t. rectifier to cure this. You don't say whether the multiple images are side-by-side (incorrect line hold) or stacked vertically (incorrect field hold). If there are side-by-side images, check the ECC82 (V2004) line oscillator (multivibrator) valve, its cross-coupling capacitors C2060 (56pF) and C2061 (100pF) and anode load resistors R2160 (22k Ω) and R2161 (56k Ω), more particularly the latter since this is the section of the valve conducting most of the time. Other checks should include the flywheel sync valve V2003 (ECC82) and its pin 1 anode load resistor R2146 (220k Ω). If there are multiple images vertically, check the high-resistance potential divider network R4042 (3.3M Ω) and R4041 (2.2M Ω) which feeds the field-hold control, and the coupling capacitor C4016 (0.047 μ F) linked to this. (Philips 210 chassis.)

DECCA CTV19

The middle PCL84 valve on the decoder panel was running red hot in its pentode section, resulting in loss of picture. A new PCL84 was fitted, but this also runs red hot though there is a very weak picture. The sound remains all right.

The middle PCL84 is the green colour-difference output valve. The original one could have had an interelectrode short, pulling down the 260V rail. It will have damaged the associated components, so we suggest you replace the cathode resistor and capacitor – R682 (220 Ω) and C656 (0.0022 μ F) – and check its anode load resistor R674 (12k Ω , 3W). Also check its input coupling capacitor C653 (0.022 μ F) in case a leak here is the cause of the stage being over-run, and the screen grid feed resistors R679 (100 Ω) and R665 (10k Ω , 1W) in case the original valve was shorting at its screen grid.

BUSH TV191D

There are some odd troubles with this set. The focus is clear in the centre of the raster only and the whole raster is

covered with white spots which radiate outwards from the centre of the screen. A picture partly smothers the spots, but with the aerial disconnected they cover the screen, sharply defined at the centre but defocused near the edges of the raster.

The trouble seems to be associated with the DY802 e.h.t. rectifier valve base. Remove this and check for corrosion, etc. Also ensure that the c.r.t. outer coating is adequately earthed to chassis.

PYE CT152

The trouble with this set is the appearance of six Ceefax/Oracle lines, also six or seven dim horizontal lines, closely spaced, about one inch down from the top of the raster. Increasing the height moves the lines up but then some of the picture is lost. Swapping the two field output transistors round improved the situation slightly, moving the lines up about quarter of an inch.

The problem could be due to foldover. Make sure that the field output stage mid-point control RV24 is set for optimum results, then if necessary replace VT27 – this is the output stage transistor that does most of the work. If the dim lines persist once you have cleared the foldover, check RV41 on the convergence panel. This tends to burn up, causing interference across the top of the screen. (Pye 691 chassis.)

MARCONIPHONE 4704

The picture went off and it was discovered that the h.t. fuse F603 had blown. On examination this was found to be due to the reservoir capacitor (C523) for the c.r.t. first anode supply being short-circuit, the associated rectifier W505 being burnt out in consequence. The set operated normally after replacing these components. A few days later however there was a flash on switching the set on. This time the 30V supply line fuse F602 had blown, while the replacement c.r.t. first anode supply rectifier W505 was found to be open-circuit.

It is essential that W505 is a suitable type, either as specified in the manual or a BYX10. It sounds as if there may have been a flashover, as a result of which F602 failed. If a replacement blows, check with an ohmmeter whether there is a short-circuit on the 30V line. You might alternatively find that the 30V series stabiliser transistor VT301 (type SP3835) is short-circuit or leaky. (Thorn 3000 chassis.)

GEC 2029A

The picture on this set breaks up into horizontal colour bars. We have tried adjusting the line hold control but this has no effect on the condition.

This seems to be a decoder fault – we assume that the monochrome picture is o.k. Check whether the set reference oscillator frequency control P302 has some effect. If so it is possible that one of the capacitors in the reference oscillator is defective – we suggest replacing C322, C323, C324, C325 and C326, using 1% silver mica capacitors. If P302 has no effect check the correction voltage d.c. amplifier transistor TR27 (BC108) in the reference oscillator control loop.

BUSH CTV25

On several occasions during an evening the colour content will break up, independently of the signal level, resulting in green and magenta bars approximately 2in wide across the screen. The colour can be locked by altering the setting of the line oscillator coil, but this has to be readjusted on changing channel.

The decoder reference oscillator is going out of sync from time to time and it would appear that this is due to the burst gate being incorrectly aligned. 5L15/16 and 5L17/18 should be adjusted as specified in the manual: this calls for the use of an oscilloscope, without which it is impractical to try to rectify this fault. Before attending to the decoder, remove the sync input socket Z15 from the scan unit chassis and adjust the line oscillator coil 3L1 for a floating picture: this ensures that the coil is correctly set. If the picture breaks up when the sync input is reconnected, check the PCF802 line oscillator valve, the flywheel sync discriminator diodes 3D1 and 3D2 and the reference pulse feedback resistor 3R1 (47k Ω).

PYE CT200

The line hold suddenly ran free. All stations had to be retuned to get line lock but the new tuning points are so near mistuning that the picture tends to jump from colour to monochrome. In darker scenes the line unlocks, also occasionally the field timebase unlocks slightly. As the picture brightens, the line and field lock again. It is no longer possible to tune stations by depressing the button to switch out the a.f.c. as when the button is released the line unlocks and the set has to be tuned with the a.f.c. on.

The source of the trouble is in the detector module, around the TCA270 i.c. The most likely fault is a dry-joint causing either the demodulator tank coil L170 or the a.f.c. detector quadrature coil L171 to become off tune. (Pye 713 chassis.)

FERGUSON 3649

The field hold setting on this receiver is rather critical, the picture rolling on camera changes. A new 30PL14 field timebase valve has been tried and all the voltages in this stage appear to be correct.

The trouble is almost certainly in the EF80 video amplifier stage. There is a bias stabilising resistor, R26 39k Ω , connected between the screen grid and the cathode of this valve. Check its value, which has probably changed. If all is o.k. here measure the screen grid voltage (should be roughly 50V) of the EF80 sync separator valve to ensure that the potential divider feed network is in order. (Thorn 981 chassis.)

BAIRD M702

When we first obtained this old colour receiver the picture was excellent though the contrast had to be right up and the brightness nearly so. After a couple of months the picture started playing up, being either too dark or too light, and the brilliance control would not provide satisfactory conditions – if the picture was too dark and was corrected by the brilliance control it would soon become too bright and vice versa – quite unviewable in either case. At the same time the picture started to take longer to appear, while for the first couple of hours a clicking noise came from the set together with flashes of a narrow black band across the centre of the screen. Now the picture is mostly too dark to make anything out, with occasional spells of being light enough to see something. About once a week there is a freak spell of a few minutes when a good normal picture appears. It seems to be difficult to get information of this set.

The luminance output stage consists of one half of a PFL200, the other half acting as the decoder reference signal amplifier. The main brightness control sets the d.c. restoration level at the control grid of the luminance output pentode: there should be $-6V$ at minimum brightness and $-3.6V$ at maximum brightness at the anode of the d.c. restorer diode D24 (BA115). Brightness variations on this chassis are most commonly caused by failure of the preset control R330 (10k Ω) however: this is between an EB91 and a PCC88 in the top right-hand corner of the decoder panel, and sets the clamping level at the control grids of the PCC88 colour-difference output valves. There is also a brightness range adjustment (red/white lead at top of decoder board connects to chassis, $+20V$ or $-25V$) that sets the d.c. restoration level of the colour-difference drive signals applied to the c.r.t. grids. Check R330, then the PFL200 luminance output pentode and its associated resistors, especially its cathode bias resistor R359 (68 Ω). Slow warm up is often due to a tired PL505 (PL509) line output pentode. These sets were made by Radio Rentals before this firm was taken over by Thorn – after which Baird sets were fitted with standard Thorn chassis of course. (Baird 700 series chassis.)

BUSH TV115R

The voltage dependent resistor from the brightness control to chassis has come apart: can you provide the correct type number of the replacement required? Incidentally, I have been told by a friend in the trade that they never bother to replace these v.d.r.s, simply connecting the earthy end of the brightness control to chassis.

The set will work with this v.d.r. shorted out, but you will no longer have c.r.t. protection: the v.d.r. provides switch-off spot suppression. A suitable replacement is the Mullard type E299DC/P338.

EKCO CT109

The picture is normally good but from time to time a colour band an inch to several inches wide appears across the screen. The band is usually green, but can depend on the background colour. Generally it's peoples' faces that are green.

It seems that the bistable switching in the decoder is incorrect for a number of lines every so often. Try adjusting the ident coil L27 a few turns downwards, and check that the bistable transistors VT27 and VT28 are both Mullard type BC148. (Pye 691 chassis.)

FERGUSON 3713

There are severe Hanover bars which I assume are due to failure of the PAL switch, possibly as a result of the switching diodes being faulty.

There are no switching diodes as such in this chassis since the PAL switch is in the MC1327 chrominance signal demodulator i.c. on the i.f./decoder/RGB board. Whilst this i.c. could be faulty, the trouble is more likely to be in the ident clipper stage VT114 (BC157) which provides the switch drive waveform. (Thorn 8500 chassis.)

BUSH CTV25

When the set was switched on the neon on the decoder board lit up for a short while, indicating that the 280V h.t. supply was present, but next there were fireworks from the power supply. On checking I found that both the 7Ω surge limiting resistors 8R3 and 8R4, which are on a common former, had burnt out. Guidance on suitable replacements and the likely cause of the trouble would be appreciated. Also, when I checked the h.t. smoothing inductor 8L1 with a meter the needle flicked to zero: is this normal?

The surge limiting resistors 8R3 and 8R4 may be replaced with separate 10W wirewound types, or by dropper sections from the RS range. The most likely cause of the fault is that one or other of the h.t. rectifiers 8D1 and 8D2 is short-circuit. Check them both before switching on. If they are in order, disconnect power supply plug Z1 and check to see whether there is a short-circuit at the 280V pin 12. The d.c. resistance of the smoothing inductor 8L1 is very low so your reading on this is normal.

PHILIPS G20T300

The problem with this set is excessive height combined with poor vertical linearity. A new PCL85 field output valve has been tried "just in case" but made no difference. The voltages in this stage seem to be quite normal.

The symptoms excessive height plus poor field linearity point to trouble in the field linearity feedback loop. The usual cause of the trouble in these sets is that the top field linearity preset control is open-circuit – either the track itself broken or a disconnection at one of the track end rivets. We have also known the fault to be due to a leak in the integrating capacitor in the feedback circuit. This is C4007 (560pF): check it by substitution. Another possibility is the field output transformer, since the linearity feedback is obtained from a separate tertiary winding on this. (Philips 300 chassis.)

DECCA CS2230

The problem started as a bright line at the bottom of the screen. The PL508 field output valve and its $500\mu\text{F}$ cathode decoupler were replaced without improving matters, though the bright line can now be shifted out of the raster by adjusting the controls. As the set warms up, the picture gradually creeps up from the bottom and the bright line broadens, becoming a series of lines at the bottom of the picture. After a couple of hours the picture settles at about $\frac{1}{2}$ in from the bottom, with these lines.

First check the PL508's cathode bias resistor R413: this should be 560Ω . Then if necessary check its control grid coupling capacitor C403 ($0.22\mu\text{F}$) and the linearity feedback capacitor C411 ($0.047\mu\text{F}$). Leakage in either of these capacitors would result in the bottom folding up. (Decca series 30 chassis.)

AERIAL TROUBLE

The picture is good, with no ghosting – until it rains! Then there is ghosting and some rolling. The aerial is a ten-element type mounted well up on the chimney. The aerial downlead was suspected so this was replaced. The problem is still present however: every time it rains, bad ghosting and poor signal strength.

Poor reception when the aerial is wet can be caused by leakage across the plastic insulators on the aerial. This normally happens only with ageing aerials of certain makes however.

DECCA CS1910

The problem with this set is insufficient brightness. With the main and preset brightness controls and also the contrast control at maximum the picture is only just o.k. I have replaced the fixed resistors in the preset brightness control network.

Turn the background (c.r.t. first anode) controls fully clockwise: if the voltage at the first anode pins (4, 5 and 13) of the c.r.t. is less than 550V, check R475 ($220\text{k}\Omega$) which provides the feed to these controls from the boost rail. If all is o.k. here check the clipper diode D215 (BA145) in the RGB clamp circuit, also its cathode decoupler C265 ($1\mu\text{F}$). If necessary, check the beam limiter circuit. The fault can also be due to R453 ($330\text{k}\Omega$) in the line output stage – the resistor linking the width circuit to the PL509 grid circuit. Use a $\frac{1}{2}$ W high stability type here. (Decca series 10 chassis.)

PYE CT200

The picture is slightly out of focus – light captions and bright sections of the picture in particular. The picture brilliance is normal but the focus adjustment makes no difference – even when the tap is left disconnected. The c.r.t. voltages are correct, measured with a $100\text{k}\Omega/\text{V}$ meter. I notice that the c.r.t. fitted is an imported one, type A47-342X.

The focusing is not too good with these tubes unfortunately, and yours could be particularly bad. It should be possible to resolve the first three definition bars of the test card. If you can check it, make sure that the e.h.t. is about 19kV. (Pye 713 chassis.)

FERGUSON 3813

When the set is first switched on the picture rolls downwards. It then settles for a couple of hours or so, after which the rolling starts again and continues for an hour or more. All valves have been changed without success. The field hold control is at one end of its travel.

Poor sync on this chassis is generally due to R44 ($47\text{k}\Omega$) which feeds the screen grid of the sync separator valve V1A. Since the field hold control is at one end of its travel however it is likely that the trouble is in this area, i.e. the grid circuit of the triode section of the PCL805 field timebase valve. After checking that the valve itself is up to standard, direct attention to the coupling network between the pentode anode and the triode grid: the most likely suspects are the coupling capacitor C75 ($0.0047\mu\text{F}$), which should preferably be checked by substitution, and the two $18\text{k}\Omega$ resistors R101/R102 from which it is fed and which tend to change value. If the fault is still present, check the other components involved, i.e. C70 and C69 by substitution, and R90/R91 for value. (Thorn 1500 chassis.)

GRUNDIG 6011GB

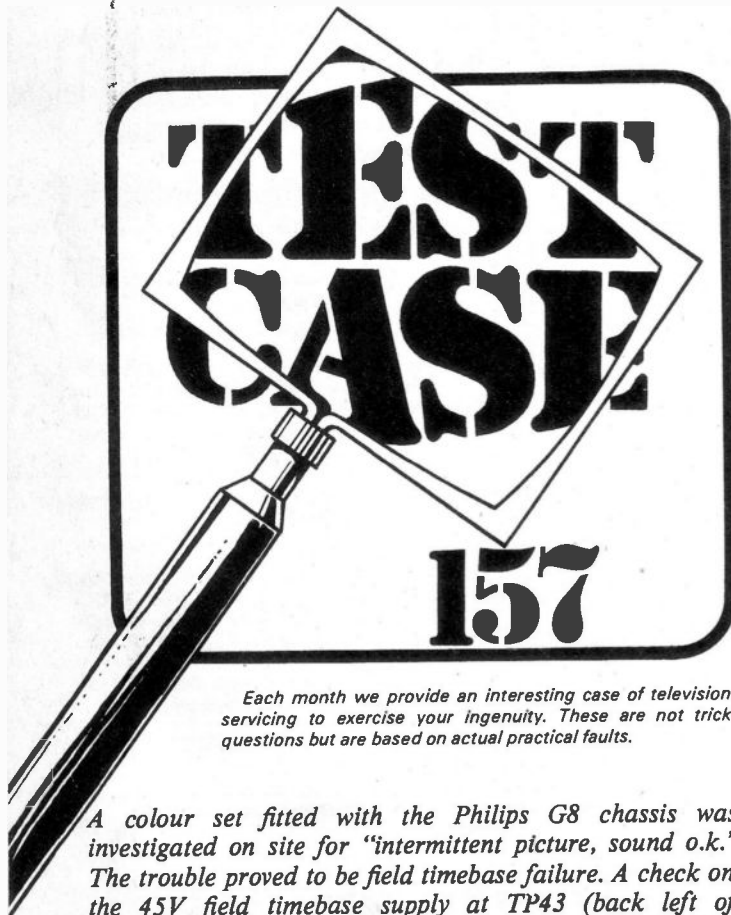
When the set has been on for any length of time (two hours or more) it drifts off frequency. This isn't disastrous, but the set needs constant retuning and must be reset when switched on again the following day.

It is possible that the TAA550 tuning voltage stabiliser i.c., mounted beside the tuner, is responsible. What is more likely however is that leakage has developed in the ceramic feed-through capacitor via which the tuning voltage enters the tuner. This is C37. It can, with difficulty, be replaced using an RS 1,000pF feed-through capacitor.

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TELEVISION JAN. 1976



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

A colour set fitted with the Philips G8 chassis was investigated on site for "intermittent picture, sound o.k." The trouble proved to be field timebase failure. A check on the 45V field timebase supply at TP43 (back left of timebase panel) revealed that this had vanished - it's obtained from a rectifier circuit fed from a winding on the line output transformer. The supply is protected by fuse 5560 (rear right of line scanning unit), and this was found to be open-circuit.

An ohmmeter test from the 45V rail (i.e. TP43) to chassis indicated an abnormally low resistance - hence the fuse failure. The field output stage in this chassis consists of a pair of BD124s which produce the scanning current. There is an AC128 driver transistor which is preceded by a BC148 to discharge the ramp capacitors and a BRY39 field oscillator, with direct coupling all the way through the circuit.

With the field timebase supply isolated, ohmmeter measurements relative to chassis indicated a low resistance at the collector of each BD124, and it was a short step to

the discovery that both output transistors were short-circuit between their collectors and emitters - not a particularly uncommon occurrence with power transistors. The resistance being measured was that of the low-value resistors in series with these transistors to chassis.

To save taking the set back to the workshop, a replacement pair of BD124s was shipped to the site. After careful fitting, TP43 was found clear of a short and a new 1.25A fuse was installed. With fingers crossed, the set was energised. Sound arrived normally, but still no picture after the requisite time interval - just the original symptom!

The previous measurements were repeated, and once again there was no 45V supply, a blown fuse and a low resistance at TP43 relative to chassis. This time however it was discovered that the replacement BD124s had run up to quite a high temperature and had undoubtedly destroyed themselves in the process.

Convinced that it was not his day, the field technician packed his kit and the set into his van to present the problem to the chief engineer back at base.

What was the most likely cause of this trouble, and what precautions should the technician have taken before risking the lives of the replacement BD124s. See next month's Television for the answers and for a further item in the Test Case series.

SOLUTION TO TEST CASE 156 (Page 108 last month)

Since the line timebase whistle was of normal intensity, the line output transformer was running cool, the pulse potential at the anode of the DY802 and the cathode of the PY800 was of healthy magnitude and the DY802 had been checked by substitution, the e.h.t. supply was clearly in order from the a.c. point of view. The ballooning nevertheless proved that the trouble was in the e.h.t. system.

The clue was the lack of illumination in the DY802. To correct its heater current, an 0.5Ω resistor is included in series with its heater and the heater winding on the line output transformer. The type of resistor employed in some line output transformer assemblies (particularly current replacements) does not take particularly kindly to solder on its leadout wires.

The trouble was traced to a dry-joint due to inadequate soldering of this resistor. Take care when resoldering, because corona can occur from solder points left on the joint.

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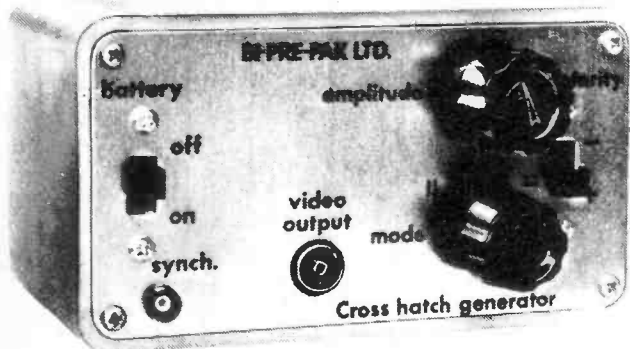
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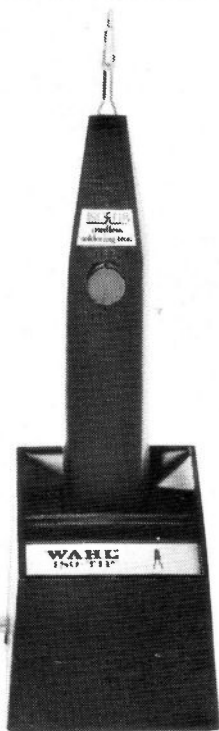
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