

TELEVISION

SERVICING • VIDEO • CONSTRUCTION • COLOUR • DEVELOPMENTS

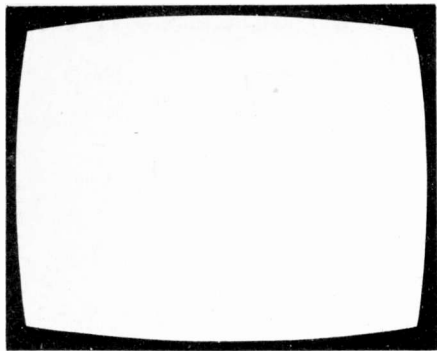
EXTRA FULL COLOUR
SUPPLEMENT
RECOGNISING FAULTS
OFF-SCREEN

**IN-SITU
TRANSISTOR
TESTER**

Also:

- SURFACE WAVE FILTERS
- REPLACING LINE OUTPUT TRANSISTORS
- SERVICING THE PHILIPS K 70 CHASSIS





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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".

TELEVISION

OCTOBER
1976

VOL. 26 NO. 12
ISSUE 312

- 621 **ITV Comes of Age**
- 622 **Teletopics**
- 624 **Dealing with the Older Set** *by Vivian Capel*
The problem of deciding whether an old set is worth servicing is discussed and hints given on appropriate servicing steps.
- 628 **In-Situ Transistor Tester** *by Alan Willcox*
Full constructional details of this handy servicing aid which enables transistors to be tested without the need to remove them from the circuit.
- 631 **Letters**
- 632 **Thorn 9000 Chassis Faults** *by Barry F. Pamplin*
A follow-up to our recent feature on faults in the Syclops circuit, dealing with the field timebase and colour faults.
- 634 **Equipment Reviews** *by Roger Bunney*
- 636 **The Granada Colourette** *by Owen Buttershaw*
This most unusual 11 in. colour portable was originally a rental set but is now appearing on the second hand market.
- 639 **Long-Distance Television** *by Roger Bunney*
- 642 **If You Have a Width Problem . . .** *by Peter Gaymead Frazer*
One of the most common complaints in valved receivers is lack of width. A complete run down on causes, with hints on well known commercial chassis.
- 645 **Surface Acoustic Wave Filters** *by Luke Theodossiou*
The use of a single SAWF does away with the need for the complex tuned circuitry at present used to form the receiver's bandpass response.
- 650 **Replacing Line Output Transistors Safely** *by E. Trundle*
Faced with a short-circuit line output transistor, how can you tell whether a replacement will instantly suffer the same fate? A summary of transistor line output stage faults and the precautions that can be taken.
- 652 **Circular Polarisation** *by R. Cherville*
A new transmission technique has been evolved in the US and may well be adopted there shortly.
- 654 **Dynamic Focusing** *by Peter Murchison*
Focusing at the edges of a 110° colour tube can be greatly improved by adding a parabolic component to the focus potential.
- 655 **Servicing Television Receivers** *by L. Lawry-Johns*
The Philips K70 chassis.
- 659 **Next Month in Television**
- 660 **IBC-76** *Philip Ross reports*
The sixth International Broadcasting Convention takes place at the end of September. A review of the present state of developments in the broadcast field.
- 662 **Video Circuits for Monochrome Portables** *by S. George*
A survey of the varied circuitry to be found in the video channels of current portables.
- 665 **Your Problems Solved**
- 667 **Test Case 166**

SPECIAL SUPPLEMENT: RECOGNISING FAULTS OFF-SCREEN

The centre pages contain an illustrated guide, in colour, to recognising faults from the symptoms displayed. Compiled by R. Fisher.

OUR NEXT ISSUE DATED NOVEMBER WILL BE
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TV

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BAIRD 600 602 604 606 608 610 612 622 624 625 626 628 630 632 640 642 644 646 648 652 653 661 662 663 664 665 666 667 668 669 671 672 673 674 675 676 677 681 682 683 685 687 688	GEC BT454 BT455 BT455DST 2000DST ... all models to 2044 2047 ... all models to 2084 2104 or /1 2105 or /1	KB-ITT By Chassis: VC1 VC52 VC2 VC52/1 VC3 VC100 VC4 VC100/2 VC11 VC200 VC51 VC300 Or quote model No. INDESIT 20EGB 24EGB	PYE 11u 40F 58 64 81 93 99 161 31F 43F 59 68 83 94 150 170 32F 48 60 75 84 95/4 151 170/1 36 49 61 76 85 96 155 171 37 50 62 77 86 97 156 171/1 39F 53 63 80 92 98 160 SOBELL ST196 or DS ST197 ST290 ST297 1000DS ... all models to 1102 THORN GROUP Ferguson, H.M.V. Marconi, Ultra By Chassis:- 800, 850, 900, 950/1, 950/2, 950/3, 960, 970, 980, 981, 1400, 1500, 1500 (24"), 1580, 1590, 1591. Or quote model No.

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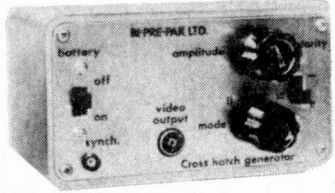
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TV8

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Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC107	0.35	AF186	0.40	BC170	0.15	BD131	0.45	BF195	0.15	BFY18	0.53	ME6002	0.17	TIP30A	0.58
AC117	0.24	AF239	0.40	BC171	0.15	BD132	0.50	BF196	0.15	BFY40	0.40	ME8001	0.18	TIP31A	0.65
AC126	0.25	AF279	0.84	BC172	0.14	BD135	0.40	BF197	0.17	BFY41	0.43	MJE340	0.68	TIP32A	0.67
AC127	0.25	AL100	1.10	BC173	0.20	BD136	0.46	BF198	0.20	BFY50	0.25	MJE341	0.72	TIP33A	0.99
AC128	0.25	AL102	1.10	BC174B	0.26	BD137	0.48	BF199	0.25	BFY51	0.23	MJE370	0.65	TIP34A	1.73
AC141	0.26	AL103	1.10	BC176	0.22	BD138	0.50	BF200	0.35	BFY52	0.23	MJE520	0.85	TIP41A	0.80
AC141K	0.27	AL113	0.95	BC177	0.20	BD139	0.55	BF218	0.35	BFY57	0.32	MJE521	0.95	TIP42A	0.91
AC142	0.20	AU103	2.10	BC178	0.22	BD140	0.62	BF222	1.08	BFY64	0.42	MJE2955	1.20	TIS43	0.30
AC142K	0.19	AU110	1.90	BC179	0.20	BD145	0.75	BF240	0.20	BFY90	0.70	MJE3000	1.85	TIS73	1.36
AC151	0.24	AU113	2.40	BC179B	0.21	BD163	0.67	BF241	0.22	BLY15A	0.79	MPS1055	0.74	TIS90	0.23
AC152	0.25	BC107	0.12	BC182L	0.11	BD183	0.56	BF244	0.18	BRX25	1.90	MPS6566	0.21	TIS91	0.23
AC153K	0.28	BC107A	0.13	BC183	0.11	BD122	0.78	BF254	0.45	BRX29	1.70	MPSA05	0.47	ZTX109	0.12
AC154	0.20	BC107B	0.14	BC183K	0.12	BD234	0.75	BF255	0.45	BRX52	1.90	MPSA55	0.50	ZTX300	0.16
AC176	0.25	BC108	0.12	BC183L	0.11	BD410	1.65	BF256	0.45	BRX443	0.68	MPSU05	0.66	ZTX304	0.22
AC178	0.27	BC108B	0.13	BC184L	0.13	BD519	0.76	BF257	0.49	BRX39	0.47	MPSU06	0.76	ZTX310	0.10
AC187	0.25	BC109	0.13	BC186	0.25	BD520	0.76	BF258	0.66	BRX56	0.40	MPSU56	1.26	ZTX313	0.12
AC187K	0.26	BC109C	0.14	BC187	0.27	BD599	0.75	BF259	0.93	BR101	0.47	MPSU55	1.26	ZTX500	0.17
AC188	0.25	BC113	0.13	BC208	0.12	BDX18	1.45	BF262	0.70	BSX19	0.13	OC26	0.38	ZTX502	0.17
AC188K	0.26	BC114	0.20	BC212L	0.12	BDX32	2.55	BF263	0.70	BSX20	0.19	OC28	0.85	ZTX504	0.42
AC193K	0.30	BC115	0.20	BC213L	0.12	BDY18	1.78	BF273	0.16	BSX76	0.15	OC35	0.59	ZTX602	0.24
AC194K	0.32	BC116	0.20	BC214L	0.15	BDY20	0.99	BF336	0.35	BSX82	0.52	OC36	0.64	2N525	0.86
ACY28	0.25	BC117	0.20	BC238	0.12	BF115	0.20	BF337	0.35	BSY19	0.52	OC42	0.55	2N696	0.23
ACY39	0.68	BC119	0.29	BC261A	0.28	BF117	0.45	BF458	0.60	BSY41	0.22	OC44	0.25	2N697	0.15
AD140	0.50	BC125	0.22	BC262A	0.18	BF120	0.55	BF459	0.63	BSY54	0.50	OC45	0.32	2N706	0.15
AD142	0.42	BC126	0.20	BC263B	0.25	BF121	0.25	BF596	0.70	BSY56	0.80	OC70	0.32	2N708	0.35
AD143	0.51	BC132	0.15	BC267	0.16	BF123	0.28	BF597	0.15	BSY65	0.15	OC71	0.32	2N744	0.30
AD149	0.50	BC134	0.20	BC268C	0.14	BF125	0.25	BF639	0.24	BSY78	0.40	OC72	0.32	2N914	0.19
AD161	0.48	BC135	0.19	BC294	0.37	BF127	0.30	BF641	0.30	BSY91	0.28	OC73	0.51	2N916	0.20
AD162	0.48	BC136	0.20	BC300	0.60	BF158	0.25	BF661	0.30	BSY95A	0.27	OC75	0.25	2N918	0.42
AF114	0.25	BC137	0.20	BC301	0.35	BF159	0.27	BF679	0.24	BT106	1.24	OC76	0.35	2N930	0.35
AF115	0.25	BC138	0.20	BC303	0.60	BF160	0.22	BF743	0.55	BT116	1.20	OC81	0.53	2N1164	3.60
AF116	0.26	BC142	0.30	BC307B	0.12	BF161	0.45	BFW10	0.55	BU105/02	1.95	OC81D	0.56	2N1304	0.21
AF117	0.20	BC143	0.35	BC308A	0.10	BF162	0.45	BFW11	0.55	BU108	3.25	OC139	0.77	2N1305	0.21
AF118	0.50	BC147	0.13	BC309	0.15	BF163	0.45	BFW16A	1.70	BU126	2.99	OC140	0.80	2N1306	0.31
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AF125	0.25	BC152	0.25	BC441	1.10	BF177	0.30	BFW60	0.20	BU207	3.00	OC200	1.30	2N1309	0.36
AF126	0.25	BC153	0.20	BC461	1.58	BF178	0.33	BFW90	0.28	BU208	3.15	OC211	0.95	2N1308	0.26
AF127	0.25	BC154	0.20	BCY33	0.36	BF179	0.33	BFX16	2.25	BU209	2.55	OC271	0.62	2N1309	0.36
AF139	0.35	BC157	0.15	BCY42	0.16	BF180	0.35	BFX29	0.30	BU209	2.55	ORP12	0.95	2N1613	0.34
AF147	0.35	BC158	0.13	BCY71	0.22	BF181	0.33	BFX30	0.35	BU78	2.65	ORP21	0.55	2N1711	0.45
AF149	0.45	BC159	0.15	BCY88	2.42	BF182	0.44	BFX84	0.25	BU79	2.85	R2010B	2.95	2N1890	0.45
AF178	0.55	BC161	0.48	BD115	0.65	BF183	0.44	BFX85	0.26	DU0NI	0.45	TIC44	0.29	2N1893	0.48
AF179	0.60	BC167B	0.15	BD123	0.98	BF184	0.26	BFX86	0.26	E1222	0.55	TIC46	0.44	2N1902	0.51
AF180	0.55	BC168B	0.13	BD124	0.80	BF185	0.26	BFX87	0.28	E5024	0.20	TIC47	0.58	2N2117	0.36
AF181	0.50	BC169C	0.13	BD130Y	1.42	BF194	0.15	BFX88	0.24	ME6001	0.16	TIP29A	0.49	2N2212	0.60
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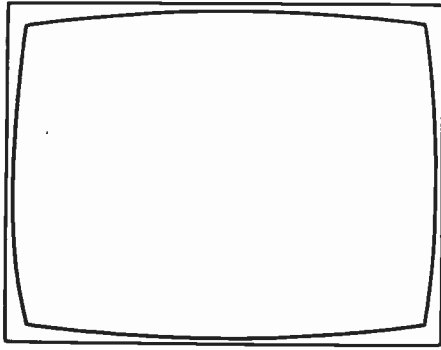
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ITV's TWENTY-FIRST

Twenty-one years ago, on September 22 1955, Independent Television programmes began in the London area. For the trade this meant more business, the coming of Band III, switched tuners and a patterning-prone horror called a universal converter. For viewers it ushered in alternative programmes and a new attitude on the part of the broadcasters: for the first time in the UK two different organisations were competing for his or her attention. No longer did the viewer have to take whatever a monopoly service deigned to offer, no matter how well intentioned. Nightly, the viewer has ever since been able to vote with his push-buttons.

Many people feared the coming of a commercially-based service, despite the safeguards written into the Television Act. The late Lord Reith, architect of the BBC, likened commercial television to "smallpox, the bubonic plague and the Black Death" – before it began. Critics gave the early ITV programmes a rough ride and initially the companies lost money. But soon the public voted overwhelmingly for ITV. And, as one critic pointed out, "The coming of ITV – the mere threat of it – woke up the BBC from a timeless trance of lethargy and complacency. If we were to go back now to the programmes in 1953 there would be instant uproar."

Sir Robert Fraser and latterly Sir Brian Young have created and nourished a regional system with local involvement and closely linked to its public, providing scope and assistance for small regional operations such as Border and the Channel Islands alongside the giants of the network.

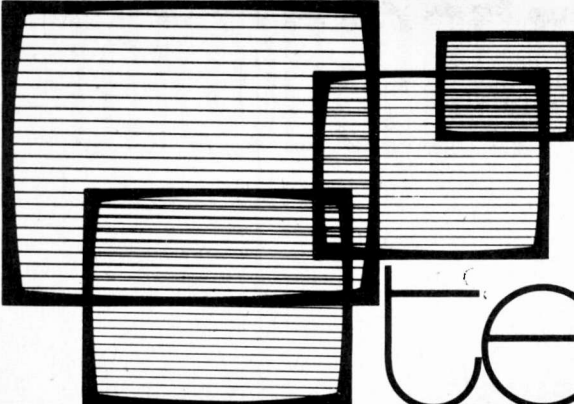
But if television is ultimately programmes, it is also engineering. The record of ITV's technical achievements and innovations is impressive: from the original Band III network that provided good coverage from few sites to the pioneering of the unattended network of transmitters for Bands IV and V or the latest digital systems from IBA's engineering centre in Hampshire; from the first British studio centres designed to use the videotape recorder as a production tool to the advanced computer-generated graphics of ITN or the Oracle teletext experiments.

Buoyant revenues have not been permitted, except perhaps temporarily, to give anyone a licence to print money; advertising seems to have proved a viable and reasonably painless way of providing the public with a service of "information, education and entertainment" without extracting a further poll tax. Not only does ITV absorb no part of the licence revenue but over the years it has paid to public funds about £500 million.

British television operates under the close and often hostile scrutiny of the public, press, Parliament, Royal Commissions and the present Annan Committee. When programmes offend against good taste or are shoddy the public says so loudly – and is listened to. ITV's controlling authority, the IBA, is equally often accused of being too harsh and too lax – suggesting that for once the degree of interference is about right.

Broadcasters are not modest lilies, and ITV rather grandly claims to be an outstanding example of private initiative coupled with public control. Even if that is pitching things a bit too high, it does appear as if for once the traditional British habit of compromise has proved reasonably successful. Without by any means endorsing all that ITV offers and does or does not do, it is not over generous to say that it forms one of the vital ingredients of what has been called "the least worst television service in the world."

Anniversaries threaten to become the bane of television – but just for once let us say "Happy Birthday ITV".



teletopics

SETMAKER PRESSURE GROUP ON IMPORTS

Following recent expressions of concern over the level of Japanese and other Far Eastern TV imports to the UK, Thorn, GEC and Philips have set up a combined pressure group to lobby the government for import controls. The first action has been to prepare a report on the state of the industry for Alan Williams, Minister of State, Department of Industry, with whom a meeting has taken place, at which both management and union representatives stressed the dangers facing the industry. It is also proposed to put pressure on MPs in constituencies where there are TV plants. In commenting on their trading results last year the UK's largest setmaker, Thorn, say that "conditions worsened with a serious increase in imports of monochrome TV sets and audio goods from the Far East at prices which seem to bear no relationship to manufacturing costs and changes in exchange rates". Meanwhile Mullard, the UK's sole remaining colour tube maker, has warned that its parent company Philips may have to review c.r.t. manufacture in the UK if conditions do not improve. The problem is low production volume which Mullard's managing director Jack Akerman says "cannot continue". "The government must make its mind up whether it wants employment in South Wales or South East Asia" he added.

HIGH STREET CHANGES

A considerable reshuffle of radio and TV chain store outlets is in progress. The main change has come with the decision by Philips to withdraw from its retailing/rental activities by selling off or closing down its Loyds outlets, which ran up substantial trading losses last year. Of the Loyds shops, 70 are to be closed by the end of the year, 33 will be closed later while 155 shops and service centres are being sold off, 66 to Henry Wigfall, 77 to Curry's and the remainder to Comet Radiovision Services and two subsidiaries of the Electronic Rental Group, Visionhire and RelayVision.

Comet Radiovision Services is also acquiring twelve Eclipse Cash and Carry shops and has taken over the McOnomy discount operation.

WORLD COLOUR TV MARKET

Some interesting forecasts have been made by the Sony Corporation in reporting their trading results for the six months to April 1976. The total world market for colour sets in the coming year is estimated at 22 million sets, the

US market being some eight million sets, the Japanese market six million sets and the market in Europe and elsewhere seven million. Japanese production is running at around 9.7 million sets a year, of which around four million are exported. Sony is producing sets in its various plants, many of which are overseas, at the rate of 1.9 million a year – roughly eight per cent of world production.

MANUFACTURERS START DROPPING RRP

Recommended retail prices look as if they may be on the way out. A number of television manufacturers have already announced their intention of dropping RRP and it's expected that others will follow suit this autumn.

It was at the beginning of August that Roberts Video informed its suppliers that it was discontinuing the policy, and one of the first larger makers to follow suit was ITT. Decca is dropping recommended retail pricing and it's likely that Pye will do the same in early October.

Last April the council of the Radio, Electrical and Television Retailers Association passed a resolution that it "no longer approves the practice of manufacturers publishing recommended retail prices". After that RETRA sent letters to all brown goods makers and discussions between the Association and various companies have taken place since. It's following these talks that the firms mentioned above have forsaken RRP. When Roberts first announced its decision a company spokesman said he understood that the discontinuance of recommended retail prices "will shortly be common practice in the TV and radio industry".

SOUTH LONDON COURSES

South London College will be holding a course of evening lectures on Teletext and Viewdata. Subjects to be covered include data generation and insertion, editorial considerations and reception techniques. The lectures will be held in the Lecture Hall on consecutive Tuesday evenings from 6.30pm to 8.30pm, commencing October 12. The lectures will be accompanied by slide shows and demonstrations. The course is intended for radio, TV and telecommunications technicians and engineers, and the course fee is £4.80.

The same college is also holding a course on i.c.s. This is a series of nine lectures on integrated circuit techniques and their applications in audio, television, power supply and digital systems. It is to be held in the Lecture Hall of the college on consecutive Thursday evenings from 6.30pm to

8.30pm, commencing October 14. The course is intended to update those with a knowledge of electronics with the ways in which i.c.s are replacing conventional circuits. The course fee is £3.

Further information and application forms may be obtained from the Senior Administrative Officer, South London College, Knights Hill, London SE27 0TX. Telephone 01-670 4488.

SEMICONDUCTOR STORAGE IDEA

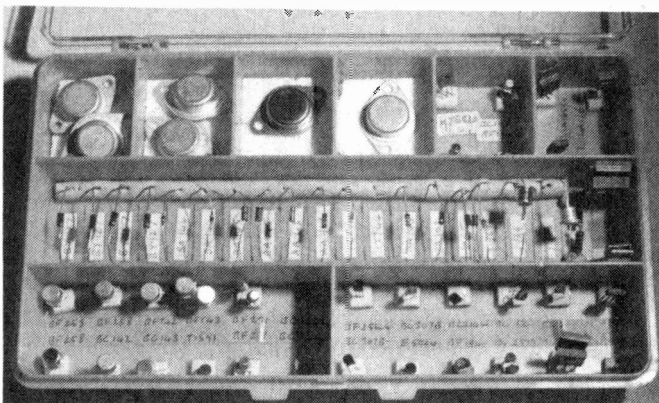
We are indebted to our reader Mr. Harold Berkley of Manchester, who passed this idea on for keeping semiconductors tidily and safely for field service. A plastic box with a hinged lid is used – the one shown in the photograph is made by Raaco but many others are equally suitable. The components are held in place with “Blu-Tack” made by Bostik. This is a plasticine-like substance, used for attaching charts etc on walls. It proved to be ideal for this purpose as it provided a firm grip on both the components and the box. The kit has been jogging around in an estate car for several months, winter and summer, and has proved very effective. It is easily adaptable for other components and although it may appear very simple, it can save time and money – every serviceman must admit that he has lost small but expensive components at some time!

RETRA TO INFLUENCE TRAINING

The Radio, Electrical and Television Retailers Association (RETRA) intends to liaise with Technical colleges in order to try and influence the content of courses being offered to tie up with the needs of the Association's members. The organisation will also advise its members on where to find the most appropriate course to suit their requirements. As a first step, RETRA will send a questionnaire to its members requesting information on such topics as training requirements, trainee intake, etc. The results of this exercise will be used as the basis for discussion between RETRA and local colleges. The organisation pointed out the fact that courses are normally geared to the needs of local industry with little built-in flexibility. What RETRA is proposing is a modular system by which students may choose the course content to suit the needs of their future employers.

NEW LOW LIGHT LEVEL CAMERA TUBE

Mullard has announced a new type of camera tube which, due to its high sensitivity, is said to be particularly suitable



Harold Berkley's method of keeping a supply of semi-conductors tidily and safely for field servicing.



The "Television" Teletext decoder – more news soon – was on show at Radcomex 76. The IBA transmitted this Oracle page as part of the demonstration.

for surveillance and security applications. Called "Newvicon", the tube features a heterojunction photoconductive target composed of cadmium and zinc tellurides which is claimed to result in twice the sensitivity of silicon vidicons (which are in a similar price category) and twenty times more sensitive than a standard vidicon. A further advantage is the lack of "blooming" when subjected to a highlight. This is quite important since many security systems can encounter occasional highlights which would impair clarity if the camera tube was prone to blooming. Three Newvicon tubes are offered: types XQ1274 and XQ1275 are 3/4 in. diameter tubes, 108mm in length. Magnetic deflection is used for both, but they differ in that they are respectively magnetically and electrostatically focused. The third tube, type XQ1440, is a 1 in. diameter unit, 159mm long, which is magnetically deflected and focused.

TRANSMITTER OPENINGS

Blackmill (Mid-Glamorgan): BBC-Wales channel 22, ITV channel 25 (HTV Wales), BBC-2 channel 28. Receiving aerial group A; vertical polarisation.

Eitshal (Lewis, Outer Hebrides) ITV channel 23 (Grampian Television), BBC-2 channel 26, BBC-1 (Scotland) channel 33. Receiving aerial group A; horizontal polarisation. Transmitter e.r.p. 100kW.

Helston (Cornwall) BBC-1 (South West) channel 58, ITV channel 61 (Westward Television), BBC-2 channel 64. Receiving aerial group C/D; vertical polarisation.

Llandecwyn (Gwynedd) ITV channel 61 (HTV Wales). Receiving aerial group C/D; vertical polarisation.

Pennorth (Brecknock) ITV channel 23 (HTV Wales), BBC-2 channel 26, BBC Wales Channel 33. Receiving aerial group A; vertical polarisation.

Rosneath (Dunbarton) BBC-1 (Scotland) channel 58, ITV (Scottish Television) channel 61, BBC-2 channel 64. Receiving aerial group C/D; vertical polarisation.

St. Just (Cornwall) BBC-1 (South West) channel 58, ITV channel 61 (Westward Television), BBC-2 channel 64. Receiving aerial group C/D; vertical polarisation.

Swindon BBC-1 (West) channel 44, BBC-2 channel 51. Receiving aerial group B; vertical polarisation.

Dealing with the older set

Vivian Capel

IN THE motor trade they call them "old bangers", cars that have seen the best of their days and are no longer economic to try to restore to their original performance. All that can be done is to get them running after a fashion and to satisfy the MOT test requirements. Most owners do not expect too much, they know the age and the mileage on the clock and realise that the cost of doing more than the bare essentials is just not worth it unless of course they are DIY enthusiasts.

There is a similar situation with TV repairs. If the television viewing averages are anything to go by 1,000 hours a year would be quite a conservative estimate for the running time of most receivers. Imagine the number of times the line circuits have scanned the tube or the number of electrons emitted by the tube cathode in that time! The remarkable thing is that breakdowns are so few. Inevitably however there is deterioration of performance caused by capacitor leaks, tube and valves losing emission, resistors altering value and many other reasons.

Now much of this has little noticeable effect on the performance, at least to the untrained eye of the owner — who often says his picture is perfect when numerous defects are present. It's only when something that seriously affects the sound or picture occurs that the set is brought along for professional attention. The engineer may then be faced with a number of unrelated faults and has to decide just how far to go in trying to restore reasonable performance. In the case of a fairly new set all faults should be attended to in order to bring the set up to par. Unless there has been an unfortunate multiple "chain reaction" fault this should involve few replacements since the effect of ageing will be only slight. With an older set however the situation can be very different, and almost every section of the set may have faults of one sort or another.

Sometimes it is not worth putting right even the one fault complained about since the general state of the set will lead to further troubles in the near future. Also it often happens that disturbing the set by moving the panels, replacing a component or even transporting it to and from the workshop can result in dormant faults showing themselves. The owner then swears that he never had any trouble before the set was repaired but that since then it has done nothing but go wrong, all of which is the fault of the engineer! This demonstrates the wisdom of "letting sleeping faults lie".

State of the Tube

A major factor in deciding upon the repairability of a set is the state of the tube. With replacement costs now well up, even for regunned tubes, plus the labour involved, sets over a certain age are not worth considering if the tube shows

signs of low emission. In many cases a few moments spent testing the set on the bench will reveal whether the tube seems to be good for a while longer. Sometimes however with a no-brilliance fault the state of the tube cannot be discovered before carrying out the repair. Often it's only after some time has been spent putting right the fault and replacing components that the tube is found to be in bad condition. Even so some folk are quite happy with the result and the flaring highlights seem to bother them not at all.

Whether or Not to Service

What then is the engineer to do? How should he tackle an "old banger" of the TV world? Some engineers dispose of the problem very simply by refusing to look at anything over a certain age, and one can hardly blame them. This can be hard on the many people who find themselves in the position of having an older set in reasonable condition, yet who find that no reputable repairer will carry out a straightforward repair because of the set's age. The bodgers will always have a go of course, but usually create more problems than they solve (often including that of the solvency of the owner)! Often too the repairer may be turning down a profitable job.

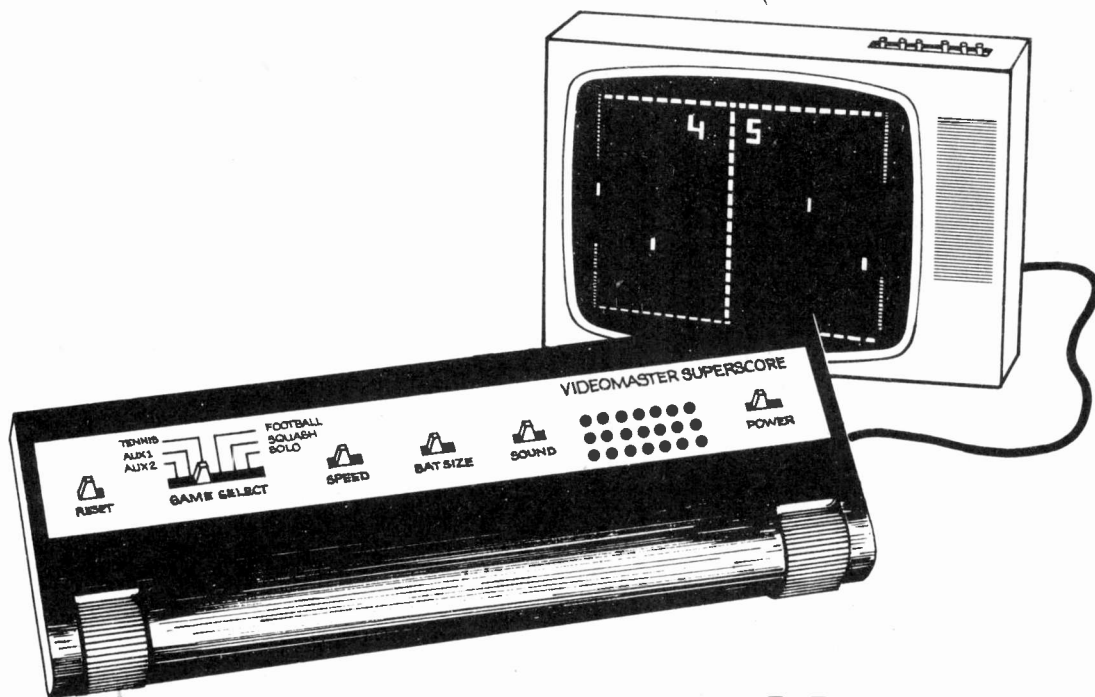
Clearly then some discrimination is required in accepting older sets for service. No one wants to find a pile of junk resting on his bench and be committed to coaxing some semblance of a watchable picture from it, often spending far more time than can be reasonably charged for. On the other hand it's not good business to turn sets away that may be put in reasonable working order with just a few components and adjustments.

Vetting

If it's decided to make condition rather than age the criterion for taking in a repair some sort of vetting will have to be conducted at the outset. As already mentioned the tube is an important factor and this should be the first point to consider. A glance through the ventilation holes in the back will reveal whether the tube is the original or whether it has been replaced — in the latter case it may be of a different make to the original, perhaps a regunned unit, or the glass may look cleaner than the age and the condition of the rest of the set would lead one to expect. If the tube appears to have been replaced recently it is a fair (though not infallible) assumption that the tube is serviceable. If the tube seems to be the original one then a lot depends on the make. Some makes such as Mullard have proved noteworthy for their longevity: certain other brands however show marked deterioration after a few years. If an original of one of these is found in a set it's highly likely to need replacement.

The tube situation should be explained to the customer and an inquiry made as to whether the brilliance and focus were reasonable before the fault occurred. If it's pointed out that he will be throwing money away by having repairs done to a set with a poor tube you should get a truthful answer. If it turns out that the tube is poor after the repair has been carried out you will at least have the customer's word that he was satisfied with its performance.

Another question that could be asked is when did the set last need attention and who repaired it? Some owners boast about how long the set has run without a service, but this should put the engineer on his guard since it is almost certain that all the output valves if nothing else will need replacement, and with the rising cost of valves plus the iniquitous VAT this will turn out to be an expensive job. Here



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again the make of the valves can be an important aspect of the cost – some valves with no direct equivalents can be very pricey indeed.

The identity of the previous repairer can also give a clue as to the possible condition of the set. If it's been through the hands of the local bodger (and these are usually well known by legitimate repairers) this fact could well disqualify the set without more ado. On the other hand a repair by a reputable (even though a rival) firm, especially if carried out not too long ago, should at least mean that some of the possible faults have been put right properly.

Another circumstance which should make the engineer wary is whether the set has been acquired by its present owner as a gift. Often sets are handed on by another member of the family – usually married sons or daughters pass on a set to their parents – but it's frequently found that what they have given, although perhaps unwittingly, is a load of trouble. The reason for the gift is generally because another set has been purchased. If another monochrome receiver has been bought however it is usually because the old one was ailing: few people replace a set that is giving perfect results. If the new set is a colour one there is a better chance that the gift set may be in good condition, but this is not necessarily so. Sometimes the change to colour, although long intended, is precipitated by a deteriorating picture on the previous black-and-white set. So here's another inquiry worth making.

Many dealers automatically refuse to touch anything they did not originally sell. The reasoning is that members of the public only patronise the dealer when they want service or assistance but go to the discount houses when they want to buy. In a lot of cases this is quite true, and the dealer's feelings are understandable where, as in many instances, the service department runs at a loss or at best breaks even, being subsidised as a necessary service to customers out of the profits made from sales. Why therefore should he subsidise his cut-price rivals?

Making it Pay

The answer is to make servicing pay by charging realistically. Work under guarantee must be done at a loss and most dealers charge only a nominal amount for work on sets just recently out of guarantee. All other work should be charged so that not only are all costs covered (including many overheads often left out of price calculations) but a reasonable profit made as well. This applies to recent models bought elsewhere, which gives the dealer an opportunity to recover some of the profit lost to the discounters. Such jobs should be welcomed rather than turned away.

This applies to the old bangers too. Some owners are under the impression that because the set isn't worth much the cost of any repairs will be proportionately low. Some dealers have encouraged this view by making uneconomic charges for repairs in the hope that the goodwill thus generated will eventually result in the sale of a new set. While this does happen, more often an engineer keeps an ancient relic running for years on a shoestring and then one day gets a service call to find in its place a brand new model obtained from the discount shop up the road. So if the owner wants to keep an old set going, fair enough, but he should be informed that the cost is likely to be high even if the set proves worth repairing at all.

Signal Strength

Another factor that could influence the decision as to whether a set should be accepted for service is the location

of the owner's premises. If this is in a poor signal-strength area there may well be a battle to get enough gain, and the tuner and i.f. valves may need replacing. If the signal strength is good however the valves, even if below par, may be adequate. A transistorised tuner is rather more hopeful: the gain of these does not normally fall off with age except when the r.f. amplifier transistor is defective.

Check List

To summarise, the following check list will give a good idea as to whether an old set is worth servicing. A high proportion of "yesses" is needed if it is to be worth while.

<i>Query</i>	<i>Yes/No</i>
Has the tube been replaced recently?	
If not, is it a make noted for long life?	
Has the set been serviced within the last year?	
If so, was it done by a reputable firm?	
Was the set working satisfactorily before the fault occurred?	
Is it operated in a good signal area?	
Has set been in owner's possession for some time?	

How Many Faults?

A final question to the owner should be whether there is any fault present other than the one initially reported. Not only will this give a clue as to the general condition of the set or the magnitude of the repairs needed, but if minor faults are found to be present these can be regarded as acceptable to the customer if he did not mention them and can be ignored.

Simple Remedies

When carrying out the service a quick investigation can be made of any other faults spotted to see whether there is a simple and inexpensive remedy. For example, where there is bottom cramping of the field scan the effect of a new output valve cathode bypass capacitor can be tried by bridging the old one, or the value of the cathode bias resistor can be measured to see whether it has changed value – both are common causes of this fault. Apart from such points and any known "stock" faults on the model it may be uneconomical to pursue further any faults not specifically mentioned by the owner.

If the width is a little short it may mean a costly line output valve or worse a transformer replacement. It could however be only a high value resistor in the line output valve grid stabilising circuit gone high. A quick check and a replacement if required would obviously in this case be worth the trouble.

Many video and sync faults can be traced to the PFL200 valve. Although not a cheap valve to replace a change would be worth while if it materially improved the picture.

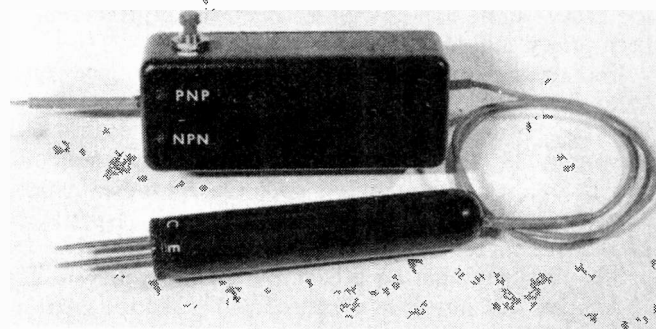
Short-cuts

Short-cuts which would not be entertained with a normal repair can often be taken to keep the cost down. Where poor or distorted sound is due to misalignment on u.h.f. reception for example, instead of a full instrument realignment a judicious tweaking of the discriminator core will often restore satisfactory results.

continued on page 635

In-Situ Transistor Tester

Alan Willcox



It may be argued that in-circuit transistor testers are unnecessary because a faulty device may be isolated by means of voltage measurements. Well, this may be true but there are many occasions where things are not so straightforward and readings can be hard to interpret. Such is the case with large-signal circuits, for example timebase and sync separator stages where the d.c. voltage read is mainly the average of a large a.c. component, and in this situation we cannot expect to find the familiar 0.6V base emitter difference to give us a clue as to whether all is well. Ohmmeter readings can be helpful but then the presence of circuit impedances confuses the issue.

Basic Requirements

For an in-circuit tester to be really useful it was felt that it should be able to test both npn and pnp transistors without any switching or operating of controls. This is achieved in the circuit here by using two LEDs as indicators: if the transistor is a good npn device one LED flashes, whilst if it is a good pnp transistor the other LED flashes. If the transistor is faulty either both LEDs flash alternately or both are extinguished, depending on the nature of the fault. The tester ignores the presence of in-circuit resistors as low as 40Ω or so across either the base-emitter or the collector-base junctions and also electrolytics and reverse breakdown diodes.

The Circuit

In order to test both npn and pnp transistors it is arranged for the supply to the suspect transistor to reverse its polarity at a rate of about three times a second. This polarity reversal is achieved by the timer i.c. (IC1) and transistors Tr1/Tr2 (Fig. 1) which together effectively form a double-pole, double-throw electronic switch. The i.c. is connected in the astable mode and is set by R2/C1 to run at around three times a second, so causing the output at pin 3 to switch continually between the battery supply rails. Now when pin 3 connects to the positive rail Tr1 is biased on, and when it connects to the negative rail Tr2 is turned on. The common collector connection of Tr1/Tr2 forms one supply line to the transistor test circuitry, whilst pin 3 forms the other. So while one supply line (a) connects successively to each battery terminal via pin 3, supply line (b) connects

to the other battery terminal via Tr1 or Tr2. The resulting a.c. squarewave is applied to the test circuit formed by the remainder of the circuit.

Good Transistors

If a good npn transistor is connected it will conduct each time supply line (b) is positive, so diverting current from LED2 and preventing it from illuminating. On the negative half cycles the transistor being tested will turn off, allowing LED1 to continue to flash, signifying that the transistor is an npn type and is o.k. With a pnp transistor being tested conduction occurs when (b) is negative, causing LED1 to extinguish, leaving LED2 to flash. The bias resistor R5 supplies a much greater current to the transistor under test (TrX) than would normally be necessary, so that even if a low-value resistor is present in the base circuit sufficient current is still available to saturate the transistor.

Transistor Fault Conditions

If the transistor being tested has any of its junctions open-circuit it will of course fail to turn on irrespective of the polarity of the supply. Both LEDs will therefore remain flashing, indicating a fault condition. If a collector-emitter short is present on the transistor being tested it will be conducting continuously, and the current to both LEDs will be diverted. This condition with both LEDs extinguished indicates uniquely a collector-emitter short.

If a collector-base or an emitter-base short exists the

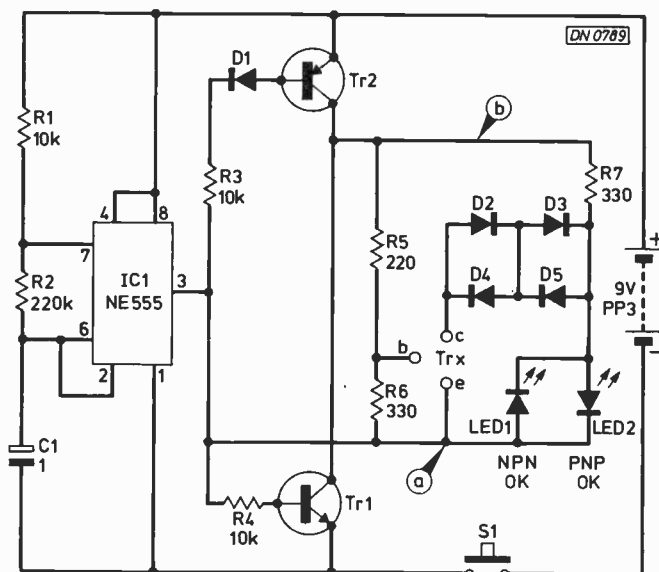
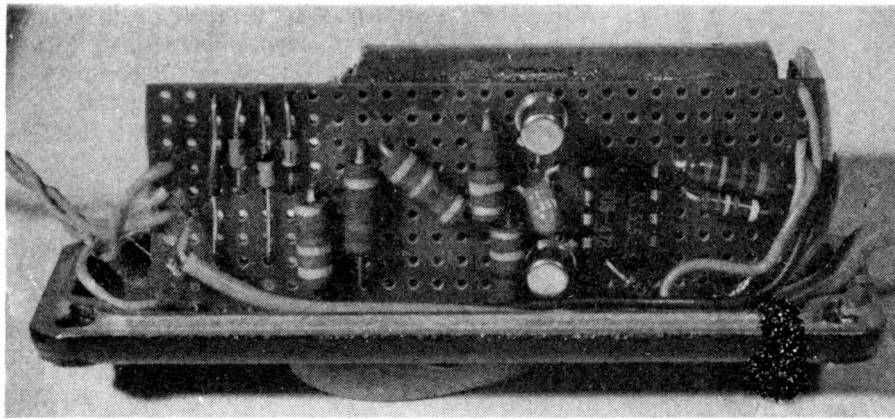
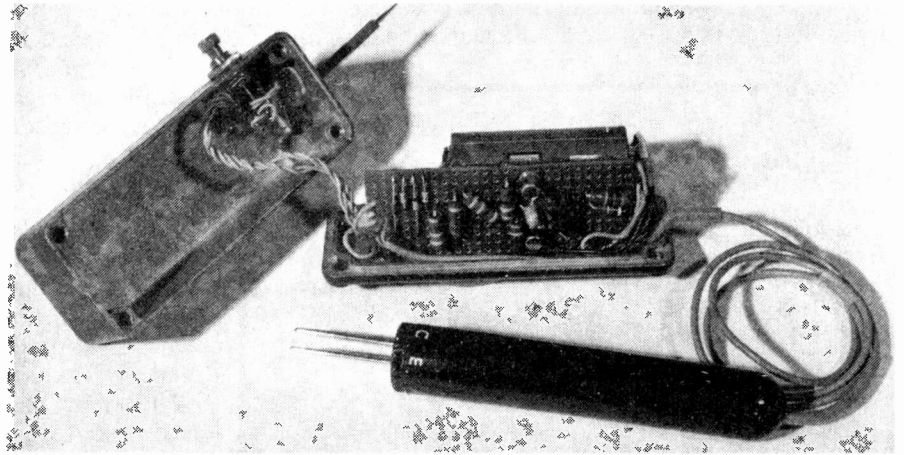


Fig. 1: Circuit diagram of the in-situ transistor tester.

General internal view of the unit, showing the preferred method of construction. All the components are mounted on Veroboard which is attached to the lid of the diecast box. The base probe and on-off switch are mounted on the box itself, the collector and emitter probes being mounted in the cigar tube shown in the foreground.



Close-up view of the component layout on the Veroboard. Refer to the layout diagram (Fig. 2) for the positions of the breaks required in the tracks.

situation is a bit more complicated, with the faulty transistor acting as a diode – which is able of course to conduct when the supply polarity is favourable. Steps must be taken to ensure that this “diode” does not in fact conduct and give an o.k. indication, and this is where the diodes D2-D5 come into the story. The relationship between the forward voltage drop of the LEDs and that of the diodes D2-D5 is such that only when the voltage across the collector-emitter connections is able to fall to around 0.1V or so will D2/D3 or D4/D5 conduct. A transistor with a collector-base or an emitter-base short acting as a diode, with its associated forward voltage drop (0.6V for silicon), does not meet this requirement and so does not enable conduction. With this type of short, therefore, both LEDs remain flashing as though the transistor was open-circuit. The collector voltage of a good transistor when turned fully on falls to around 0.1V and thus meets this requirement, allowing the diodes to conduct and divert the LED current as described.

Components

From what has been said it will be appreciated that this relationship between the forward voltage drop of the LEDs

and that of the diodes is the crucial factor enabling the tester to differentiate between a good transistor and one with a collector-base or an emitter-base short. The requirement is that two diodes across an LED must be able to extinguish it, while three diodes must not. Because of this the circuit as it stands will function correctly only if the recommended diodes and LEDs are used. If alternative LEDs are used it may be necessary to replace one diode of each pair with a germanium type to reduce the overall voltage drop, but results if a departure is made cannot be guaranteed since some types of LED seem to remain illuminated over a wider range of forward voltage than others.

Construction

A diecast box was used to house the prototype, with all the components mounted in the lid, except for the switch and the two LEDs which are installed from inside the case body. The base probe can be a long bolt filed to a point at its end, and if the junction R5/R6 is connected to the case lid then the case itself may provide the connection to the base probe. The collector-emitter probe was fabricated from two needles, soldered to a strip of veroboard, then wrapped

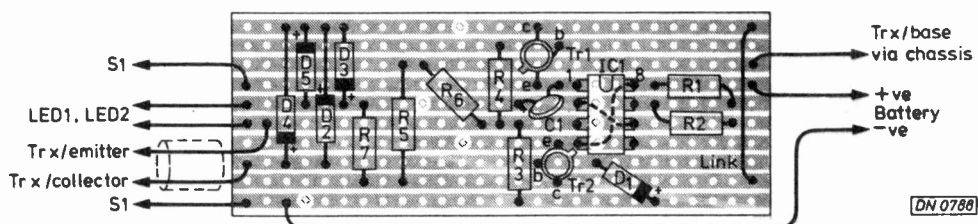


Fig. 2: Layout of the unit on 0.1 in. matrix Veroboard. Shown full scale.

with insulating tape until sufficient bulk was obtained for it to be a tight fit in a cigar tube. Although solid darning type

needles were used a more versatile probe may result if the more flexible sewing type needles are used instead. The circuit board is glued via some insulating material to a light aluminium bracket shaped to accept a PP3 battery and bolted to the lid.

★ Components List

Resistors:

R1, R3, R4 10kΩ
 R2 220kΩ
 R5 220Ω
 R6, R7 330Ω
 All ¼W 5% carbon film

Capacitor:

C1 1μF tantalum

Semiconductors:

Tr1 BC108 or similar
 Tr2 BCY70 or similar
 D1 - D5 1N4148
 IC1 NE555
 LED1, LED2 RS Components code 586-447 (other types may not be suitable, see text)

Miscellaneous

Case Diacast box 89 x 35 x 30mm (R. S. Components code 509-923)
 S1 Miniature push-to-make switch (Eagle)
 Battery PP3
 Veroboard 0.1in. matrix 2¼ x 1in.

Using the Tester

The tester does not in any way give an indication of current gain, only that transistor action is present, i.e. that the collector current is capable of being turned on by the base current. An ambiguous case is that of some power transistors, particularly line output types, where a collector-emitter leak sometimes develops but normal transistor action may be present and the tester would mistakenly show o.k.

Line output transistors cannot be tested in circuit in any case because of the low resistance of the driver transformer etc. Although the tester was designed with silicon transistors in mind, germanium types (increasingly rare in TV) can also be tested but with one proviso. Because a base short in a germanium transistor produces a diode with a low forward voltage drop it is important to note that the transistor does not show o.k. until the base connection is applied. So the procedure with germanium transistors is to apply the collector-emitter probe first, and make sure that both LEDs flash until the base connection is made. ■

Automatic Transistor Tester - Television, May 1975; page 312

Transistors with hFE less than 30

EXPERIENCE with the unit over a time has shown that the need has sometimes arisen to test transistors having a gain of less than the 30 minimum of the instrument. To allow for these occasions the prototype has been modified by the addition of two resistors (see Fig. 3) and a push-button to give a ÷5 position, extending the range of hFE that can be indicated down to values as low as 6.

The push-button is operated with S1 in the ×1 (closed) position, and works by increasing the bias current to the transistor under test by a factor of 5. The reason for the use of two resistors for this purpose is to allow half the extra bias current to flow through the meter movement on both positions of the npn/pnp switch, thus avoiding any unbalance between the two positions. It is true that the circuit is already unbalanced as it stands, but the error is small and is in fact equal to 6.8k divided by the value of the base resistor × 100%. This amounts to only ¼% on the ×5 range and 3½% on the ×1 range, but would be a significant 17% on the new ÷5 range if the two resistor arrangement was not employed.

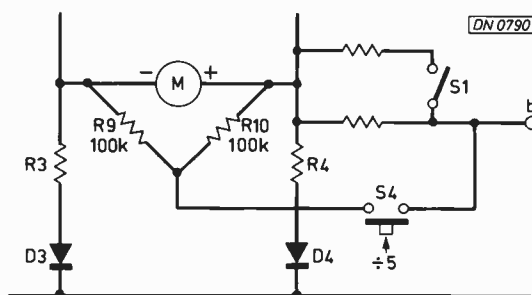


Fig. 3: Modification to the automatic transistor tester (May 1975 issue) to measure down to hFE of 6. Add R9, R10 and S4 to the original unit.

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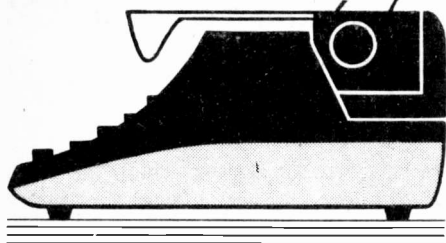
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Letters



THORN 1400 CHASSIS

With reference to the fault mentioned in a recent *Your Problems Solved* – lack of field scan with the bottom two-three inches inverted on an Ultra Model 6661 fitted with the Thorn 1400 chassis – over the last six months I have had in about eight such sets fitted with the unmodified version of this chassis and exhibiting this fault: in all but one the fault was due to a leaky or short-circuit heater supply rectifier W10 (IRCTV6). I have yet to come across this fault in later sets fitted with a BY126 in this position. – **J. Phillips** (*Ammanford, Dyfed*).

UNUSUAL COLOUR FAULT

An unusual fault recently experienced on a GEC 2028 dual-standard colour receiver may be of interest to other readers. I was setting the receiver up after servicing when I noticed that the blue lateral convergence was out at the extreme top and bottom of the picture, and would not adjust. As I was looking at the picture via a mirror on the bench I couldn't see the whole picture, but when I turned the set round I discovered that about 2in. of the left-hand edge of the test card was missing – completely blanked out! I subsequently found out that by adjusting the blue tilt control the blanked out area could be adjusted from about 1in. to 4in. from the edge of the screen. Eventually I found that the fault was due to the centre tap of the field output transformer winding that supplies the convergence waveform having come adrift from earth. This winding also supplies the field blanking pulses and is linked to the 625-line blue static convergence potentiometer. I have serviced quite a number of these sets but have never come across anything like this before.

Many people don't like the double-sided printed boards used in GEC sets, because it's very easy to peel yards of the print off the board if the solder hasn't melted on both sides before removing a component. The problem can be overcome by unsoldering the components from the top of the board, using a small iron, after removing any valves, plugs, leads etc. that might be in the way. – **P. Nutkins** (*Charmouth, Dorset*).

THORN 1500 CHASSIS

In the July *Your Problems Solved* the fault of poor focus and picture quality with the appearance of a low-emission c.r.t. in a set fitted with the Thorn 1500 chassis is described. You mention R115 (3.9M Ω) in the feed to the c.r.t. first anode as a possible cause and while it's true that this component can be responsible for this fault in quite a few cases I've found one of the video output transistor's collector load resistors to be the culprit. This is R41, 5.1k Ω – a 5.6k Ω resistor will work fine if a 5.1k Ω one is not available. This foxed me for a while once after I had

changed the tube for the same symptoms, since the fault does not affect the tube's d.c. conditions.

A couple of other unusual faults encountered on this chassis are as follows. First, repeated failure of the line output transformer tuning capacitor C95 (180pF) for no apparent reason – try reducing the value, but not below 120pF total. Secondly, an effect similar to a faulty e.h.t. tray, i.e. ballooning and black flicks on the picture, has been traced to the socket part of the c.r.t. earth lead being burnt due to arcing at the pin (22) on the c.r.t. base panel. – **R. T. Bennett** (*St. Helens, Merseyside*).

BLOWN MAINS FUSE

I doubt whether the blown mains fuse in the Bush set fitted with the A823 chassis (*Service Notebook*, June) was due to 8R5 in the degaussing circuit going low in value. If on test the set had been switched on with the degaussing coils disconnected 8R5 would indeed have got hot! But the current would not have been sufficient to blow the fuse "with a considerable bang". The fuse originally blew after the set had been on for an hour however, so the thermistor 8TH1 would have been hot, i.e. in its high-resistance state, thus clearing the degaussing circuit of suspicion. If the fuse had shattered in these circumstances the most likely cause would have been an intermittent short-circuit in the mains filter capacitor 8C5. – **T. Haines** (*Southall*).

Editorial comment: We have received several letters on this point. The overload current that would have flown through 8R5 when the set was switched on from cold with the degaussing coils disconnected was overlooked. It does seem that some mains filter capacitors have a habit of shorting intermittently.

TRAINING AND STATUS

There has been a recurrent theme running through a number of leaders and letters recently, namely Status, Money and Training. There has been a fair share of non-sense spouted which detracts from the main essentials of the argument.

(1) Our trade will never enjoy the rewards it deserves until we acquire the status that rates those rewards.

(2) We will never acquire that status until our tradesmen and trainees are qualified to a *recognised standard*.

(3) We will never have the qualifications and standards until (a) we agree, as a trade, on training courses and exams, and (b) employers recognise the necessity for having well trained staff.

The heaviest burden of guilt must lie with some of the large rental companies who do not encourage day release, who do not structure wages as an incentive for qualifications, and who arbitrarily grade their engineers.

Servicing new colour sets requires very capable men. How will they be provided? By everyone – unions, engineers, employers, teachers, trainees – making known how they feel about current training and changing courses if they don't meet the needs of the trade. Pie in the sky? Perhaps, but *you can* make a start now by getting in touch with your local Technical College and asking if they are preparing a TEC course (The Technical Education Council will eventually have responsibility for running all technician courses). Make known your own feelings and urge others to do so. Let us have a trade to be proud of – we *can* do it. – **J. Macdonald**, T.Eng., AFSERT, Lecturer in Radio and Television (*Burnham-on-Crouch*).

FAULTS ON THE THORN 9000 SERIES COLOUR CHASSIS

Barry F. Pamplin

THE Thorn 9000 chassis with its 20in. PIL tube was introduced some eighteen months ago. Its more unusual circuitry was described in these pages in August 1975. Faults in the "Syclops" combined line output stage/regulated power supply were dealt with this August. This time we are going to report on our fault experiences to date in the other sections of the receiver.

Field Timebase Operation

The complete field timebase circuit is shown in Fig. 1. Just to recap, VT401/VT402 form a complementary relaxation oscillator — a transistor version of the silicon controlled switch. The field charging capacitor C405 produces a sawtooth waveform which drives the gate of the f.e.t. buffer transistor VT403. VT404 is the output stage driver. VT405/VT406 form a Darlington pair. At the start of the scan both are conducting while VT408 and VT407 are cut off. VT408's base voltage is held constant by the network W407/W408/R409, the voltage across R405 holding it cut off during the first part of the scan. Since there is then no current through R408, VT407 is also cut off. The drive to the base of VT406 is a negative-going sawtooth. Thus as the scan develops it is progressively driven towards cut off. Towards the centre of the scan the voltage across R405 falls to a level at which VT408 starts to conduct, in turn driving VT407 on. At scan centre both output transistors (VT406/VT407) pass equal current, and during the second part of the scan VT407 is progressively turned on while VT406 moves progressively towards cut off. During the first part of the scan the deflection coil coupling capacitor C413 charges via VT406: during the second part it discharges via VT407.

During the flyback, VT406 is driven towards saturation and VT407 to cut off. W414 protects the output transistors by preventing the flyback pulse at their common connection exceeding the supply rail voltage (24.4V).

D.C. feedback from the output via R402, W405 and FR3 7-3 to the base of VT404 stabilises the centre point

voltage (10.9V). VT408, in conjunction with diodes W407 and W408 which provide its base with a reference voltage, stabilises the mean current: if the current rises, the voltage across R405 increases and VT407 is switched on later to reduce the current flowing in the stage.

Field Faults

Because of the rather tortuous way in which the circuit operates it's difficult to adopt any very logical approach to fault finding. With a total of eight transistors the effect on the screen when any one is defective is not easily deduced. The following is a summary of the present state of our knowledge.

<i>Suspect device(s)</i>	<i>Symptom</i>
VT402	Field collapse.
VT403	Field collapse or "hunting". Cramped top, expanded bottom and little control of height.
VT404	Lack of height associated with intermittent field collapse and field bounce.
VT405	Top cramping.
VT406	Grossly excessive height.
VT407	Top cramping. Top stretched with bottom cramping.
VT406 and VT407	Lack of height with bottom cramping.
VT408	Field collapse.

It must be stressed that where a transistor is suspected of being faulty the only way to check the diagnosis is by replacing the device with a known good one. Of the faults listed above the two most common ones are failure of VT403 and failure of the output pair VT406/VT407.

Apart from the transistors, the other components which have been found defective on the field panel are the oscillator h.t. supply decoupler C406 which goes short-circuit causing field collapse, W406 which went leaky causing excessive height, and diodes W407/W408 which caused field collapse with overheating of R407. The strange thing about this last fault was that both diodes appeared to be perfectly o.k. when checked for forward resistance and reverse leakage. This fault appears to be quite common and unless one has been forewarned can cause a great waste of time since there seems no reason to replace the diodes.

Field Sync Faults

Few field sync faults have been encountered but the components to check are C406 and the field driver VT404. In one chassis we found a completely open-circuit VT404 which seemed to produce no more serious an effect than intermittent field roll!!

The Decoder

The decoder panel used in the 9000 chassis is very similar to the one used in later versions of the 8500 and the 8800 chassis. Thus many of the following comments apply equally to these other sets.

Intermittent or No Colour

Intermittent colour or complete lack of colour are perhaps the most common symptoms. Both the

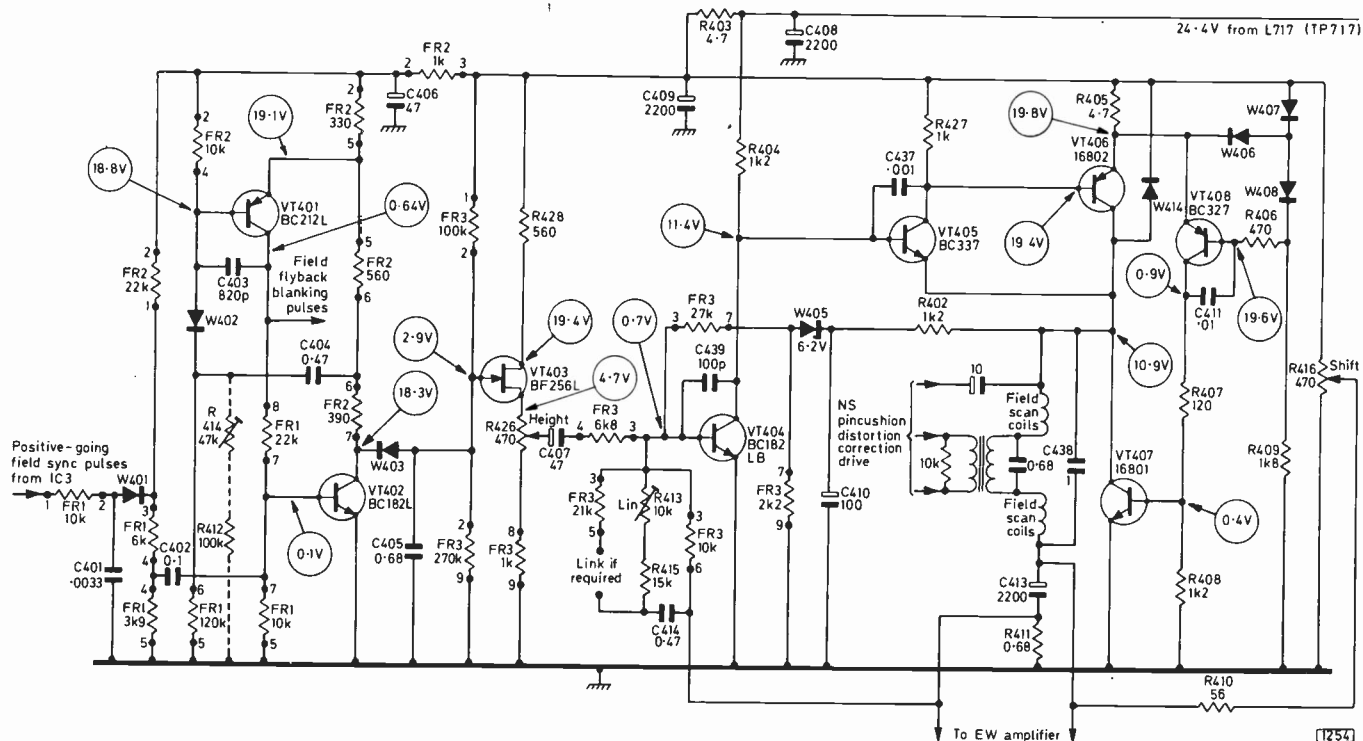


Fig. 1: Thorn 9000 chassis field timebase circuit, including modifications.

luminance/chrominance processing i.c. IC3 (SN76226) and the chroma demodulator/matrix i.c. IC4 (SN76227) can cause this effect but in practice the trouble is more likely to be due to a faulty capacitor or a dry-joint. In particular check the chroma coupling capacitor C181, the crystal's series trimmer C188 and the electrolytic C186, and look for dry-joints around the a.c.c. preset R213 and the series 7.8kHz tuned circuit L139/C193.

Incorrect PAL Switching

Incorrect PAL switching, resulting in phase reversal on alternate lines, has been tracked down to IC4 which includes the PAL switch. In one case however the capacitor which feeds the PAL switch in IC4 with the output from the bistable in IC5 (TBA395) was the culprit – it's the 1µF electrolytic C194.

Poor Chroma plus Patterning

A chroma fault which we have met several times caused us a lot of head scratching the first time it appeared. The symptom was of decidedly poor chroma but in addition a very persistent patterning, especially on red areas. The general consensus of opinion was that the trouble was in the tuner unit so this was changed. The results with the new tuner were little different and as a next step the decoder panel was changed in an attempt to localise the fault. It was clear from this test that the fault lay on the decoder panel, but we were little nearer to finding the cause.

Beat Signal

A close examination of the nature of the patterning suggested that it was probably at 1.57MHz, caused by beating between the 6MHz and 4.43MHz signals. The circuit uses a trap (L134, C151, C152) to eliminate the 6MHz sound signals from the chroma circuits. Adjustment of the core of L134 had virtually no effect upon the fault,

which was somewhat suspicious: although we were not certain that the interference was in fact sound/chroma beat, misalignment of the filter should have produced an obvious patterning, especially in areas of high saturation, and failed to do so.

All three filter components were transferred from the good panel to the defective one and the cure was instant. Subsequent checks showed that C151 was open-circuit while C152 was reduced in capacitance from 330pF to about 40pF!!

Slow Colour Drop in

A common fault reported by customers is slow colour drop in after changing channel. In most cases this trouble has been due to incorrect setting of either the reference oscillator frequency (R210) or the a.f.c. coil L111 rather than a component fault.

IC Faults

Two i.c. faults which have shown up and are worth reporting if only to save time when they next appear are really chronic hanover bars caused by IC4 and a random absence of colour in various parts of the picture caused by IC3.

Tuning Faults

Some faults which are reported as colour faults are on investigation found to be front-end troubles which cause difficulties in tuning the colour signals. Apart from the tuner itself, the other culprits giving rise to poor tuning performance are the vision detector/a.g.c./a.f.c. i.c. IC1 (TCA270), the TAA550 tuner control voltage stabiliser, and the tuning capacitors C136 and C138. A side effect of poor tuning performance is the complaint that the set never comes on tune. This should not be dismissed as "finger trouble": when operating properly the 9000 is a very stable set. ■

EQUIPMENT REVIEWS

Roger Bunney

WOLSEY SIGNAL-LEVEL METER

IT MAY be argued that a signal strength meter is not essential for aerial installation purposes: certainly it's no substitute for experience gained by field work in a particular area. With the increasing need for efficient aerial installations however, particularly the need for higher signal levels for colour receivers, a signal strength meter is a very useful adjunct to experience. Apart from displaying a meter reading of the output from the aerial, it enables optimum alignment of the aerial installation to be carried out – something which is impossible by observing the set's screen due to the a.g.c. action masking signal variations.

Maximising the aerial orientation also gives considerable reduction in co- and adjacent-channel interference – which can rise to high levels at times due to certain atmospheric conditions. If such interference signals appear a few degrees off the aerial's main forward lobe the result when the aerial is "off direction" is inferior reception.

Quite apart from optimising local reception, a signal strength meter is invaluable for assessing the possibilities of receiving alternative transmitters and for determining the "goodness factor" of various amplifiers and aerials. It's also an essential tool when installing, balancing and checking aerial distribution systems. Another use is in tracking down sources of interference – ignition, sticking thermostats, electric motors and so on.

An economically priced u.h.f. signal strength meter was reviewed not so long since (the CED signal strength meter, see May 1975), and I am at present constructing the new Manor Supplies varicap kit – but hopefully modifying it so as to be able to sweep over the complete tuning range using a 9V source. Recently however I obtained an imported Italian meter, the TES field strength meter type MC661C, in order to carry out measurements in the long-distance television reception field. I feel that an account of this unit should be of interest to those engaged in aerial work and associated activities. The meter is distributed in the UK by Wolsey Electronics.

The majority of signal strength meters consist of a standard domestic u.h.f. tuner and an i.f. strip modified so as to display a signal level reading on a suitable meter. The TES meter differs in both coverage and electronic construction. It has wideband v.h.f. and u.h.f. coverage, and uses a circuit specifically designed for field measuring work.

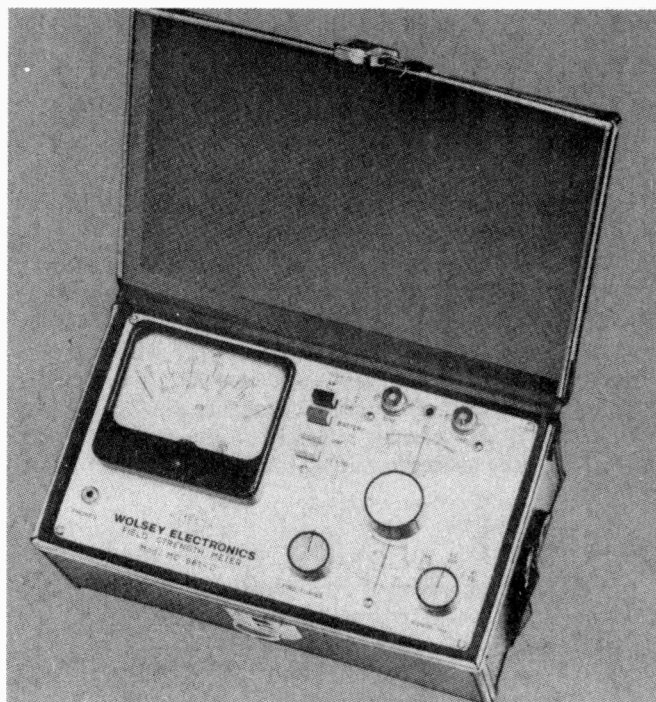
The basic circuit consists of a mixer whose input is tuned at either v.h.f. or u.h.f. by a variable inductor consisting of a coil of silver-plated copper wire tuned by a silver-plated cursor. A 1N82A diode is used as the mixer, with an AFZ12 local oscillator. The three-stage i.f. amplifier (three BC113 transistors) gives 70dB gain to drive a peak-to-peak detection circuit (pair of OA159 diodes). There is an ASY26 audio amplifier stage for headphone monitoring.

The three v.h.f. ranges are 41-65MHz, 65-108MHz and

155-270MHz, with a u.h.f. coverage of 465-830MHz in one range. The sensitivity is calibrated from $20\mu\text{V}$ to 1mV (range 1), with a $\times 10$ extension to read up to 10mV (range 2). For signal levels greater than this an external attenuator is used. There are separate, unbalanced 75Ω coaxial input sockets for v.h.f. and u.h.f. The meter is powered by an internal 4.5V battery – average battery life is quoted as 100 hours, intermittent.

I found the meter extremely easy to use. The tuning is very simple, with a clear and accurate readout on the calibrated (in MHz) tuning scale. When tuning through a signal, two closely spaced signal peaks will be heard – the local oscillator \pm the i.f. The carrier frequency is the null between these two peaks, the field reading being the maximum meter deflection on the two peaks. There is a fine tuning control adjacent to the main tuning control for accurate setting and meter reading. Four pushbuttons provide on/off, battery check, u.h.f. operation (associated with the appropriate range switch selection) and 20dB attenuation for the 10mV meter f.s.d. A leather pouch is provided on the lid to house the headphones – which are included – and an attenuator. A table of channel/frequency details is fitted inside the lid, in a perspex window. The meter unit itself is housed in a robust steel case, a flap at the rear giving access for battery replacement. For external aerial work the unit is held in a simulated leather case with a shoulder/neck strap.

One criticism in use is the tendency for the encased meter to turn over and away from the operator when the lid is open. It is impossible for the meter to fall from the leather case however since a retaining screw passes into the meter



The Wolsey MC661C signal-level meter.

body through the base of the leather case. The quality of the construction and the finish of the meter and case are excellent and can in no way be faulted.

The price from Wolsey is £108.90 plus VAT at 8%. For further details apply to Wolsey Electronics, Cymmer Road, Porth, Rhondda, Glamorgan CF39 9BT.

Physical details of the unit are as follows. Weight 5½lb total, 3¼lb meter only. Dimensions 9¾ × 5¾ × 4in. deep total, 9½ × 5½ × 2¾in. deep meter only.

MANOR SUPPLIES GREY-SCALE BOARD

LAST January I reviewed the Manor Supplies Mark 2 crosshatch generator. I have recently added to it a newly introduced accessory — a grey-scale generator board. This can be incorporated in the crosshatch unit and is controlled via the unit's four-way mode selection switch.

The board has one i.c. and five transistors plus associated components, and as with the basic crosshatch generator is easy to construct following the clear wiring illustrations provided. Several interconnecting leads between the new board and the existing crosshatch generator boards are necessary. The wiring to the four-way switch should be screened. Since this switch originally provided on/off control, an additional toggle switch is provided to take over this function, the four-way switch then selecting the grey-scale, the crosshatch pattern or peak white or black rasters.

The circuit consists of an oscillator running at approximately 100kHz during the active line period, synchronised to the line frequency by the input blanking pulses from the main pulse generator. The output from the i.c. oscillator is clipped and differentiated and then drives a 2N3702 charge pump stage which discharges via a BC107 during the blanking periods. Two further stages provide buffering and a low-impedance output. The number of grey-scale steps depends on the value of a single resistor: values are given for either a six or a ten step scale.

Construction is very simple and no undue problems should be experienced. It may be necessary to optimise the grey-scale output level on the completed unit in order to match the outputs obtained with the other pattern settings — a 1kΩ resistor (R6) is provided but I found that a 1.2kΩ resistor gave better results.

My main criticism of the unit is crosshatch pattern breakthrough on other pattern settings. To minimise this problem it's essential to follow the earthing routes exactly and to use screened cable connections to the four-way selector switch. In particular, if the earthing routes in the vicinity of the u.h.f. modulator module differ from those suggested r.f. instability may occur.

These points apart, the crosshatch/grey-scale kit provides an extremely versatile test instrument, particularly with its 3mV u.h.f. output in the channel 35-45 range. This enables the unit to be simply plugged into the aerial input socket of the receiver under test. The price is extremely reasonable — the nearest comparable unit commercially available is roughly twice as much, and has no grey-scale!

The present price of the crosshatch unit kit, complete with u.h.f. modulator, is £11 plus 45p post and packing. Complete, tested units ready for use are available at £16.60 (aluminium case) or £18 (de luxe case) plus 75p post and packing. The grey-scale kit to add to the unit is £2.90 plus 25p p.p. VAT must be added at 8%.

DEALING WITH THE OLDER SET

continued from page 627

Where poor field sync cannot be quickly traced to the usual causes an increase in the value of the field sync pulse coupling capacitor will frequently give an improvement.

When the preset hold controls are set fully at one end in order to lock a timebase this can be due to the oscillator valve, changes in value or leaks in capacitors, or a changed value series resistor. The latter should be checked: if it's within tolerance, indicating one or more causes elsewhere, it may be cheaper to alter its value to bring the lock within range of the control rather than to hunt for the true cause.

Normally it's not good practice to bridge a defective section of a multiple electrolytic with a single capacitor, as the bridged section can subsequently develop trouble in the form of high leakage. In view of the present high cost of multiple electrolytics and the limited future life of the set however bridging may be the only economic solution.

Swapping Valves

Where valves are below standard it is an old trick to change them over with those of the same type in a less critical circuit. Thus where poor gain is due to low-emission vision i.f. valves a swap can be carried out with those in the sound i.f. strip. In the same way field and sound output valves can sometimes be interchanged, also PCF80s in the tuner and timebases. This is becoming possible less frequently however because in recent years valves have increasingly been produced for specific applications with the result that duplication of types in the same set is correspondingly rarer.

Salvaged Parts

In every workshop old rental and part-exchange sets are from time to time scrapped. Where these are of a popular type and perhaps not too old certain components such as the line and field output transformers, scan coils and possibly main electrolytics can be salvaged and a limited stock built up. If a set contains replaceable printed panels these can certainly be saved to give a future cheap, quick repair. Valves from scrapped sets are also worth saving in limited quantities. When this is done, always label the spare with the model number. Valves need not be boxed. They can be kept in trays or larger boxes, and to avoid wasting time rummaging when one is required they should be sorted according to general type if not type number. The owner should be informed that used parts have been fitted to his set. It's wise to make only a nominal charge for them, refundable if the component fails within a month. The profit comes from the labour charge which of course is not refundable.

Conclusion

While many old sets can be a headache and a nuisance when they find their way on to the service bench, nevertheless by carrying out filtering and vetting, which takes only a few minutes, then servicing them along the lines suggested above they can form a normal and profitable part of the workshop's work load. ■

The Granada Colourette

Owen Buttershaw

THE large number of TV sets that have been imported from many countries in recent years means that the unsuspecting service engineer can come up against some rather unusual receivers. One of the most unconventional ones we've come across is the small (11in.) mains-only colour portable set imported from Germany and distributed by Granada – the Granada Colourette Model C11GZ1, or Kuba Porta-Colour as it is also known. Whilst being somewhat old fashioned in some respects – it's largely valved – it was well ahead of its time in using an in-line gun c.r.t. – type 11SP22.

The CRT

The tube itself is unusual in several respects. First, although the guns are mounted in line – green centre, as in the Trinitron, 20AX and Toshiba tubes but unlike the PIL and Mitsubishi in-line gun tubes which have the red gun in the centre – there is a standard shadowmask and a phosphor dot screen. The dots are in line rather than in triad groups, successive lines being staggered in relation to each other. Secondly the three cathodes are internally connected – the signal drive consists of luminance to the cathodes and the colour-difference signals to the three grids. Thirdly, the deflection angle is 70° . And finally with this small deflection angle, the in-line guns and a toroidal deflection yoke a very simple convergence system can be employed. In fact there are just two dynamic convergence adjustments, while the dynamic convergence coils are simply connected in series with the scan coils which, as shown in Fig. 1, are also linked. The tube is operated at 17kV e.h.t. which is obtained

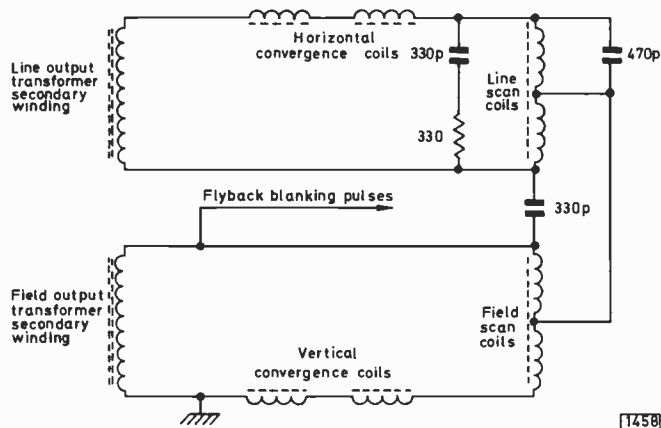
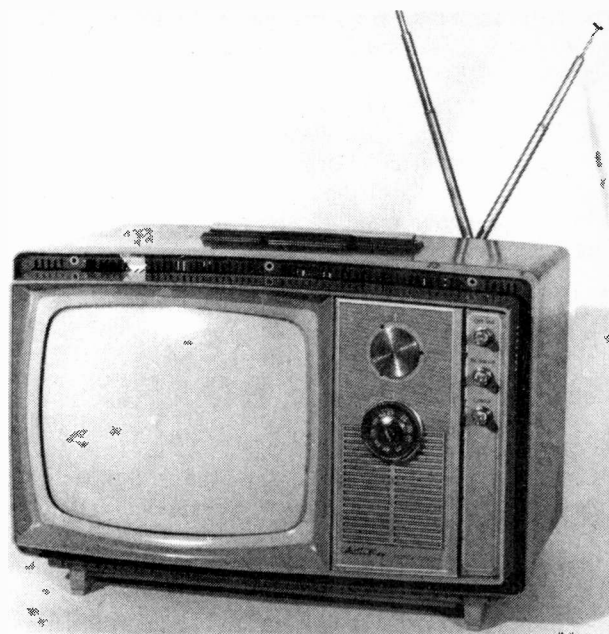


Fig. 1: The deflection coil and dynamic convergence circuitry. There are two sliders on the convergence coil assembly to enable the vertical red and green lines and the vertical yellow and blue lines to be converged at the sides of the screen.



The Granada Colourette/Kuba Porta-Colour, an unusual colour transportable set with an in-line gun c.r.t. dating from the early 1970s.

from a 1AD2 valve rectifier, and has unipotential focusing. There are the usual final anode presets to set the black levels, while the d.c. levels at the blue and green grids can be adjusted with respect to the fixed red grid d.c. level to get the required white.

Valves

Many of the valves in the set will be more familiar to those used to monochrome sets than colour receivers – there are several EF183, EF184 and PCL84 valves for example while the line output valve is a PL500. The block diagram (Fig. 2) shows the valves used in the various stages.

Tube Drive

Being a small screen portable model certain liberties can be taken with the tube drive. Thus the luminance signal is a.c. coupled to the cathodes, with the brightness control setting the d.c. level, while the colour-difference signals are also a.c. coupled, with presets to set the white level as already mentioned. There is no clamping in either the luminance or the colour-difference stages. PCC85 triodes are used for the colour-difference output stages, with the G – Y matrixing and flyback blanking carried out in the cathode circuits.

Timebases

Much of the receiver follows normal monochrome practice, with our old friend the PCL85 providing the field deflection while a PL500 and PY83, driven by an EF184 sine wave oscillator, provide the horizontal deflection. An unusual method of stabilising the line output stage is used however – by varying the line output valve's screen grid voltage. The arrangement is shown in Fig. 3. Negative-going line flyback pulses are fed to the cathode of diode D11 and in consequence the current flowing through R424 is the sum of the PL500's screen grid current and the current flowing through the diode. As the amplitude of the

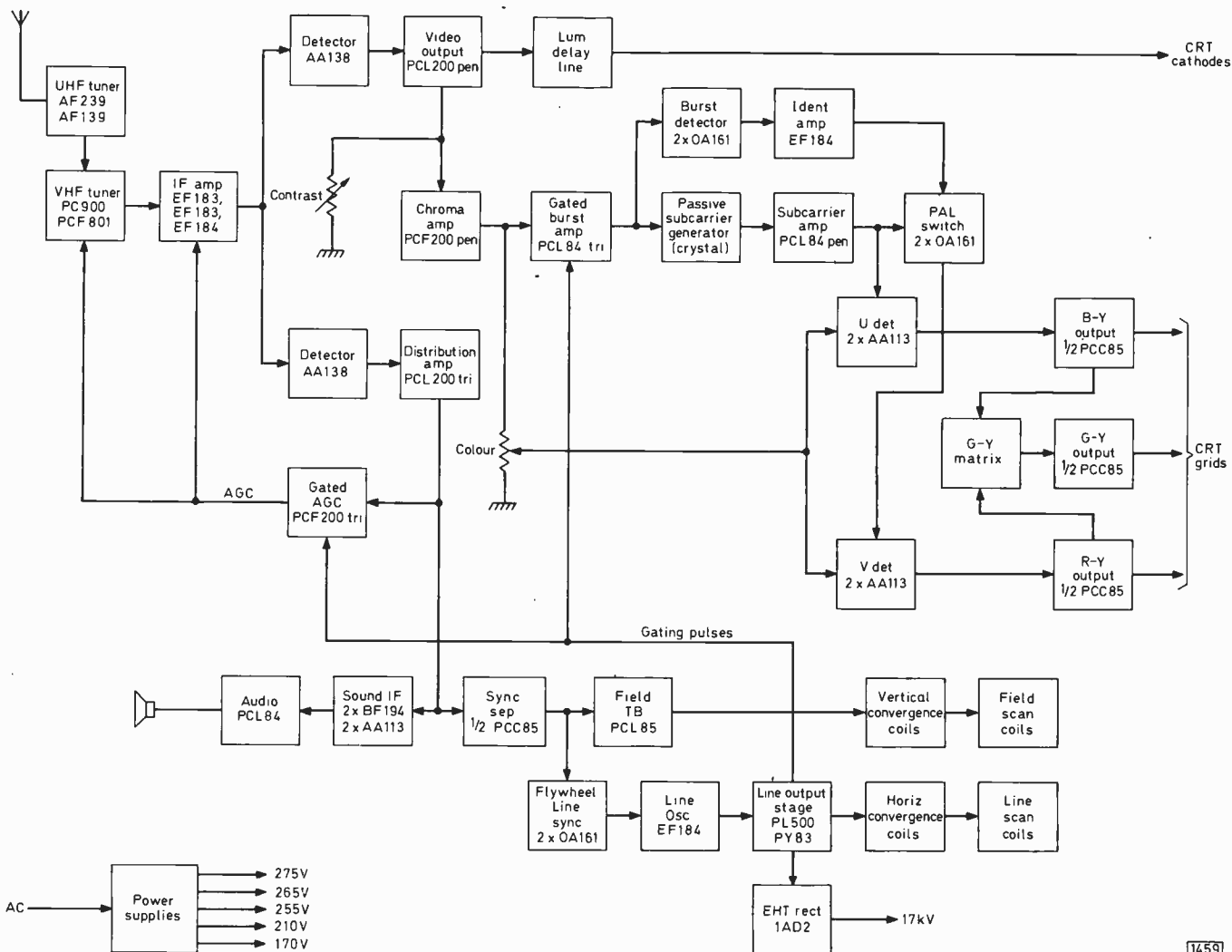


Fig. 2: Block diagram of the Granada Colourette 11 in. colour portable receiver.

flyback pulses varies with changes in the output stage loading – or with valve ageing – so the current through R424 and the voltage across it varies, adjusting the PL500's screen grid voltage in order to stabilise its output.

The Decoder

Another unusual feature of the set is that it uses simple PAL, i.e. there is no chrominance delay line etc. In fact the decoder is relatively simple, using just four valves if the output triodes are not considered part of the decoder. The

output from the vision detector diode is fed to the PCL200 (pentode section) luminance output stage. A bandpass filter in the cathode circuit of this stage feeds the chrominance signal to the single PCF200 (pentode section) chrominance amplifier. The output from this stage is fed to the two (U and V) synchronous chrominance detectors and to the cathode of the burst amplifier (PCL84, triode section). This latter valve is gated at its grid, acting as a grounded-grid amplifier to the burst signal. The bursts are applied to the reference oscillator and burst detector circuits. This circuitry is also unusual. A passive reference oscillator circuit is employed, i.e. the bursts are fed directly to a 4.43MHz crystal, in a manner similar to that used in the Rank A823 chassis. The pentode section of a PCL84 amplifies the 4.43MHz signal thus produced and drives the double-diode U and V synchronous detectors. The burst detector circuit is used simply to drive the EF184 ident amplifier, whose output in turn drives the PAL switch. Since there is no chrominance delay line, the U and V signals are not separated prior to detection and in consequence demodulation is more critical. This means that the reference signal circuitry should be set up carefully. Preset controls at the demodulator outputs set the level of the R – Y and B – Y signals fed to the output stages.

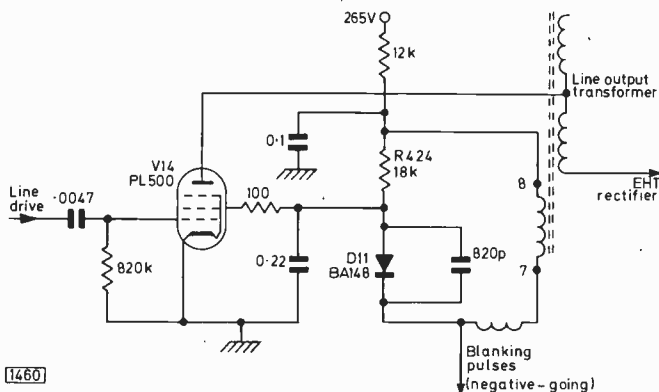
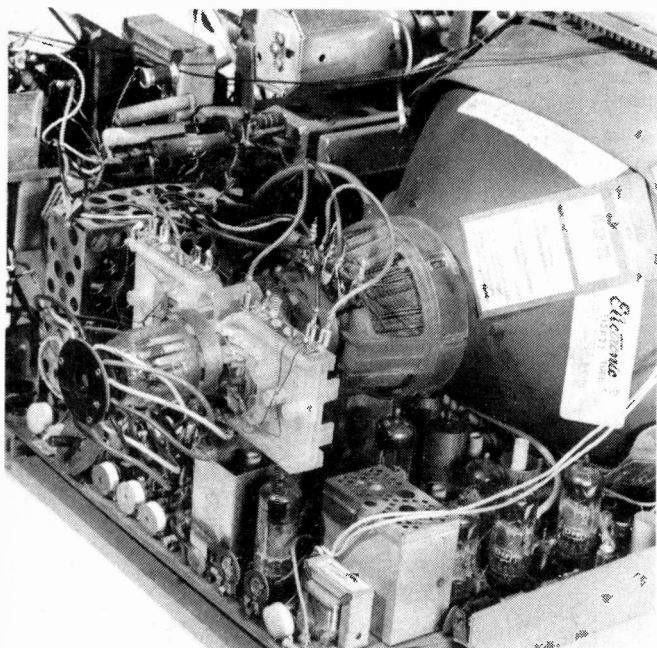


Fig. 3: Line output stage stabilisation circuit. Variations in the output lead to the line output valve's screen grid voltage being altered to compensate.

Using up the Triodes

The odd triodes left over after the above functions have been taken care of provide sync separation, gated a.g.c., and



Interior view of the Granada Colourette, showing the unusual arrangement of tube neck components.

a distribution stage which feeds the sound channel and the sync and a.g.c. circuits.

Power Supplies

The power supply consists of a silicon h.t. rectifier followed by LC and RC filters which provide five h.t. lines.

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The primary winding of the mains transformer is returned to chassis via the series heater chain, thus providing some of the voltage dropping required. The secondary winding supplies the c.r.t. heaters, the voltage set by the brightness control (c.r.t. cathode d.c. level) being superimposed on the c.r.t. heater voltage (13.8V at 0.58A). The four transistors used in the set – two in the u.h.f. tuner and two in the intercarrier sound strip – are supplied from the 210V h.t. line via large value resistors.

Some Faults

These sets are now finding their way on to the ex-rental second-hand market – we've already had several in for repair with a variety of faults. One problem is that being a virtually all-valve set housed in a relatively small cabinet a substantial amount of heat is generated. This must lead to component failure in the long term.

One set came in with a bright red raster which led us to suspect the colour-difference output circuit around V12. In fact this valve had gone soft and a replacement cleared the fault.

Another set had no raster or sound, implying a fault in the power supply circuit. We found the mains fuse blown, and when we replaced it and switched the set on it blew again. After switching off and checking with a meter we found a short-circuited mains filter capacitor (0.47 μ F). When this was replaced the heaters lit up but there were still no signs of life elsewhere. We then discovered that the original mains dropper resistors, two 30 Ω 10W components wired in parallel, had at some point been replaced with a single 15 Ω 15W unit. This had obviously worked for a time and then decided it could no longer be abused, open-circuiting itself. On replacing it with two 15W components – to allow a little more margin – the set came to life.

We were somewhat baffled by another of these sets when it arrived with no luminance. Prodding around the luminance output valve (PCL200, pentode section) with a voltmeter revealed nothing since all voltages were correct (within test limits at any rate). We attached a scope to the anode of the PCL200 pentode and sure enough there was plenty of luminance signal. On transposing the probe to the c.r.t. cathodes the signal disappeared. The luminance delay line is connected between the luminance output pentode and the c.r.t. cathodes, so a strong possibility was an open-circuit delay line. Just as we were about to check this we noticed that the board's output connection was rather poor. We decided first to apply soldering iron and solder here just to make sure and the fault promptly disappeared.

A commendably clear service manual for the set was issued by Granada. It is desirable to have this available if you wish to set up the convergence, purity etc. since the unusual tube means that the recommended procedure is not exactly what one might expect. Another thing about the tube – the purity magnets are mounted between the convergence assembly and the scan coils. A good picture can be obtained with careful setting up.

Conclusion

Although the design is a little strange, these sets are quite easy to service – partly due to their accessibility and partly due to the low component count (approaching that of a dual-standard monochrome set).

One last hint: don't forget the tint control at the back when dealing with "wrong colour" faults. This is a trimmer (10-100pF) in the reference signal amplifier circuit. ■

LONG-DISTANCE TELEVISION



ROGER BUNNEY

It looks as if the 1976 Sporadic E season will go down in the records as the year of exotic signal reception. Reports of Middle Eastern Band I transmitters being received at good strengths continue to come in, and we now have loggings from several enthusiasts of 525-line System M signals on channel A2 (vision 55.25MHz). The tropospherics also improved at the start of July, so enthusiasts have little to complain about! Indeed as I type this column on July 29th at 2030 Spain (RTVE) is producing good signals on ch. E2.

System M Signals

The 525-line System M signals appeared on two occasions. Clive Athowe and Hugh Cocks logged the signals on July 15th, Hugh with Arab looking people and Clive a little later at 1522 with a pulse and bar pattern. In Hugh's case the line lock was within the normal range for 625-line operation but the field hold (System M has 30 fields per second) was at one end of its travel. Mike Allmark logged similar signals on July 20th at 1808. Speculation as to the origin of these signals points mainly to the AFRTS base at Iraklion on Crete, or somewhat farther distant at Dhahran, station HZ22, in Saudi Arabia. Both outlets have relatively low powers, but from experience during previous openings Iraklion has been received in the UK and certainly HZ22 has been logged in Italy. We are awaiting the results of letters addressed to the two stations.

Jordan a Star Performer

Whilst in Arabic vein, Jordan has been proving a star performer this year. The signals from Amman have appeared in many parts of the UK and Europe, even filtering into my own aerial system at Romsey! Charles Hayden (Barnsley) has sent an impressive shot of the test pattern – the PM5544 pattern is now used, with clear identification at top and bottom. This was the first indication that they had actually gone over to the PM5544 – it's a trend not too happily received. For many the sight of the old Marconi No. 1 card on ch. E3 confirmed reception of Jordan and the thoughts of another PM5544 floating over Yugoslavia during a good opening to the South-East indicates the difficulty we are going to have in logging this station in the future, at least if the signal is weak.

Our Hungarian contact Hetesi Laszlo has sent us a number of photographs of Amman TV received via single-hop Sporadic E – see photographs. It's interesting to note that Kuwait now seems to be in operation on ch. E2 – this isn't listed at present. Hetesi, together with several friends, logged a station opening. This consisted of colour bars, followed by shots of a fortress and a large eagle with Arabic script. The Koran was also noted and the end of

programmes produced the Retma card! This was clearly seen one afternoon between 1410-1500, with test patterns and the station opening with the Kuwait flag at 1500 g.m.t. This could be a "possible" in the UK with conditions being as they have been just lately – a most encouraging sign in view of the tendency for stations to operate in Band III in most Eastern countries.

Conditions at Romsey

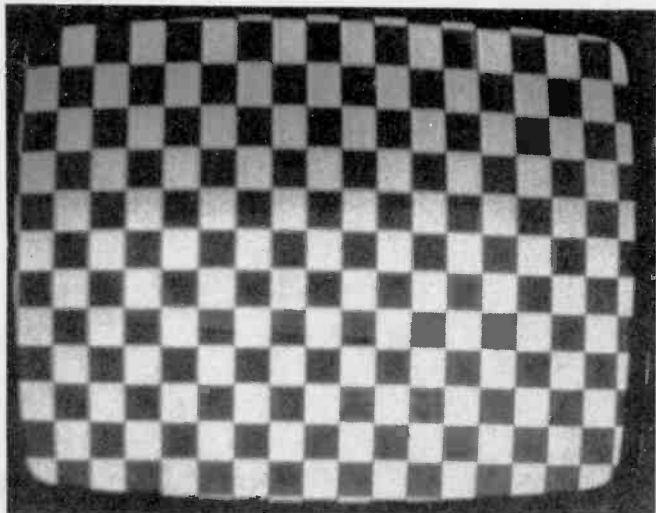
With so much activity to report I again feel that the log must be omitted. Here's a very brief rundown of my reception however. Signals have continued to come mainly from the south through to the east, with a lack of Scandinavian openings. Italy has been particularly frequent, often before 0800 on colour bars and the PM5544 pattern. I've noticed that their version of this pattern has varying identifications: on some mornings there is no identification, on others simply "RAI" and on yet another day "RAI 1" was seen. Sporadic E was present daily until the 12th when conditions just died, reopening on the 16th with TSS (USSR) etc. Conditions then built up to give some quite fantastic openings – the 24th at 1800 rejoiced with both Albania and Italy ch. IC fighting for supremacy. With the advent of the Olympics, station identification became rather trying – since last year the various VITS displays have changed, further adding to the confusion. At the time of writing I detect a slackening off in the "enthusiasm" of the Sporadic E openings and feel that within the next two weeks the magnitude of recent conditions will have fallen off considerably.

Trops

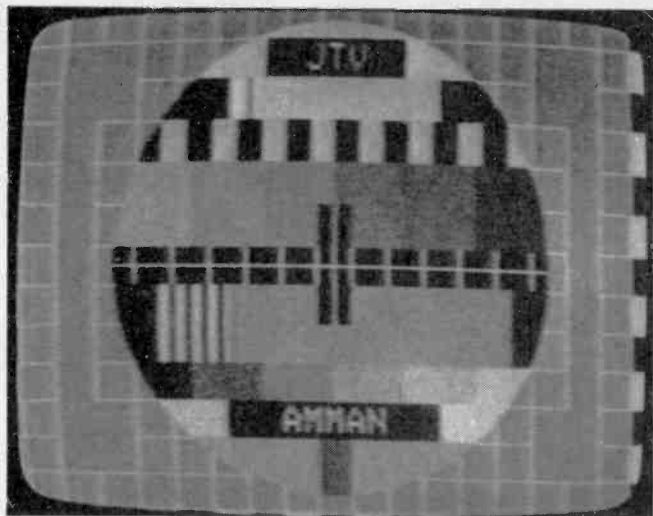
Trops were particularly active throughout the first week of July. Reports received to date are of signals from West Germany and Scandinavia. David Martin (Shaftesbury) reports NRK (Norway) giving good signals on the 5th, with ducting into East Germany on ch. E11. I was more fortunate than most perhaps as several new stations were logged, including NRK ch. E6 and three Swiss u.h.f. outlets on chs. E23, E25 and E29.

Miscellaneous Matters

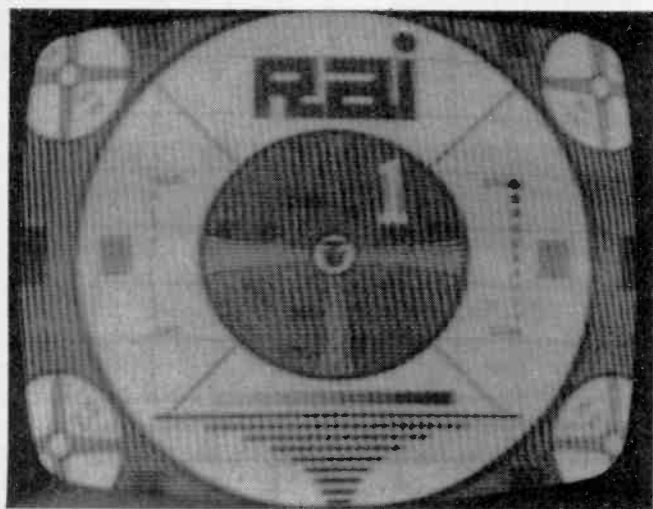
What has been puzzling many of us is the appearance again of a WDR (West German) station half way between chs. E5 and E6. This has been confirmed since both chs. E5 and E6 carried NOS (Dutch) test patterns at the time, yet between the two settings there was a strong programme which certainly seems too far from either channel for an offset and clearly displayed West German captions. For the



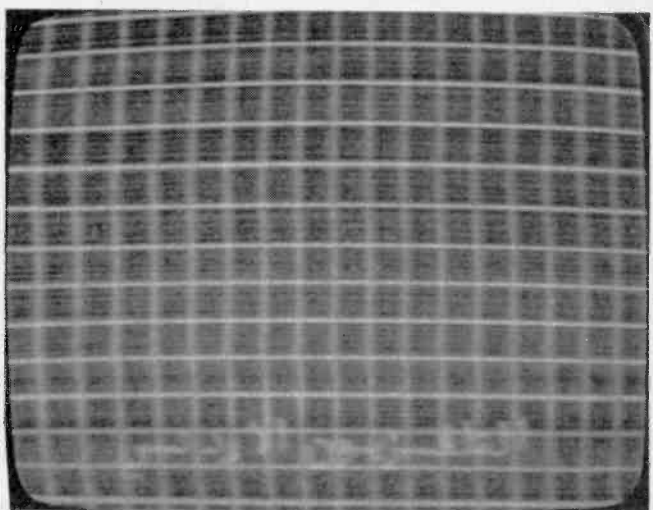
Chessboard pattern used by CST-1 (Czechoslovakia). Courtesy Hetesi Laszlo.



The PM5544 test pattern as radiated by JTV Amman (Jordan). Received by Hetesi Laszlo in Hungary via SpE.



The old monoscope pattern used by RAI (Italy), but with a new identification.



Crosshatch pattern used by JTV Amman (Jordan). Received in Hungary by Hetesi Laszlo via SpE.

time being the channel is being suffixed ch. E5a – until such time as this mystery can be cleared up. The West German authorities have been approached but as yet there has been no satisfactory explanation!

Another excellent signal here has been Hungary chs. R1 and R2 – at times their PM5544 pattern is without identification, so beware!

As a final note on reception this month the old RAI mono card appeared during one opening. Initial glances indicated that something was different – but what? Then all was clear, the large “N” had been deleted and the figure “1” inserted – see photograph. Incidentally the card less “N” was the original RAI card used in the early 1960s – certainly before 1963, as I had never seen this version.

News Items

Italy: We understand that the Italian Constitutional Court has effectively given permission for the many private (pirate) radio and TV stations at present in operation to continue their transmissions quite legally and within the constitution, provided they do not cause interference to any established communications networks or the RAI broadcasting service. The Italian PTT had been trying to close these stations before the case came to the High Court.

It is anticipated that the number of private TV stations will increase following this ruling. The Court gave its ruling on the basis of the freedom of speech written into the Italian Constitution.

West Germany: The American Forces Network will be transmitting programmes in colour to military bases in West Germany shortly, using the NTSC System M. RCA is to provide studio equipment for the Frankfurt centre which should be in operation by the end of the year. The programme output will be microwave linked to over 100 transmitters located at bases throughout West Germany.

Bulgaria: Bulgarian TV transmits for 83 hours weekly with the first programme reaching about 80% of the population and the second chain serving about 35%. New TV Centres are being constructed at both Sofia and Stara Zagora.

Czechoslovakia: Peter F. Vaarkamp has been in contact with authorities in Prague and has received the following information. The EZO pattern which we often receive with the identification “RS-KH” is produced by a pattern generator made in Czechoslovakia. The identification is adjusted at the factory, but customers can preset their own identification. It is possible however for the Czechoslovakian identification “RS-KH” to be radiated by a Soviet transmitter – indeed this does happen at times! Great care must be taken with this pattern therefore since

it's quite likely to have originated from countries in Eastern Europe other than Czechoslovakia.

Indonesia: Following our recent report on the expansion of television over the Indonesian Archipelago, Pye have now released further details of this contract. Ten new transmitters are included, linked by a satellite to the main centre at Djakarta. The existing stations operate in Band III and the 10 new transmitters will operate in both Bands I and III. The new stations are Pakanbaru, Jambi, Pontianak, Palangkaraya, Banjarmasin – all 10kW, Band III; Pandai Sikat, G. Gompong – both 5kW Band III; Bengkulu 1kW Band III; Banda Aceh, G. Betung – both 1kW Band I. The powers are transmitter outputs, not e.r.p. Five programme centres will have new equipment (or updated existing equipment) to enable satellite and colour signal processing.

New Zealand: Following the changes in radio and television broadcasting in April, the three broadcasting Corporations – Radio NZ, TV1 and TV2 – are to be abolished and to be replaced by a central control board known as NZBC. The three services will continue largely as at present but with certain changes in programming.

United States: Following earlier reports that certain Buffalo, NY TV stations propose to jam their output to prevent it reaching Canada because Canadian CATV operators intend to remove the US commercials in favour of local ones, we understand that there are to be negotiations with the Canadian CRTC (organiser of all Canadian CATV operators).

Space News

With the end of the Indian satellite transmissions only two days away I am pleased to report that yet more enthusiasts have been successful with this reception. David Martin (Shaftesbury) received good signals using my old dish; his colleague Geoffrey Chapman using a well constructed dish assembly with a Jaybean MBM slot dipole noted excellent quality signals.

A Russian satellite is to be launched later this year for programming back to Earth at 714MHz. This synchronous orbiting satellite, called Statsionar T, will be located at 99°E over the Equator – at the Eastern end of the Indian Ocean – to cover areas in Siberia, East of the Urals and the far North of the USSR. Another satellite, Statsionar 2, will be positioned near the ATS position but will radiate at 4 and 6GHz. The 714MHz transmissions lie well within our scope but possibly the Eastern location may mean that the satellite is just over the horizon for us in the UK and hence out of range. I intend to look into this further and will report back if reception seems feasible.

Italy

Another query has arisen regarding the identification on the RAI mono test card. The old "N" card carries an identification number in the top corner circle. Usually the numbers are as follows: 3 is Mt. Penice, 11 Mt. Faito, 14 Mt. Caccia, 32 Mt. Cammarata and 31 Mt. Nerone for channels IB, IB, IA, IA, IA respectively. Some years ago we had a problem with the identifications changing to "S" and "8". This transpired to be network output from the Rome TV centre. Kevin Jackson (Leeds) has now seen the identification "2"! Having checked up on this we can confirm that the transmitter responsible was Penice ch. IB, taking the Lombardia regional programme feed from the Turin centre (Turin is No.2).

Further confusion with Clive Athowe noting ch. IB going on to programme whilst ch. IA radiated the old mono card

with a "20" identification. This does confuse me since 20 is for the Mt. Beigua u.h.f. outlet on ch. 32, in the Turin region. Does anyone have a solution to this problem? The May 1971 *Television* gives the RAI list.

TV Sets for Disposal

Many enthusiasts are currently using the Bush TV125 series for DX purposes. T. C. Bray of Sparkes Place, Womersley, Nr. Guildford, Surrey has two TV125 receivers for disposal and a "considerable collection of spares". Anyone interested should write to Mr. Bray enclosing an SAE – the equipment must be collected however.

DX-TV Book

I have now seen a proof copy of the third edition of the *Long Distance Television* booklet, so by the time this column is read the book will be ready. I apologise for the delay over publication – due to reasons beyond my control – but I feel it has all been worth while. There are 60 pages this time, with many more pictures and diagrams and a complete update to the present – including satellite reception! The price is £1.11 inclusive of postage and packing, from Weston Publishing, 33 Cherville Street, Romsey, Hants, SO5 8FB.

From our Correspondents . . .

The recent excellent Sporadic E conditions have resulted in a large mailbag this past month or two. Brian Fitch (Scarborough) has received many new stations using a Philips u.h.f. receiver – an enviable total in fact for a relative novice to DX-TV. Apart from many West German stations he has been fortunate in receiving Swedish u.h.f. on ch. 23 and many Dutch and French channels. Despite his use of a normal u.h.f. receiver it was possible to read – although somewhat broken up – the FR3 identification of the ch. E24 outlet at Lille. The reason for the signal being broken up is that France transmits with positive-going vision. When this is displayed on a normal u.h.f. receiver for negative-going vision the picture tends to be broken, with a large white line sync pulse down the centre of the screen.

John Lees (Gloucester) has been using only a small aerial some 12ft above the ground and with no preamplifier, yet has managed to log most of Europe at high signal levels – John comments that he hopes his letter will encourage dabblers who are unable to spend much money on the hobby. (I have been experimenting with a new form of aerial some 8ft high, made from an old rotary washing line, and hope to be able to give more details along with illustrations shortly.)

James Burton Stewart is off to Greece and has sent us the programme times of Greek TV. EPT Network: Sunday 1300-2400; Monday-Thursday 1400-1515, 1830-2400; Friday 0800-1515, 1830-2400; Saturday 1400-1515, 1730-2400. Yened: Sunday 1325-2400; Monday-Thursday 1325-1445, 1730-2400; Friday 1100-1445, 1730-2400; Saturday 1325-0045. All local times.

Finally David Roche (Worksop) has a modified wideband Band I array which it seems gives improved results. We supplied details of a wideband Band I array based on the Antiference Tru-match design. David added to the 88in. directors a second director cut to 80in. – basically making a form of Tru-match director assembly. This has apparently made a notable improvement in early morning Tropics from Holland!

If You Have a Width Problem . . .

Peter Gaymead Frazer

SOME people with width problems take them to the Weight Watchers or just cut down on their eating and drinking. If the problem is confined to a TV set however the solution is likely to be a trifle easier. Usually the trouble is lack of width, and it's usually found in valved sets. So here is the subject of this article, lack of width in valved receivers.

Basic Circuit Operation

The basic theory of line scanning has been the subject of many articles in this magazine and we are not too concerned here with the finer detail. Briefly however the sequence is as follows. The line oscillator produces a waveform – a modified sawtooth – which is used to control the line output valve. Fig. 1(a) shows the basic line output stage configuration. Roughly half way through the forward scan, the output valve V2 is turned on. The efficiency diode V1 is also conducting and a sawtooth current builds up in the transformer (T1). This is coupled to the line scan coils which in turn produce a magnetic field to drive the spot from the centre of the screen to the right-hand side. At the end of the line the waveform from the oscillator cuts the line output valve off. Its inductive load together with the stray capacitance present then form a parallel tuned circuit. As the magnetic field around the coils collapses, a large positive pulse is produced and is reflected back to the anode of V2 and the cathode of V1, cutting V1 off. The resonant action of the circuit during this period rapidly returns the spot to the left-hand side of the screen, i.e. gives the flyback action. When the circuit tries to swing negatively, V1 starts to conduct thus damping the circuit. The subsequent decaying current flow drives the spot towards the centre of the screen and when the current falls to zero the line output valve is turned on again to complete the forward scan.

As the beam has to travel farther from c.r.t. gun to the sides of the screen than from the gun to the centre of the screen some means must be incorporated to vary the speed at which the spot scans the screen – in order to produce an even scan with reasonably straight edges. This is done by including a capacitor (C3) in series with the scan coils. The charging and discharging of this capacitor modifies the speed at which the spot travels across the screen thus providing the required correction. For this reason it's known as the S correction capacitor.

Stabilisation

A bit more theory is required since this is very relevant to width problems. Since the early sixties it has been customary to provide a kind of a.g.c. action in the line output stage to enable it to function evenly despite varying conditions, e.g. mains voltage fluctuations. The basic

system used is shown in Fig. 1(b). The scan waveform is fed back via C4 to the voltage-dependent resistor Z1 in the output valve's grid circuit. Now the waveform is highly asymmetrical, with a brief positive-going flyback pulse. The resistance of the v.d.r. varies with the voltage applied to it and is much lower when the flyback pulse arrives. In consequence a negative potential proportional to the amplitude of the flyback pulse is generated at the junction of C4/R1/R2/Z1 to bias the output valve. As the conditions in the stage vary so the flyback pulse amplitude varies but as a result of the action of the network just described the stage is stabilised. A positive voltage is obtained from the boost rail and fed to the grid circuit via R4/R3/R2 to offset the negative bias, thus giving control over the width. R3 acts as a width control therefore. It is usually adjusted for a specific boost voltage, when the width should be correct provided there are no faults in the stage.

Prior to the introduction of this technique even the slightest fall off in performance reduced the efficiency of the stage to such an extent that it usually showed up as lack of width.

Early Days

With the normal run of sets now encountered lack of width will indicate a line output stage fault. In earlier models without such stabilisation however there was a different list of possibilities. For example, the type of h.t. rectifier had to be borne in mind. Whilst the present day silicon diode is essentially a "go or no go" device, a valve or metal rectifier could lose efficiency. The h.t. voltage would in consequence fall, producing a smaller picture. The height could usually be adjusted to make up for this but the width was mainly affected and was the first obvious sign that something was amiss.

Another primary cause of lack of width was a fall off in the efficiency of the line oscillator valve – most often an ECC82 or ECC81. It is instructive to play the generation game for a few moments in order to illustrate these points.

Let us start with the old Model TV53 from the Bush stable. Lack of width was often due to a failing PL81 line output valve. One quickly learnt that to replace this valve

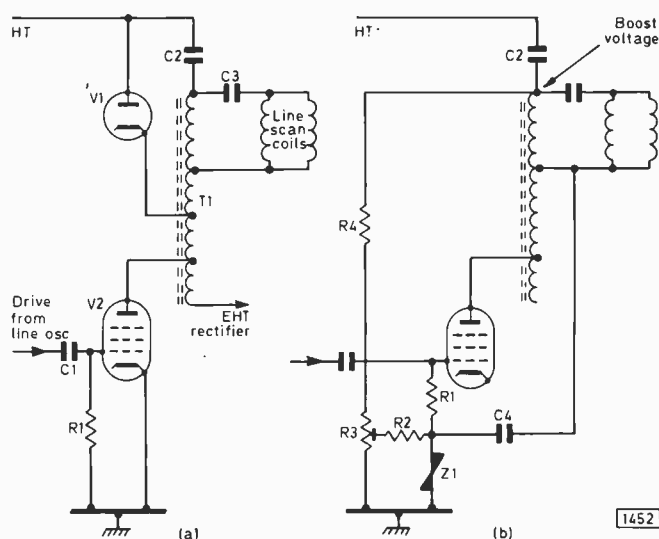


Fig. 1: The basic valve line output stage is shown at (a). V1 is the boost diode, C2 the boost capacitor. The conduction of V1 during the first half of the forward scan charges C2 to several hundred volts, giving a boosted h.t. supply at the junction of C2/T1. Since the early sixties it has been the general practice to incorporate the stabilisation arrangement shown at (b).

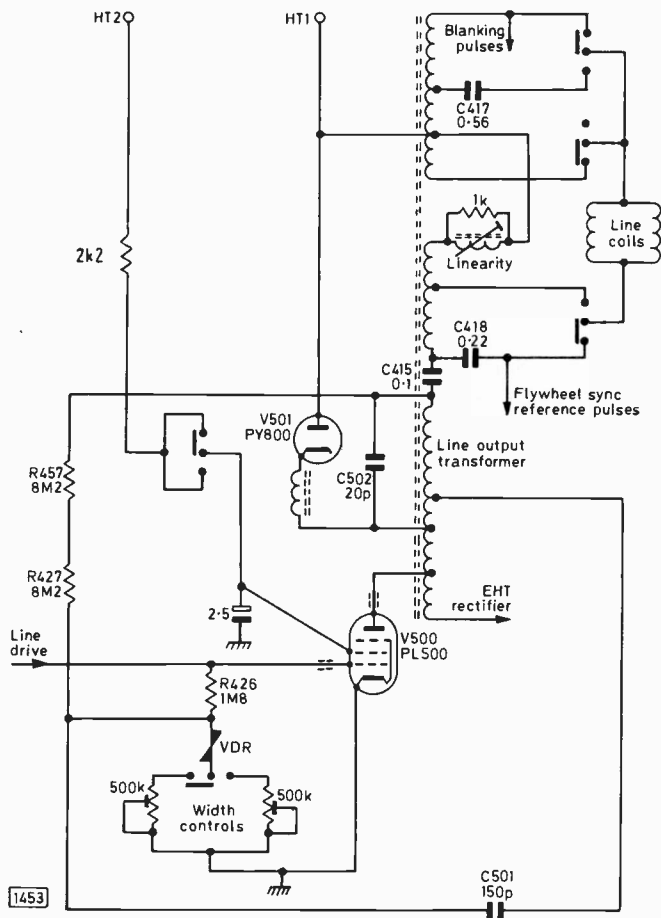


Fig. 2: Line output stage circuit used in the Philips 170 ("Style 70") series chassis. The boost reservoir capacitor C415 is connected between sections of the transformer's split primary winding. C502 provides third harmonic tuning.

only was to ask for trouble and the discerning also noticed that although a new PL81 restored the width it did tend to run hot. In fact it would quickly fail because of this, and the proper drill was to replace the ECC82 line oscillator as well as the PL81 and incidentally give the PY81 boost diode a tap to ensure that it didn't spark inside. Whilst the lack of

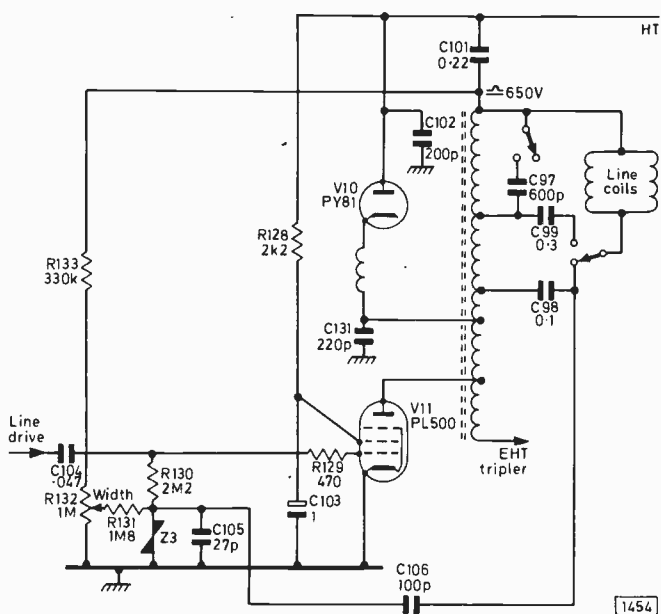


Fig. 3: Typical Thorn line output stage – in this case as used in the 950 Mk. II chassis. C131 provides harmonic tuning.

width could have been due to low h.t. this would not have caused the PL81 to overheat and in most sets which, like this, used two PY82 rectifiers low h.t. was not a common trouble unless one of the surge resistors had become open-circuit leaving one rectifier to carry the load instead of two. This latter condition carried a few interesting pitfalls for the uninitiated – but that's another story which doesn't really fit in here.

Now later Bush sets used a metal rectifier to supply the h.t. and this then became the primary trouble spot and the first voltage check to make on receivers carrying model numbers in the 70, 80, 90 and early 100 series. After this, the use of silicon h.t. rectifier diodes shifted the suspicion back to the line output stage – but more of this later. There are still quite a few dual-standard KB (RGD and Regentone) receivers around which do not have a stabilised line output stage. The line oscillator (ECC81) in these should not be above suspicion when lack of width is the trouble. The same could be said for many other older receivers – Philips ones for example where the line oscillator could be an ECC82 or an ECL80.

Faults in Stabilised Circuits

Generally however these are a passing breed, and the vast majority of sets are stabilised. It is in the scheme of things however that the system intended to stabilise the width and output power is itself responsible for the majority of width troubles.

The basic failure is in the use of small-wattage resistors or resistors of an unsuitable type which change value over a period of time. A few examples may be quoted to illustrate this point.

The trouble spot in the Philips 170 chassis is the two 8.2M Ω resistors (colours grey, red, green) situated above the width controls (dual-standard chassis using separate width controls, see Fig. 2). Replacement of these with larger resistors of the same value is essential. The same trouble persisted with the 210 chassis but became less frequent on later production versions which used more reliable components.

A vast range of Thorn receivers under the Ferguson, HMV, Marconiphone and Ultra banners, not to mention other makes employing Thorn chassis, used a standard circuit consisting of a 330k Ω resistor from the boost line to the width control (set boost or whatever other label the control carried) with a couple of high value resistors leading to the output valve's control grid (typical values 1.8M Ω and 2.2M Ω). A 100pF pulse capacitor couples the line output waveform to the VDR (see Fig. 3).

Now several things can and do happen in this circuitry. Most commonly the 330k Ω resistor goes high, producing lack of width, or goes low, damaging the width control and producing (usually) the same symptom. No trouble here, in the former case merely fit a larger resistor of the same value and in the latter clean up the mess and fit a new control as well as a larger resistor.

If neither of these items is at fault and lack of width is not solved by valve replacement, either the 1.8M Ω or the 2.2M Ω resistor will be found to have increased in value – perhaps both. A quick check for this is to connect the voltmeter positive probe to chassis and the negative probe to the control grid of the PL504 (or whatever) valve. As well as reading the drive voltage this action may well restore full width as a high-resistance alternative path is provided to chassis by the meter. This immediately directs attention to the resistors in the control grid circuit.

In passing it may be mentioned that if the resistor(s) go

high enough the output valve control grid is left floating and this produces a "wasp waisted" or "hour glass" effect on the screen where the centre of the raster is drastically reduced in width, the upper and lower parts being wider.

The other common occurrence is for the pulse capacitor (normally 100pF) to short. This can damage the panel and cause the VDR to become red hot. The latter can be damaged and may have to be replaced but most often survives to live another day.

Width Circuit Resistors

High-value resistors are a prime cause of lack of width in most valved line timebases, both monochrome and colour, and therefore deserve close attention.

We have mentioned Philips and Thorn as examples but the same remarks apply to most other makes, only the values are changed: two 4.7M Ω resistors in some Pye group models, a 10M Ω resistor (may be two resistors in series) in the ITT VC200 chassis, a 470k Ω resistor in some GEC-Sobell sets, a 10M Ω resistor in some colour sets, show the wide variety of the values used in the supply to the width (set boost, set EHT or whatever) control. The values used in the circuit from the width control to the output valve's control grid are more uniform, being in the region of 2M Ω .

Next Steps

If the valves have been checked, the h.t. is up to standard or perhaps a little low, the resistors check out o.k. and the line drive is somewhere near right, what next?

Before moving on perhaps we had better dwell for a moment upon what we have just said. One should not be surprised if the h.t. is a little low if the line output stage is drawing excessive current. This excessive current causes a higher than normal voltage drop across the smoothing resistor(s), and this in itself may cause a further fault (no h.t. at all) as one or more of the resistors gives up the struggle and becomes open-circuit or the fuse fails. This is side tracking however and we must return to the main theme. Since we are dealing with the subject of insufficient width, the current will not actually be too excessive and therefore the h.t. voltage will not be too low and indeed may well be high if insufficient current is being drawn, due say to a low-emission line output valve.

Line Drive

We also said "if the line drive is somewhere near right". If this sounds a little slap dash we hasten to point out that an output stage fault which causes the output valve to overheat will indirectly damp the line drive at its control grid. So it's a matter of weighing up one factor against another, or disconnecting the output valve's screen grid feed resistor to render it inoperative and therefore incapable of damping anything, whereby the line drive should return to its proper figure of say minus 40V depending upon the set.

Having partially cleared up these red herrings, let us return to the line output stage and consider the other likely causes of lack of width.

Excessive Damping

A symptom we haven't mentioned so far is when the width is lacking at low brilliance but the raster rapidly balloons to enormous proportions and fades to a blank screen as the brightness is increased. This is a very common symptom and seems to catch out quite a few of our less

experienced readers. They reason that if the picture balloons in this manner the e.h.t. is falling under load, which is quite true, and therefore the e.h.t. rectifier is at fault. This is true only if the e.h.t. rectifier is properly supplied, but all too often it isn't. If there is a fault which is damping the stage down a bit, the rectifier cannot function to the best of its ability and the ballooning must be accepted as a secondary effect of a primary cause which is elsewhere (though not far away).

There are several possible causes of excessive damping, or perhaps incorrect tuning which may be encountered once in a while. Amongst these must be included the scanning coils and the capacitors associated with the transformer, but generally these tend to kill the line output altogether and it is no real bother to disconnect them.

An exception is the S correction capacitor which is wired in series with the scan coils. When this goes short-circuit the width is affected though not a lot, and there is a white line down the left of the picture (looking at it). When these things have been accounted for we are left with one item more likely to cause trouble than any other (remembering that we have eliminated the valves, resistors, etc.).

Enter the Demon King

It's a sad fact that the line output transformer is all too often the cause not only of complete line output stage failure but also of lack of width and poor e.h.t. regulation (ballooning). Some makes and models are more prone to line output transformer failure than others. Firms which specialise in supplying line output transformers will confirm this fact and will often be able to guess which transformer you want before you ask for it. It may be said that this is because some sets are more widely distributed than others and therefore the dice are loaded. This is not true. The most widely distributed sets of all use a transformer which rarely fails (they can give lots of trouble in other directions, so we are not handing out any Oscars). So we are forced to the conclusion that some makes of transformer are more troublesome than others. The maker of the transformer is not necessarily the maker of the set, so we are not trying to get at any particular brand name or group, rather the model which uses a particular transformer.

We would also point out that firms supplying replacement transformers do not as a rule supply components from the original makers, rather transformers which do the same job but which may differ in appearance. We have found by experience that many of these alternatives have a better life expectancy than the original designs. Even though the fitting demands the transfer of some components and leads from the old assembly to the replacement, this is well worth the extra trouble.

Guide to Common Chassis

Pye Group, including Ekco, Ferranti, Invicta and Dynatron: In early dual-standard models (the Pye 11U series) check the valves (PL36, PCL84, PY800) and, if the PL36 is overheating, suspect the coupling capacitor C87 (0.01 μ F) which tends to leak.

In later dual-standard models check the PL500, PY88 and ECC82 (some models use half the PCL85 as the line oscillator - where only one ECC82 is fitted, this is used as the field oscillator). Then check the high-value resistors from the boost line to the width control - the value of the resistors varies from model to model, up to two 4.7M Ω resistors.

continued on page 653

RECOGNISING FAULTS



How much money, and how many hours, have been wasted because the fault symptoms that were plain to see on the c.r.t. were incorrectly diagnosed? Looking for component failures in the i.f. amplifier and decoder when all the time the h.t. rail was low, or hunting around the chrominance delay line and demodulators while not realising that the subcarrier oscillator had stopped! Every receiver has its own stock faults, but real skill in efficient fault finding comes into its own when the fault symptom, or for that matter the particular type of receiver, has not been met before. As equipment and signal processing methods become more complex, so the art of correct fault diagnosis is going to increase in importance and difficulty – and also become far more expensive for the poor customer. Recognising the fault symptom and mentally selecting the part of the receiver that's caused the failure is half the battle these days. The failure still has to be confirmed by the use of the oscilloscope or multimeter, but starting off in the right place is of paramount importance.

In this colour supplement a series of 18 off-air fault symptoms that can occur throughout the many stages of a modern colour receiver have been photographed. The photographs have been colour coded to correspond with the associated stages in the receiver block diagram (Fig. 1). This will enable the reader to quickly relate the fault symptom to the correct section of the set, and from there to start on the task of tracing the fault to a particular stage and component.

A modern 110° receiver was chosen because some of the scanning faults that can arise in such sets are not normally encountered in the more conventional 90° models, while with the extensive use of i.c.s in the i.f., decoder and timebase sections a new generation of fault symptoms is emerging.

The receiver used for these photographs was a Bush Model BC6100 (RRI Z718 chassis). For those interested in photography, here are the details. The camera was a 35mm Pentax ES fitted with a Takumar 1:1.8/55 lens, tripod and shutter cable. Kodachrome 25 colour transparency film was used (ASA 25) with a fixed shutter speed of 1/25th second. The lens aperture was adjusted to suit the brightness of the picture from the screen.

Text and photography by R. Fisher.

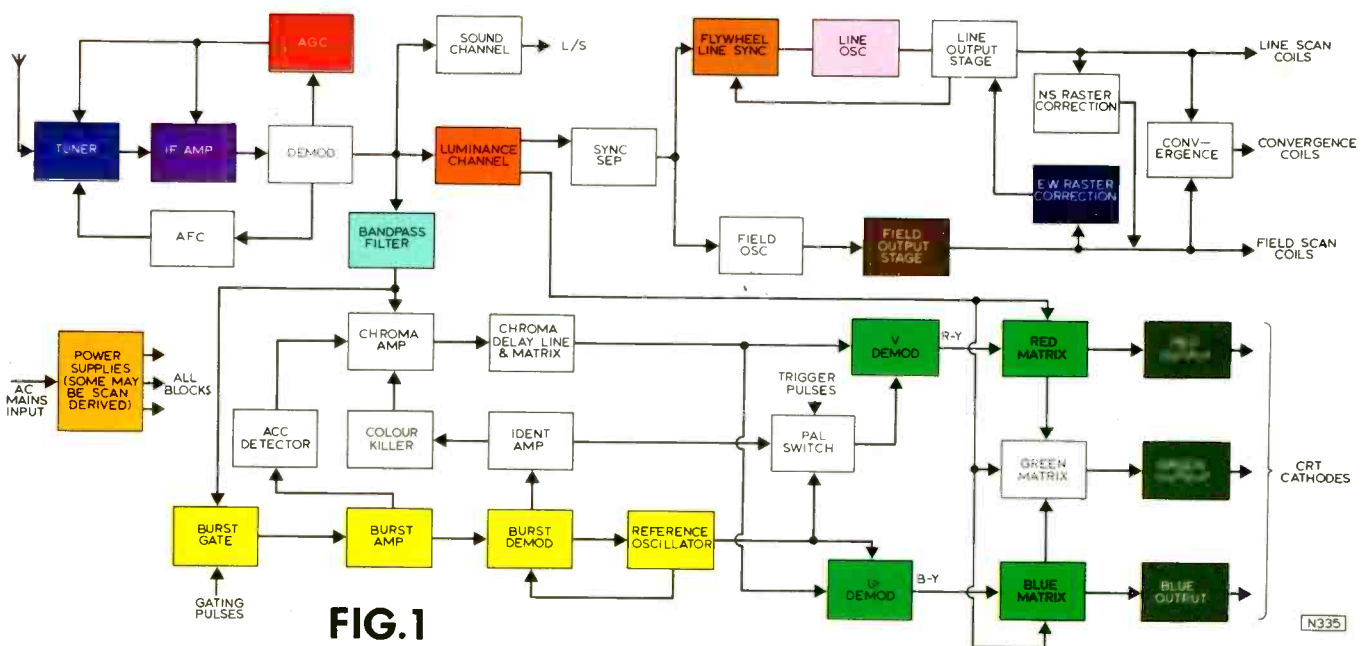


FIG. 1

RECOGNISING FAULTS OFF-SCREEN



1

Severe picture noise is caused by either poor reception or low gain in the tuner/i.f. amplifier. Normally it will be the tuner, but first, check the coaxial cable feed. All coaxial plugs and sockets should be *soldered* to the cable.



2

R.F. patterning can be one of the most difficult faults to locate. The coarser the pattern the lower the interference frequency. First make sure whether the interference is coming from the set. If not, turn off all other electrical equipment in the house until the offending equipment is found.



3

H.F. ringing is nearly always caused by a misaligned i.f. amplifier, and that means using a wobulator to realign the strip. If valves are used in the i.f. amplifier *check them all first*.



4

Instability is usually found in the i.f. amplifier but could be caused by the failure of the a.g.c. stages. Use of a wobulator and detector probe is still the best way of location.



5

The a.g.c. section of a receiver can cause a number of different fault symptoms. This one is the result of poor decoupling of the control voltage to the amplifier and tuner.



6

Luminance amplifier failures are normally quite obvious, with the exception of a few. This fault is caused by the delay line having shorted turns. The result is ringing of the luminance signal and the displacement of the chrominance information.



7

Complete failure of the luminance amplifier will result in a colour-difference signal only display on the screen. If the receiver has no picture at all, but sound is present and the scans locked, turn the colour control to maximum to make sure the colour is missing.



8

When a monochrome only picture is displayed override the colour killer. If the fault is still present the problem probably lies in the a.p.c. loop or the subcarrier oscillator.



9

Another patterning problem, but this time the colour picture only is affected. The problem must lie in the decoder or the vision demodulator circuit. Check the bandpass filter first, then move to the chroma amplifier.



10

Absence or either the U or V signal will affect the green content of the picture as well. In this example the R - Y signal is missing, which could mean failure of the red signal matrix or the R - Y demodulator. The problem could also lie in the delay line matrixing circuit or in the subcarrier feed to the demodulator.



11

No B - Y signal is normally caused by failure of the blue matrix or the B - Y demodulator. Again check the delay line and subcarrier feeds.



12

Field flyback lines are more noticeable at low brightness levels. In this particular set the fault was due to incorrect clamping conditions, but check the flyback suppression circuits to the c.r.t. as well.

RECOGNISING FAULTS OFF-SCREEN



13

The line oscillator and output stages are becoming more complex, and so are the faults. This one is caused by poor decoupling of the line oscillator control voltage from the flywheel sync circuit. The result is severe line oscillator hunting.



14

Modern line timebase i.c.s incorporate line phase adjustments. If incorrectly set up or fails in some way the picture can be horizontally displaced. In this example the displacement is accompanied by line pulling.



15

"Push-pull" field output stages bring with them a new variety of faults. This example was caused by a fault in the field output stage, as a result of which the bias was upset. Height and linearity circuit failures could also cause the same result.



16

Trapezium distortion – a type of fault that is now being found in 110° receivers that employ width modulators to provide EW raster correction. The fault could also be found in 90° sets, due to a defect in the line scan coils.



17

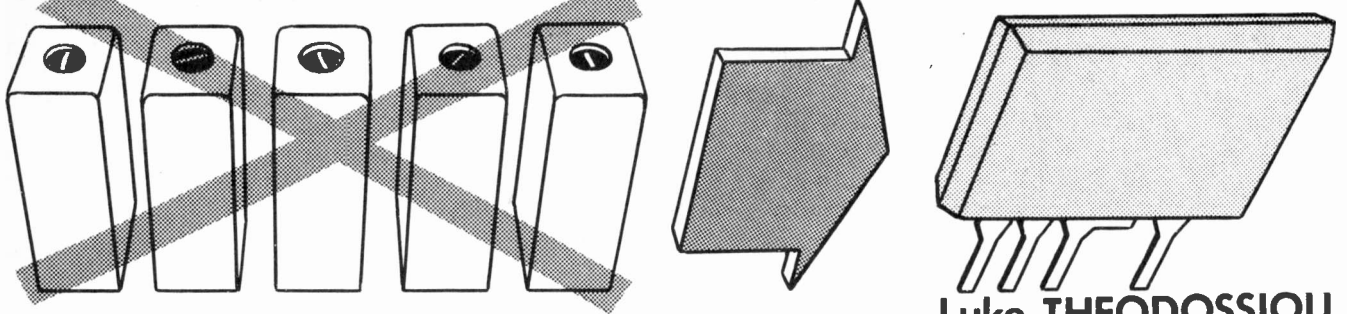
Pincushion distortion is another width modulator problem, but failure of the transducer and associated circuits in 90° colour receivers can produce the same result.



18

Reduced line and field scan amplitudes can only mean one thing – low h.t. The picture colour quality and brightness need not vary, especially if the l.t. supplies are derived from the line output stage. Check the h.t. rails before you start fault finding in any section of the receiver.

SURFACE ACOUSTIC WAVE FILTERS



Luke THEODOSSIOU

DURING the last decade or so a number of i.c. manufacturers have been investigating surface acoustic wave devices. These exploit the phenomenon that if a voltage is applied to the surface of a piezoelectric material via a metal grid, an acoustic wave is generated. The grid thus acts as a transducer, its shape determining the frequencies that are produced.

Plessey for example have done considerable work in the design and construction of bandpass filters in the range 10 to 1500MHz. These have become firmly established in various military and professional applications, particularly in radar. The development of mass production techniques and consumer orientated encapsulations has now made the use of these devices in television receivers a viable proposition. In this application they will perform all the necessary filtering in the i.f. stages so as to provide the required bandpass shape. They thus obviate the need for coils and adjustments on the i.f. strip, providing consistent performance which is determined solely by the design and layout of the circuitry and is completely independent of operator efficiency or alignment equipment.

The advantages of SAWFs are (a) economy, (b) improved performance and (c) ease of servicing. The economy results from the fact that one SAWF replaces all the i.f. filter coils, no alignment is required, assembly time is reduced, no alignment equipment is required, factory space is reduced since there is no need for coil winding while only one small item need be held in store, and the size of the i.f. board can be reduced. Improved performance comes from the accuracy of the trap positions, the high reproducibility and the linear phase response of the filters for the UK and US standards. The latter makes them ideal for Teletext and Viewdata. The improved performance is sustained through production — discrete component designs suffer from production tolerances. And since SAWFs for different TV standards can be interchanged, the same i.f. strip can be used for both home and export models, again with saving in the amount of equipment required. Servicing advantages come from the inherent reliability of the devices and the fact that there are no alignment adjustments. Reduction in the number of servicing calls helps both the customer and the dealer.

Construction

The construction of a typical bandpass SAWF is shown in Fig. 1. The device consists of a piezoelectric substrate on to which are deposited the input and output transducers and a coupler. The transducers are in the form of an interleaved grid of electrodes (referred to as "fingers"), fabricated in 2000Å thick aluminium. The width of each finger and the

gap between them is a quarter of an acoustic wavelength. The length of the fingers (i.e. the overlap) is determined by the source to which the filter is to be connected.

When an a.c. voltage is applied to the input transducer an acoustic wave is propagated bilaterally along the surface of the substrate. The wave to the left is absorbed by an acoustic absorber placed at the end of the substrate. An absorber is also incorporated in an equivalent position behind the output transducer. Various substrate materials may be used but the one favoured at present is lithium niobate, due to its high piezoelectric coupling factor which ensures a relatively low insertion loss. Other advantages of this material include a low temperature co-efficient and low cost.

The coupler consists of a uniform grid of insulated electrodes. This redirects the generated surface wave toward the output transducer. When a signal is applied to the input transducer, some energy in a bulk wave mode is generated in addition to the wanted surface wave. The bulk wave mode energy, not being a surface component, passes under the coupler and therefore misses the output transducer which for this reason is offset relative to the input transducer (see Fig. 1).

Other design features include an acoustic absorber on the back face — this also serves as a mounting; cutting the edges at an angle to steer reflections away from the transducers; and the use of double electrodes to reduce reflections.

Fundamentals

If the transducer consisted of a large number of identical electrodes with even spacing (λ_0) between electrodes of the same polarity, the frequency response of the filter would be a $(\sin x)/x$ function (see Fig. 2) with the centre frequency f_0 given by:

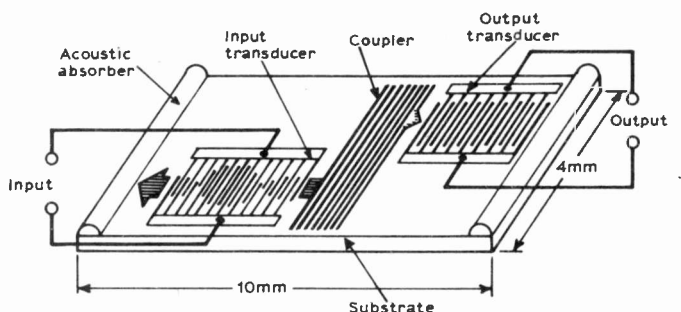


Fig. 1: Construction of a typical bandpass filter (Plessey). The substrate is lithium niobate.

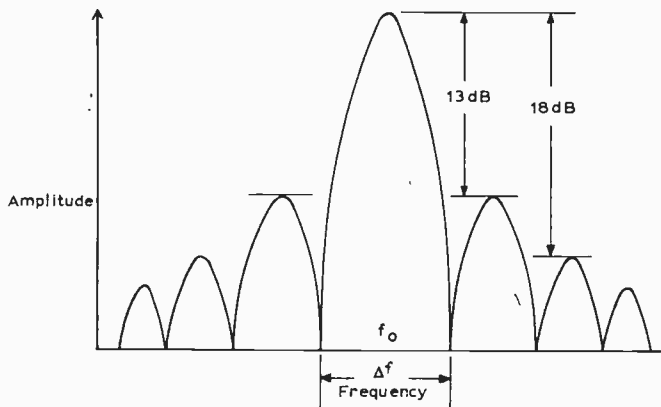


Fig. 2: Fundamental filter response using a large number of evenly spaced electrodes.

$$f_0 = \frac{\text{The velocity of wave propagation}}{\lambda_0}$$

The bandwidth (Δf) between the first nulls is given by:

$$\frac{F}{\Delta f} = \frac{2}{N}$$

where N is the number of electrode pairs. The device would have a side lobe rejection of 13dB and a linear phase response. By modifying the geometry of the input transducer the amplitude and phase response of the filter can be tailored to the required broadcast standard.

General characteristics

Some of the more important SAW parameters which affect system design are amplitude response, signal delay and insertion loss.

The most obvious requirement of these devices is that they should have a suitable amplitude response to complement the broadcast standard employed.

Figs. 3 and 4 show typical responses of the Plessey UK device for standard I, type SW150, and the European device for standard G, type SW170. These figures also show the test limit "gates" which correspond to the values given in the manufacturer's data sheet.

The out of band response is very different from that obtained with a conventional filter. These devices show well defined nulls and peaks, the character of which varies very

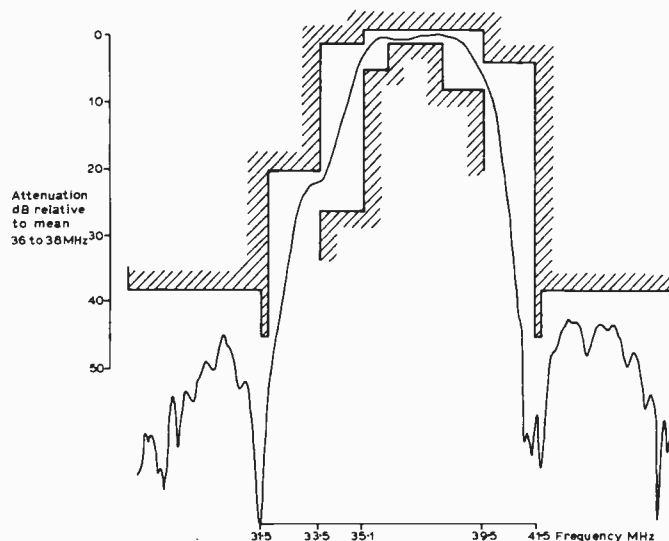


Fig. 3: Response of the Plessey SW150 filter which is tailored for the UK standard I. The shaded areas show the production limit spreads.

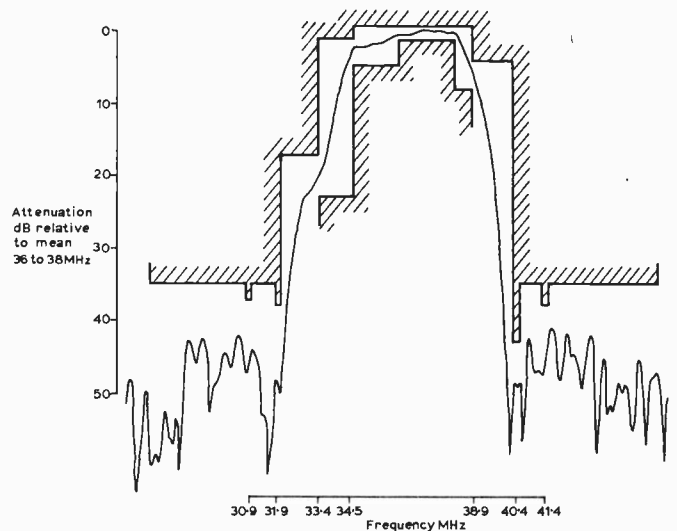


Fig. 4: Response and production limit spreads for the Plessey SW170 filter which is tailored for the European standard G.

little from device to device. Because of this out of band response it is necessary to define two additional limits, the upper and lower side lobe rejection.

The very large deviations which occur just out of band in these figures are not a direct effect of the device's phase response, they are the result of its amplitude response causing too much attenuation to allow the measuring instrument to function.

The device introduces a large delay, of around 1.6 μ S, into the signal path. This delay makes it impractical to measure the phase response directly and then look for deviations. A better approach is to measure the group delay and look for deviations on the average. Figs. 5 and 6 show typical group delay responses of the SW150 and SW170 respectively.

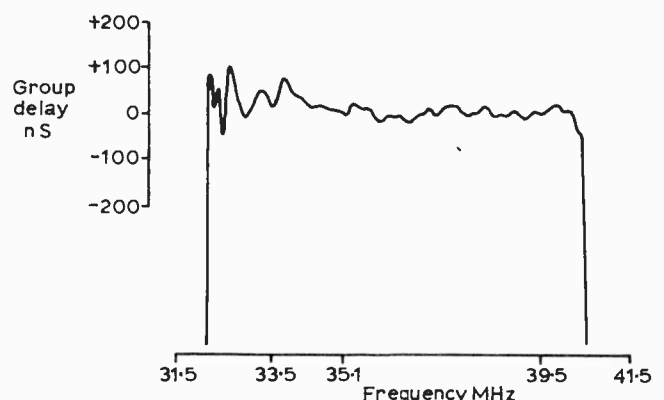


Fig. 5: Group delay response of the SW150. As can be seen this is very linear as compared to LC block filters.

The short term ripple of the group delay response is also an important parameter, and this is specified as the worst deviation from the mean over any 500kHz bandwidth between two defined in-band frequencies. Any direct breakthrough of signal external to the device will seriously affect the ripple amplitude.

The insertion loss is very dependent on the input drive and the output load impedance. By conjugately matching the input with a small series inductor and using a high impedance output load (about 2k Ω) an insertion loss of less than 10dB can be achieved. This arrangement would produce an unacceptable performance with regard to spurious reflections however. A compromise, which results

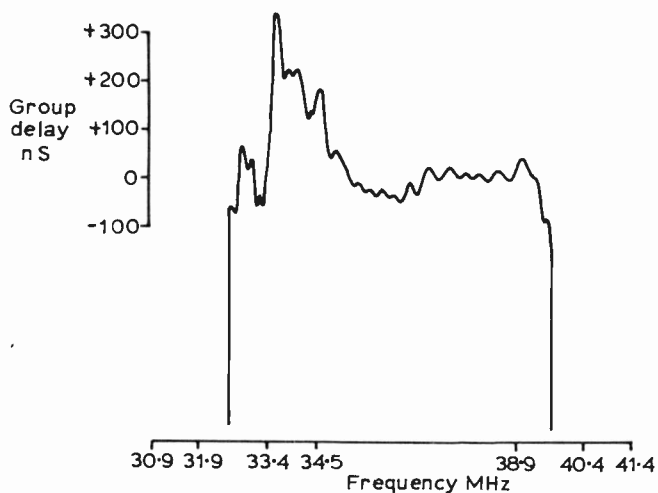


Fig. 6: Controlled group delay response for the SW170 European filter.

in spurious reflection levels better than -40dB , is to use a load impedance of 500Ω . In this condition the devices give rise to a voltage insertion loss of typically 16dB , with less than a 2dB variation from device to device.

Use

The most important characteristic which needs to be taken into consideration when applying SAWFs is the insertion loss incurred compared to a conventional LC design. When operated into an impedance of 500Ω this amounts to about 16dB . To overcome this, the conversion gain of the tuner or the gain of the i.f. amplifier – the filter being driven directly from the tuner's 75Ω output impedance – can be increased. Since most modern systems using an LC bandpass filter at the front end of the i.f. strip employ a pre-filter gain stage this can be utilized to provide the required additional gain (see Figs. 7-11). In order to ensure that the intermodulation distortion produced at high signal levels is minimized, this stage requires very careful design – it may even become necessary to employ a.g.c. on this stage. The filter itself has a very high input signal handling capability.

Although there is no internal d.c. path between any of the pins, it is advisable to keep d.c. voltages below 100mV to ensure a long operating life in conditions of high temperature and humidity. This may easily be achieved by the use of $0.0022\mu\text{F}$ ceramic coupling capacitors.

As with any delay line, the filters can suffer from spurious reflection outputs. These outputs take two basic

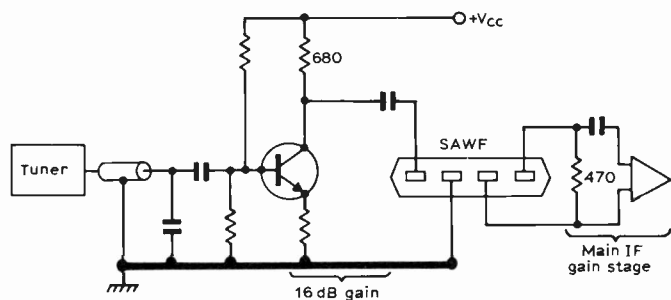


Fig. 7: Basic single transistor preamplifier stage providing 16dB of gain. The output impedance of this stage is 680Ω which is satisfactory for most applications.

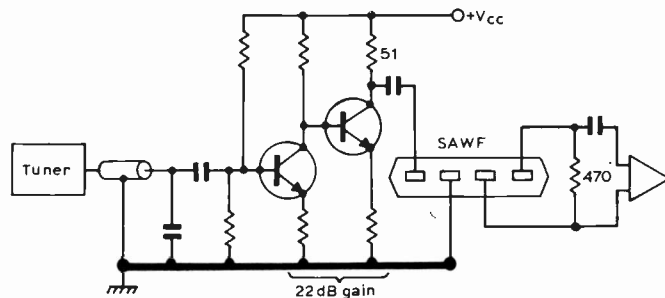


Fig. 8: A two-transistor preamplifier gain stage providing 22dB of gain. The output impedance of this configuration is 51Ω , making it particularly suitable for Teletext decoding applications.

forms: edge reflections and triple transit reflections. Edge reflections are short term (less than $1\mu\text{s}$) which gives rise to faint multiple images following the main image on the screen. As these are a function of the filter design they are generally reduced to insignificant levels by the manufacturer.

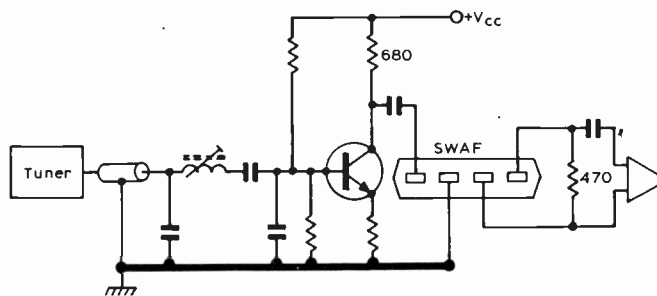


Fig. 9: The conversion gain of the tuner may be conveniently increased by the use of an input coil as shown in the diagram.

Triple transit reflections occur when parts of the main surface wave are reflected from the output transducer back along the original path, then reflected by the input transducer, finally appearing at the output. This form of reflection shows up as a single fixed image approximately $3.2\mu\text{s}$ after the main one. To minimise this effect at least one transducer should be loaded with a low impedance. If the input and output impedances are such as to give an insertion loss of at least 16dB , reflective outputs will be lower than 45dB and hence imperceptible.

To ensure very low levels of such spurious signals it is advisable to drive the filter from a low-impedance source. This is particularly important when the device is used for Teletext reception. This is usually a simple matter to arrange by modification of the preamplifier stage.

The design and construction of the filter removes most problems that can alter the band shape. However, direct breakthrough due to poor layout cannot be compensated for, and thus great care is required during printed circuit layout design. The results of direct breakthrough are first to reduce the trap depths (see Fig. 12), secondly to introduce a faint image $1.6\mu\text{s}$ before the main screen image, and thirdly to introduce ripple on the amplitude and phase responses.

Direct breakthrough is the result of a direct signal path between the input and output of the filter. This may take the form of capacitance between the input and output connections or a common impedance in the earth lead (see Fig. 13). To achieve the 60dB rejection over 25mm necessary for satisfactory trap performance CD and LD must

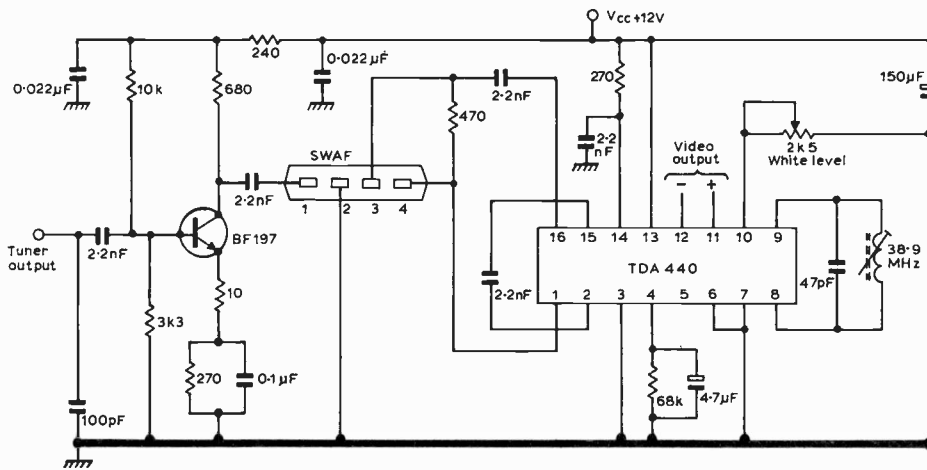
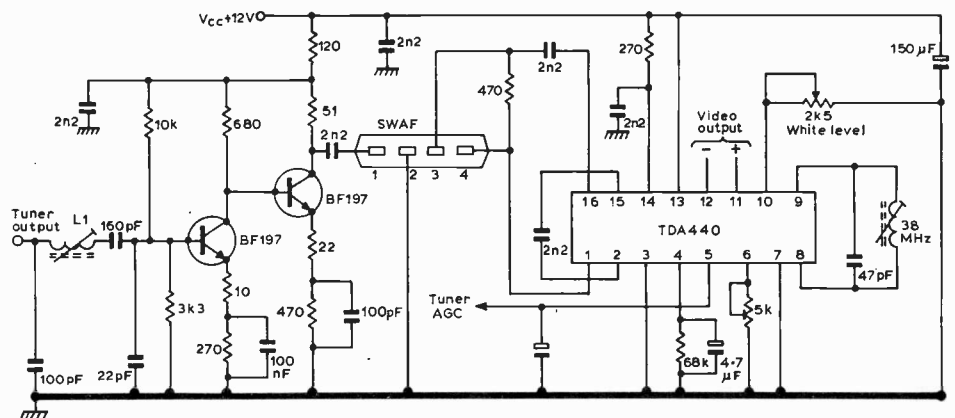


Fig.10: A more complete i.f. strip using the TDA440 i.c. and a single stage preamplifier. This configuration provides satisfactory performance for most normal domestic applications.

Fig. 11: A higher performance i.f. strip. This uses a two transistor gain stage with input tuning, resulting in high gain and a low output impedance, making the design suitable for data reception applications.



be minimised. The layout shown in Fig. 14 should be used, keeping the input and output track lengths as short as possible.

The future

In order to fulfil setmakers' requirements, which can vary significantly from manufacturer to manufacturer, new devices can be readily designed with the aid of a computer. Once the design has been finalised it can be quickly put into production – samples can be available within a few weeks!

It is understood that a number of variants on the basic block filter concept have been developed, including a filter with two different selectable bandpass responses, and a filter to extract just the vision carrier for more accurate synchronous demodulation.

As we have pointed out, samples of these devices have been circulating among setmakers for some time. What is

the reason for not seeing them so far in chassis? The answer is mainly economic. As far as we can ascertain the technical problems have been overcome and the advantages of SAWFs "sold" – at least to the design engineers! The problem as we see it is twofold. First Plessey are the only people manufacturing these devices at present, and by tradition one should never commit oneself to a design which uses single-sourced components. It is likely, however, that Plessey will rectify this situation, while Siemens, Mullard and GTE Sylvania have all done much work on SAWFs. At present the devices are economically unattractive, but once they become integrated into production sets the price will come down and in the long term there is likely to be a price advantage over LC filters.

Another factor which is holding back the use of SAWFs – and many of the new i.c.s – is the difficult economic climate at present.

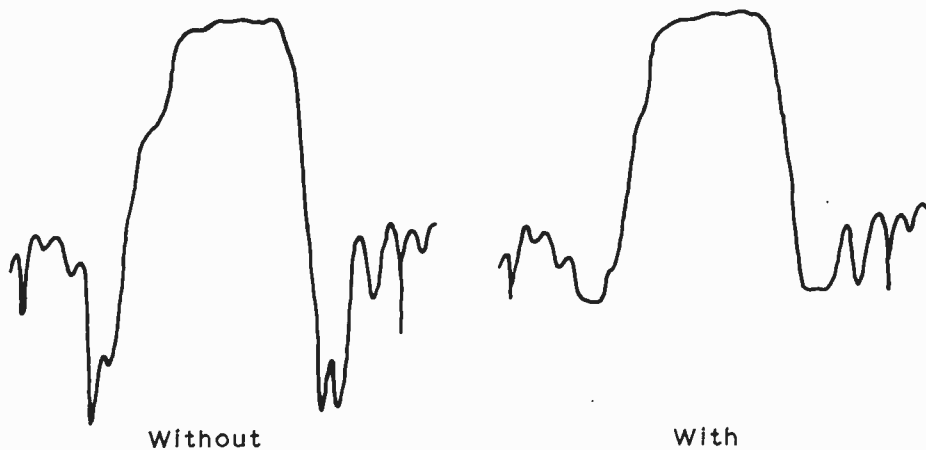


Fig. 12: The result of direct break-through due to poor layout. The response on the left was taken with good layout while the one on the right shows reduced trap depths due to breakthrough.

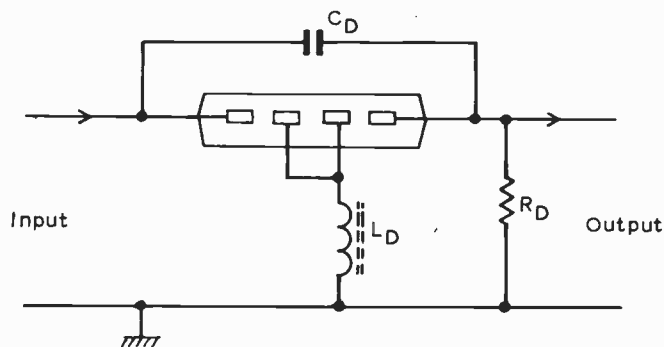


Fig. 13: Diagrammatic representation of direct breakthrough, showing the "components" responsible. C_D is capacitive coupling between input and output; L_D is a common impedance in the earth track.

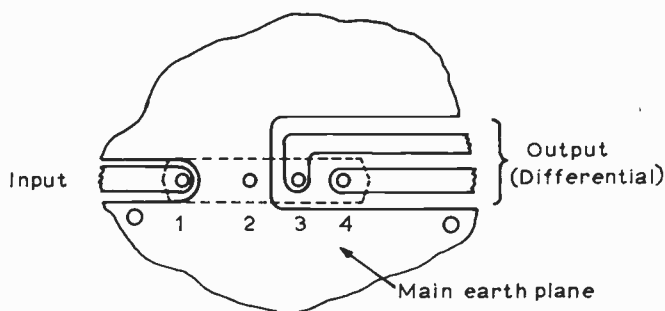


Fig. 14: Recommended p.c.b. layout to ensure low breakthrough. Any departure from this may result in unacceptable performance.

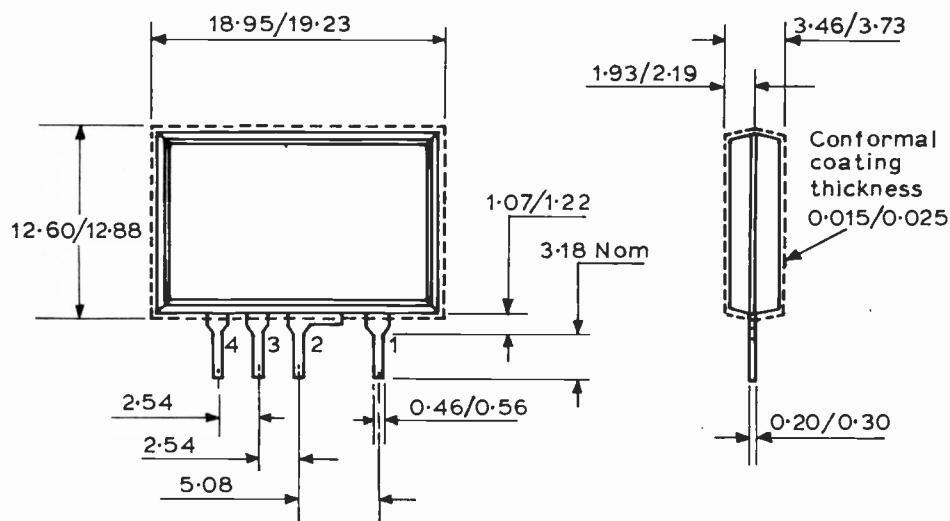


Fig. 15: Package details of the Plessey device. The saving in board space can be clearly seen when compared to say five coils.

It's nevertheless our belief that these are only temporary factors. There is little doubt that much can be gained from the use of SWAFs in a television receiver and it will not be

long before we see them emerge from the design laboratory into a production chassis. These devices are in fact currently used in one special chassis. ■

Table 1: Electrical Parameters of the Plessey SW150

Characteristic	Frequency (MHz)	Value			Units	Conditions
		Min.	Typ.	Max.		
Vision carrier	39.5	-8	-6	-4	dB	The reference level (0dB) is taken as the mean level between 36 and 38MHz
Colour carrier	35.1	-5	-3	-1	dB	
Sound carrier	33.5	-26	-23	-20	dB	
Trap depths:-	41.5	45			dB	
	41.4 to 41.6		45		dB	
	31.5	50			dB	
	31.4 to 31.6		45		dB	
Upper side lobe rejection	41.6 to 46.5	38	50		dB	
Lower side lobe rejection	26.5 to 31.4	38	50		dB	
Inband ripple	36 to 38		0.5		dB	
Group delay:-						
Deviation	36 to 38		10	50	nS	
Ripple	36 to 38		10		nS	Peak
Mean attenuation	36 to 38		16		dB	Load impedance 500Ω//5pF
Temperature coefficient			90		Hz/MHz/°C	

Test Conditions (unless otherwise stated):
 $T_{amb} = +25^{\circ}\text{C}$

Input drive impedance = 50Ω
 Load impedance = 100Ω (differential)

Safe Line Output Transistor Replacement

E. Trundle

ONE of the major hazards in servicing modern solid-state television receivers is the vulnerability of the line output transistor to instant destruction when a fault is present in the line output stage. No longer do we see a cosy red glow spread across the anode of the PY500 or PL509, or casually take voltage and current readings in the minute or so before the 500mA line output stage protection fuse blows. And with many line output transistors costing more than £4 apiece the "suck it and see" approach comes dear: in the best-regulated circles it is possible to reduce a stock of five BU208s to zero on one repair job – and without seeing any pictures! This offering is made in the hope of reducing, if not eliminating, those sad little piles of blackened fuses and dead transistors which, lying feet in the air, all too often grace the workbench these days.

Let us assume that we are faced with a set whose line output transistor has gone short-circuit. If a replacement is fitted and the power is applied there is a risk that the replacement will be instantly dispatched to that great TV set in the sky. . . .

The two basic reasons for failure of a line output transistor are: junction breakdown due to excessive inverse voltage, and destruction due to over-dissipation as a result of high forward current through the junction. There are several precautions which can be taken to lessen the chances of destroying a replacement device. Many do not call for sophisticated test gear, and can be carried out on site.

Check the HT Voltage

Excessive h.t. voltage is the first hazard that springs to mind. So if the power supply uses a series control element, be it a thyristor or a transistor, a chopper or regulator, check that this device is not short-circuit or leaky. Most small-screen monochrome portables use a series regulator, and this point is particularly relevant to them. In all cases, disconnect the h.t. feed to the line output stage (if this is difficult, isolate the collector of the line output transistor) before applying power. Then confirm with a voltmeter that the h.t. voltage is not excessive, and that the h.t. regulator is working. If all is well at this stage, leave the h.t. set at the lowest possible voltage.

Excessive Damping

The next most common cause of line output transistor failure at switch-on is a heavily loaded line output stage. A faulty e.h.t. tray, shorted or leaky flyback/scan rectifiers or their reservoir capacitors (used for c.r.t. first anode and l.t. supplies for instance) and shorting turns in the scan coils, the shift choke or the line output transformer can damp the stage sufficiently to destroy the line output transistor. Thus before applying power it is wise to disconnect the e.h.t. tray from the e.h.t. overwinding along with as many of the other peripherals as are reasonably accessible. If the line scan coils are taken out of circuit make sure that the e.h.t. is also disabled – to prevent c.r.t. phosphor burns. Where a plug is

used to connect the line scan coils, it will often be necessary to restore the h.t. link on the plug or socket.

To take this to its logical conclusion we arrive at the stage where the line output transformer stands alone and unencumbered. By this time there will probably be two TO3 corpses bearing mute witness to the difficulty of diagnosing shorting turns in a line output transformer. This effect is fairly common on Thorn 3000/3500 series colour sets and their derivatives. The story is simply told. The e.h.t. tripler develops a leak which loads the line output stage, the resulting heavy current and overheating destroying the insulation of one, or sometimes both, of the output transformers – line scan and e.h.t. The picture has long since disappeared, but the viewer – or rather listener now – determined not to miss anything keeps the set on until the R2008 line output transistor finally succumbs, sometimes taking the chopper transistor with it. In this sort of situation the technician is likely to get through a lot of R2008s in his unhappy quest.

Current Limiting

The best course is to insert a series resistor in the h.t. feed to the line output stage to limit the current. Except in those evil designs where the line oscillator is powered from the line output stage (an externally applied voltage is then necessary to maintain oscillation when trouble-shooting) this technique is useful and almost foolproof. As a rough guide, sets with a 60V h.t. line require a series resistor of about 30-35Ω while the more common high-voltage system, with a 160-200V h.t. line, will need a resistor of 300-350Ω or so. Standard fire-bar elements can be used to make these resistors – ordinary ones will quickly overheat. Thus protected, the line output stage can be powered.

The h.t. voltage appearing across the line output stage in this condition will depend on the type of set. A small-screen 90° colour set will develop almost two-thirds normal voltage, while a 26in. 110° model with l.t. lines etc. powered from the line output transformer will manage between one-third and half the normal h.t. voltage. Other types of set fall between these two extremes. Apart from the latter case, a workable though undersized raster is usually visible. If the voltages specified appear with the limiting resistor in circuit, it is reasonably safe to apply the full h.t. If the voltage developed is markedly lower than expected however the progressive load-shedding mentioned earlier should be resorted to. When the faulty component is removed from the circuit the current through the line output stage will drop and the voltage across it will correspondingly increase. Incidentally, don't put the firebars on the top of the cabinet or on the carpet during these tests!

Drive Faults

The third threat to the newly-installed line output transistor is incorrect line drive conditions. We have left this till last because it is the least common of the three causes so far mentioned and except in the case of two-transistor line

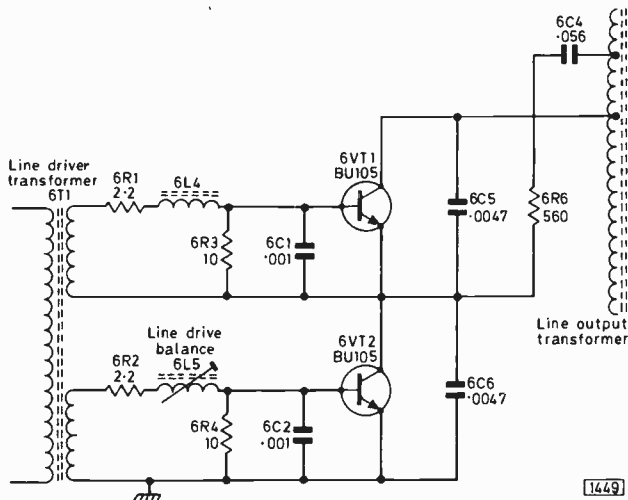


Fig. 1: The two-transistor line output stage widely used in earlier solid-state colour chassis. This example is from the Rank A823 chassis. To ensure that the line flyback pulse voltage developed across the two transistors is equal the output stage tuning capacitance consists of two series connected capacitors 6C5 and 6C6 whose junction is connected to the centre tap on the primary winding of the line output transformer via 6R6 and 6C4. These latter two components were omitted on later versions of the chassis. They can safely be removed from earlier models.

output stages (more about that in a moment) cannot usually cause line output transistor failure due to excessive p.i.v. across the collector-base junction.

The line drive can be checked only with an oscilloscope. It must be correct as to waveform, amplitude and mark-space ratio to avoid over dissipation in the line output device. Most setmakers illustrate this waveform amongst the oscillograms shown in their service manuals.

Two-transistor Circuits

Since the arrival of the BU208 and similar line output transistors the two-transistor line output technique has, with one or two notable exceptions, become far less common. Many popular chassis such as the Rank A823 family, the Philips G8 and some early Thorn 3000 modules use the two-transistor approach however, with the two devices effectively in series so that the flyback voltage is shared equally between them. In the Thorn design no line drive adjustments are necessary or provided, but the Philips and Rank circuits incorporate a means of phasing the line drive to compensate for differences in the storage-time characteristics of the two transistors fitted. Each manufacturer gives precise and detailed setting up in-

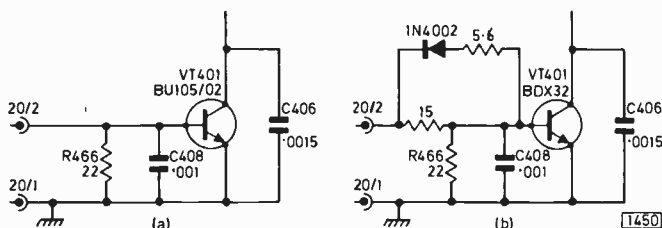


Fig. 2: A BDX32 line output transistor can be used to replace a BU105/02 transistor in the Thorn 8000 and 8000A chassis provided the modifications shown in (b) above are carried out. The extra components modify the drive conditions and can be mounted on the transistor's heatsink. They must be removed if either a BU105/02 or its successor the BU206 is subsequently fitted, restoring the circuit to its original state (a).

structions in the appropriate service manual, and we cannot over emphasise the importance of this adjustment.

Whenever a transistor replacement is carried out in the Rank double-transistor line output stage (see Fig. 1) we have found it essential to check the other transistor for leakage, also both tuning capacitors (6C5 and 6C6, 4,700pF, in the A823 and subsequent variants) since these can become leaky, open-circuit or low capacitance. If in doubt, it is safer to replace both capacitors. Later versions (A823B chassis) delete 6C4 and 6R6 altogether, and these may be removed from earlier models. The same applies to the equivalent components (R5525 and C5530) in the Philips G8 chassis. These remarks about checking both tuning capacitors and the second transistor apply equally to other double-transistor circuits, although the Rank set seems more prone to this problem, especially in early models where the tuning capacitors were of a type which has since fallen from favour.

Miscellaneous Miseries

From bitter experience we would add a few further causes of electrocuted line scan transistors, roughly in order of likelihood.

First comes intermittent opening of the tuning capacitor – the one connected across the collector and emitter of the transistor in question. We have a great distrust of these capacitors, and although they are expensive as capacitors go they are worth changing by way of insurance. The capacitors in the Rank line output stage have already been mentioned and we have on occasions found the tuning capacitor in the Thorn 8000/8500 series (C406) guilty on this count. In all cases a type approved by the manufacturers should be fitted. These capacitors lead a hard life, and if an ordinary capacitor is fitted the ripple current will fix it if the peak voltage doesn't.

In some chassis there is a separate efficiency diode, e.g. W504 in the Thorn 3000 family. Check this when replacing the line output transistor – if it's open-circuit or dry-jointed this bodes ill for the newcomer.

EHT Flashovers

E.H.T. flashover is not a common cause of line output transistor failure these days, but if flashover is suspected it is worth checking the c.r.t. aquadag earth path to the c.r.t. base sparkgap panel, and that the e.h.t. voltage is not excessive.

Correct Replacements

Finally we come to the question of incorrect type transistors being fitted and dying with their boots on as a result. The quick answer here is that only the transistor specified by the setmaker should be fitted. There was a flurry of activity by semiconductor and TV set manufacturers a few years ago however, resulting in the early obsolescence of some transistor types, especially those with confusing numbers like BU105/02. Early Thorn 8000 series receivers using the BU105/02 should be fitted with a BU206 as a replacement. With the modification shown in Fig. 2 a BDX32 may be fitted, but under no circumstances replace a BDX32 with a BU206. The BU105/01 may be encountered on occasion, the current replacement type being the BU205 which also replaces a BU105 if necessary. The BU108 is now replaced by the BU208: an equivalent to both is the 2SC1172. ■

CIRCULAR POLARISATION

R. Cherville

EXTENSIVE experimental TV transmissions have now been carried out in the USA using circular polarisation (CP) instead of the normal single plane (vertical or horizontal) signal polarisation – usually horizontal in North America. The results obtained from these experimental transmissions are being assessed by the industry and it's possible that the Federal Communications Commission will amend its regulations before long to allow transmitters to adopt the new system on a regular basis.

Circularly polarised signals differ considerably from the vertical or horizontally polarised signals we normally use. With vertical or horizontal polarisation the electric field is transmitted in either of these planes and a dipole mounted in the same plane will have induced in it a signal which gives the maximum output voltage across its terminals. If the dipole is rotated through 90° it no longer lies in the electric field of the transmission and minimum signal voltage will appear at its output terminals.

Generating a CP Signal

The generation of a circularly polarised signal is a more complex process since the field has to be produced and transmitted in a rotating sense, with either a clockwise or an anti-clockwise screw. The rotation can be produced by feeding the signal energy to two dipoles mounted at right angles to each other. To control the sense of rotation, i.e. whether the signal has a right-hand (clockwise) rotating field or a left-hand (anti-clockwise) rotating field, an additional quarter wavelength of cable is inserted in the feed to one of the dipoles or, alternatively, the spacing of the

dipoles along the transmitting aerial boom is displaced by a quarter wavelength. Another approach is to use a multi-turn helical array of approximately full wave diameter and with a quarter-wave pitch: the sense of rotation is determined by the screw of the helix.

Reception

At the receiving end of the propagation path the circularly polarised aerial gives maximum output when receiving a similarly polarised incident signal, i.e. a signal with either a right-hand or left-hand sense of rotation. Conversely when the sense of rotation of the signal and aerial are opposite minimum output is obtained from the aerial. Unfortunately however it's impossible to transmit a signal which has completely circular polarisation. The signal tends to be elliptical instead and as a result there tends to be a slight amount of the opposite signal present, i.e. with an RH CP signal there will be a slight amount of LH CP signal present. The result with a receiving aerial is some response to signals in the reverse sense to the designed for one.

The photograph on the right shows a circularly polarised transmitting aerial developed by Jampro in the U.S. The spiral radiating element is wrapped around the vertical mast.

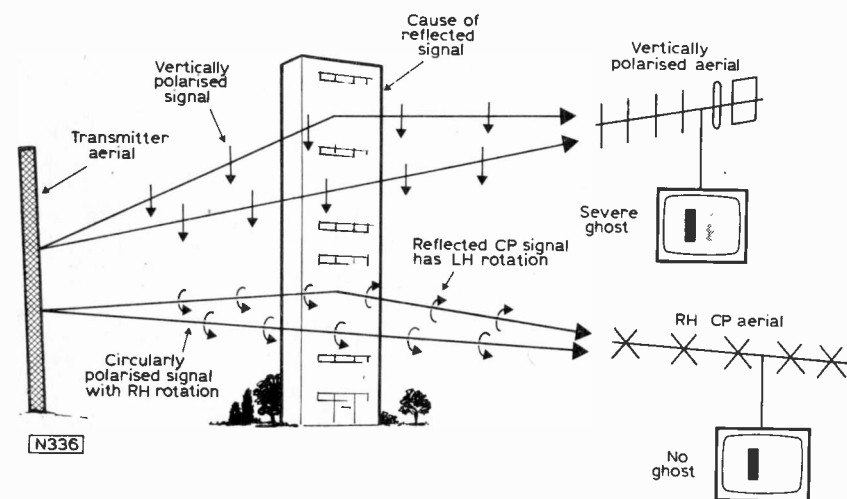
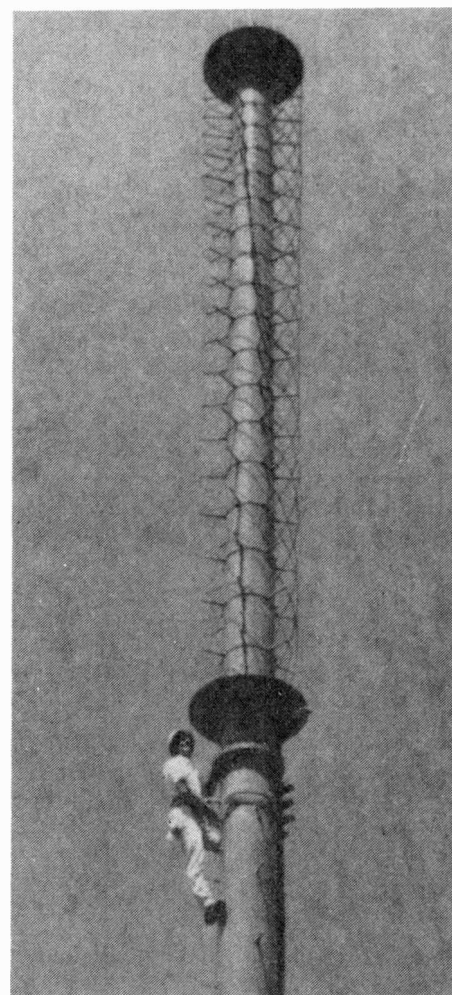


Fig. 1: Illustrating one of the advantages of circularly polarised transmissions: since a reflected CP signal reverses its sense of rotation while a CP receiving aerial discriminates between CP signals of opposite sense, ghosting is considerably reduced.

Goodness Factor

RCA, who are active in this field, suggest that the quality of circular polarisation can be described in two ways. First *polarisation ratio* – the mathematical ratio of the maximum vertical to the maximum horizontal component of the signal. Secondly, *axial ratio* – the ratio of the major axis of the polarisation ellipse to its minor axis.

For television purposes the axial ratio has the greater significance since this denotes the aerial goodness factor – the nearer to unity, so the quality deteriorates.

Benefits

The main benefits of circular polarisation are obtained in heavily built up areas where ghosting is a problem with conventional polarisation. Ghosting can be severe in such areas even when elaborate log-periodic arrays are used. The advantage of circular polarisation in these conditions is that a reflected circularly polarised signal undergoes a 180° phase shift: thus a right-hand circularly polarised signal on reflection becomes a left-hand circularly polarised signal. An RH CP aerial with its minimal response to LH CP signals will in consequence give a display with greatly reduced ghosting. The principle is shown in Fig. 1 which compares the situation with vertically and RH circularly polarised transmissions and aerials. One aerial manufacturer in the States has suggested that the ghosting figure is reduced between 10-20 times when CP is used instead of single plane polarisation.

Compatibility

Since built up areas are generally served by good signal levels from local transmitters there is a tendency for viewers in such areas to make greater use of indoor aerials. Many such aerials, such as the well known bisquare, have random polarisation. Circular polarisation is compatible with aerials orientated for any polarisation, so that improved performance should be obtained on such indoor arrays.

A conventional outside aerial mounted for horizontally polarised transmissions will produce a signal output from a circularly polarised signal by responding to its horizontal component. Using a plane polarised array in a fringe area would result in a lower delivered signal voltage, assuming that the transmitter e.r.p. is not increased with a change to circular polarisation. But the e.r.p. can be doubled without increasing the interference to other transmissions since the signal consists of two separate components, vertical and horizontal – this assumes that the transmitter network uses only one mode (i.e. horizontal or vertical) of plane polarisation. Under these circumstances appropriate choice of transmitted signal rotation and receiving aerial can give substantial reduction in both co- and adjacent channel interference.

Conclusion

The results of the American experiments suggest that the reception advantages that have been demonstrated with circular polarisation are likely to see its gradual adoption in future years in parts of the TV broadcasting field. As yet there has been little reaction in Europe – at least so far as terrestrial broadcasting is concerned.

Our thanks to the North American BME magazine for March 1976, in which much information on the experimental results obtained was given. ■

IF YOU HAVE A WIDTH PROBLEM

– continued from page 644

In the single-standard chassis, 169 series and on, check the PL504 and PY800, the two 4.7M Ω resistors (R85-R86), also R80 and R81, and suspect shorted turns in the line output transformer.

Philips sets (some Stella, Peto Scott, Cossor and some Alba models): In the 170 chassis check the line output stage valves and the ECC82 line oscillator. Then suspect the two 8.2M Ω resistors above the width controls. The line output transformer does fail, but this is usually a short between sets of windings, killing the timebase in the same way that a shorted boost capacitor does.

In the 210 series, check as above (valves and resistors) but suspect shorted turns in line output transformer if there is little step up in the sparks at the PL504 top cap and top of the e.h.t. rectifier.

Single-standard 300 series, check as for the 210 chassis.

Thorn Group, 850 chassis through to the 1500 series (Ferguson, HMV, Marconiphone, Ultra and some other brands): Check the valves and then the resistors, from the boost line to the width control and on from the width control to the output valve's control grid. Transformer not usually at fault. See earlier remarks.

Rank—Bush, Murphy and the Co-op (Defiant): Resistors not usually suspect. If the valves are not responsible the line output transformer must be suspected. In the majority of cases the transformer fails completely. Often however it is the cause of lack of width, with ballooning at the slightest hint of brightness. Models mainly affected range from the TV135 up to the more recent single-standard chassis (A774) which has a transformer with a plastic covered e.h.t. overwinding. The pitch covered transformers were suspect but not to the same extent. The choke on top of the transformer is occasionally at fault.

GEC Group, including Sobell, Masteradio and McMichael: Check the valves and the width control itself, the series 470k Ω resistor and the high-value resistors to the output valve's control grid. The transformer is very likely to be at fault. Check the condition of the top choke.

ITT, KB, Regentone, RGD: Check the valves, including the ECC81 oscillator in early models, and the resistors as above. The transformer is occasionally at fault.

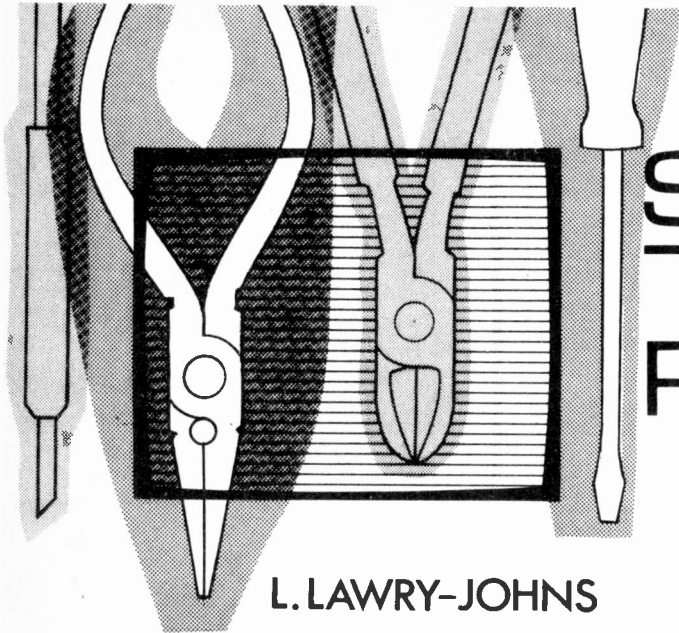
Scan Coils

Since the line scan coils are wound in two sections, shorted turns are more likely to cause a wedge shaped raster than an even lack of width.

Low HT

Lack of width, probably with other symptoms, can also be due to defective main electrolytic capacitors if the h.t. voltage is lower than normal with no sign of overheating in the line output stage.

This should also be kept in mind when dealing with hybrid colour receivers – probably accompanied by very low brilliance. We have in mind mainly the Pye group single-standard 697-723 series. ■



SERVICING TELEVISION RECEIVERS

THE PHILIPS K70 COLOUR CHASSIS

A LARGE number of these Swedish built sets were released on the market about five or six years ago, both through wholesalers and through rental outlets. A goodly number are now on the second-hand market or otherwise out of the hands of the original suppliers. There are many readers therefore who need or will need such information as we can put together in as readable a form as we can manage.

Description

The cabinet is rather bulky, housing a 26in. 90° tube. It sits on a frame and if the original fixings are still in use an Allen key is required to release the bolts. You may well find however that these have been omitted at some time in a set's career – very often the set can be lifted off without the necessity to seek the bolt holes. The front presentation is quite pleasant, with a push on/off switch at the top and six rotary controls beneath. These are volume and tone, brightness and contrast, and saturation and hue. The tone and the hue controls have a definite centre position to “feel” the preferred position.

The six press-button tuner at the bottom covers v.h.f. and u.h.f., but only the latter is of use in the UK of course. Thus all six will probably be found set to receive u.h.f. There are likewise two aerial sockets at the top rear, but only one need concern the user.

There are two loudspeakers and the quality of reproduction is very good (until the PCL86 audio output valve starts its pranks that is).

The Innards

The rear cover is secured by two sliders (secured by screws) at the top: it hinges down to free the bottom clips.

The first time one removes the rear cover and looks at the interior one's initial reaction is to put the cover back on and forget the whole thing – or remember an appointment elsewhere and promise to return at a later date. Such cowardly impluses must be controlled of course if you own the set, and you then have to take time to see where most things relevant to the fault are situated. There is a plastic plug at the top right and a plastic latch at the bottom right (marked). With the plug withdrawn and the latch swung to the right the chassis can be swung open to reveal the front of the panel, the bottom centre power supply panel and

the right side group of line output valves. Most receivers use a PL509, a PL504 and a PY500 in this group but it is quite common to find a label on the right side with PL509 boldly proclaimed. This means that there are two PL509 valves and no PL504. More on this later.

Profusion of Presets

A thing which strikes a close observer is the profusion of preset controls. Wherever the eye settles there is another preset to tempt the hopeful fiddler. Over a period of time many engineers develop an instinct for spotting the right preset almost every time, even on a strange chassis. It doesn't work on this one. The service information must be at hand at all times before any adjustment is attempted – except perhaps for convergence.

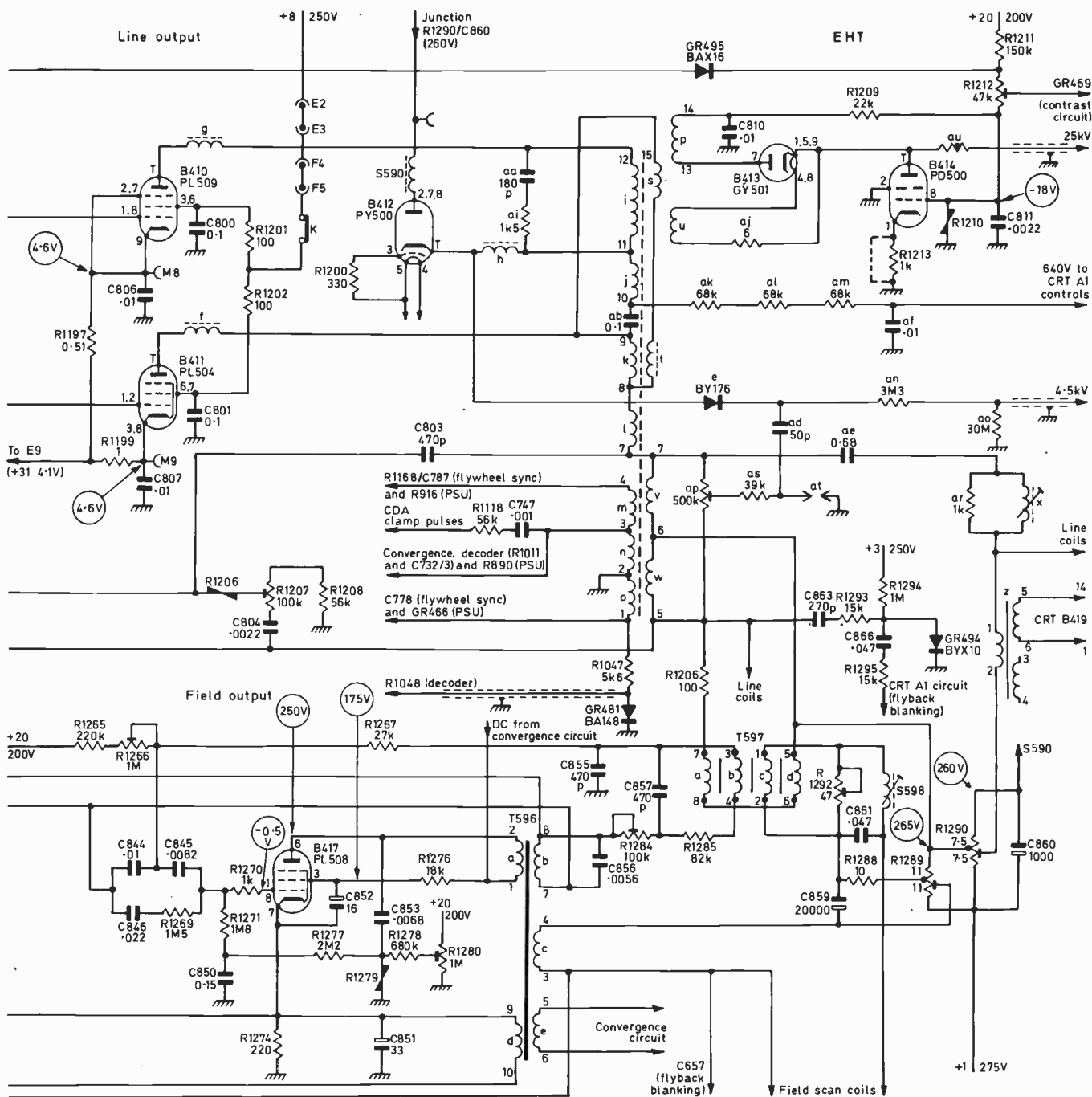
Convergence

The convergence panel is on the left side, concealed by a wood strip secured at the top by a single screw. If only a single adjustment is needed it can often be done without sliding out the panel (box is perhaps a better word) as the knobs are clearly marked both in sequence and function. For more exact setting up the panel must be withdrawn and stood on top of the cabinet. All adjustments are made, including static convergence, following the numbered sequence. There are no static magnets on the tube assembly.

There are six background (first anode or “G2”) controls. The three to the left of the tube are the initial or coarse adjustments, those on the extreme left side are the fine ones for getting the grey-scale just right without dismantling the rear cover.

Valve Functions

There is a goodly number of valves and although their functions are in the main obvious there is a joker in the pack. One looks up to the top left and sees the extreme left PCL86 which is obviously the audio output valve. To the right of this are the three PCF200 colour-difference amplifiers and clamps, following conventional practice in hybrid chassis, with the PL802 luminance amplifier farther towards the centre.



second PL509 in place of the PL504, in the line output stage. These will be shown next month.

oscillator components are along the top but the bottom is taken up with power supply resistors and smoothing capacitors.

A thing which may strike the close observer when looking at this area is the number of very small resistors in the power supply lines. In fact these act more like fuses and should not be replaced with larger types because in the event of a short the load would be reflected farther back in the supply with consequently more extensive damage and confusion as to the source of the fault. If one of the small resistors is found "looking poorly" one immediately knows at least in which circuit the fault lies. This is more important than it might at first appear to be, since some of the supply lines are drawn from the line output transformer.

It should be appreciated that there is no mains transformer and therefore all the supply lines are dropped either from the mains or derived from windings on the line output transformer (including the tube heaters). The valve heaters are in a series chain which follows the GR460

bridge of rectifiers (as opposed to the parallel h.t. rectifiers GR461/GR462). If this sounds a bit murky, look at the power unit diagram and read what comes later.

Circuit Protection

But for the moment we want to return to the subject of the small safety resistors. Let us say that R901 is found damaged. This is a 33Ω 1/8W type. It's in the "+2" (270V) supply line to the field timebase. In the event of a short in the field circuit – the output stage that is – the resultant heavy current flow will burn up this small resistor instead of opening the thermal cut-out (R897). If the 33Ω resistor was a larger type the cut-out would open and leave considerable doubt as to where the fault was.

Note also R916 which again is an 1/8W type but has a value of 100Ω. This is in series with a BA148 diode which supplies (+20, 200V) the field oscillator. The current demand is very low, hence the use of a BA148, and the

source of the supply is a winding on the line output transformer (windings N and M or 2 to 4).

Obviously a severe short across this line would overload the line output stage and indeed the writer has heard the "whine" of protest from the line output transformer just before R916 gives up the ghost and burns to a cinder. What causes this to happen? Several things, but usually the diode itself shorts as the result of local heat.

So this is the purpose of the small resistors: to act as fuse links as well as surge limiters. Although the chassis is full of somewhat unusual features we do not propose to go into lengthy explanations of all these as by and large the main part of the receiver is reliable and requires little attention. There are some parts which regularly give trouble however, presenting the repairer with quite a headache if he is not forewarned.

Power Supply Faults

Most of the troubles occur in the power supply and in fact these cause the least doubt. Most often the first sign of trouble is that the set fails to work at all. Investigation may show that either the supply fuse in the mains plug has failed (if it's a 5A type) or that one of the 3.15A fuses on the power panel (perhaps both) has blown. In fact there are three fuse holders on the panel, the centre one being unused.

In this event the first items to check are the four diodes which form the bridge (hence our earlier reference to a bridge of rectifiers rather than a bridge rectifier). Quite often these may not all be of the specified type (BY127), and may be of the square variety with a slope at one end to indicate polarity. Whatever type is found, check their back-to-front resistance: one will almost certainly be found to be short-circuit. Remember that these four diodes lead a pretty hard life, passing the heater as well as the h.t. current.

Heater Chain

In view of this one may find that replacement of the faulty diode and the blown fuse may still leave the set not working due to a more obscure trouble which initially put the "last straw on the camel's back". When the set is switched on take note of the valve heaters, particularly in the line output cage. It is sometimes the case that these will light up brightly whilst all the other heaters do not light up at all. This can be caused by a shorted heater decoupling capacitor (little brown discs from heater pins to chassis) and two of these can be seen sticking out from the PY500 valve base. On two occasions we have found one to be blackened to denote that the heater current is flowing through the PL504, the PL509, the PY500 and the capacitor only, the other valves remaining unsupplied. There could be other causes such as a heater-cathode short in another valve, but this hasn't happened to us on this chassis so far. So far . . .

EHT Compartment

Before leaving the subject of valve heaters, don't forget that the PD500 shunt stabiliser is in the top of the enclosed e.h.t. compartment and that the heater of this valve is also in the series chain. And whilst we are about it we must mention that the cover of the e.h.t. compartment operates the switch which is in series with the h.t. supply to the screen grids of the PL504 and the PL509 (or both PL509s if two are used). This is to cut off the e.h.t. when the cover is removed, thus preventing X-ray radiation from the GY501 and PD500 valves.

CONTINUED NEXT MONTH

next month in Television

● REMOTE CONTROL UNIT

The latest development by Alan Willcox in his series of remote channel change control units is a version requiring minimum connections and modifications to the TV set. In consequence the receiver section can either be built into or stood on top of the set. A new simple ultrasonic transmitter makes use of a timer i.c. while LEDs give channel indication.

● GRUNDIG COLOUR RECEIVERS

Andy Denham relates his experiences in servicing the first Grundig solid-state chassis – the 5010/5011 series. This is the first time we've looked at faults on a chassis using a thyristor line output stage.

● THE SONY U-MATIC VCR

Start of a detailed look at the signal and servo techniques used in this well known VCR.

● VIDEO CIRCUITS FOR THE EXPERIMENTER

Since building a solid-state monochrome receiver four years ago Luke Theodossiou has tried out in it a number of different video output circuits. The course of this development is traced and the advantages of the various circuits described.

● SERVICING FEATURES

John Law describes the Indesit T12LGB portable and its faults, Dewi James describes some interesting faults recently encountered on a variety of models and there's more from Les Lawry-Johns on the Philips K70 colour chassis.

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INTERNATIONAL BROADCASTING CONVENTION

Philip Ross reports

AN increasing number of national and international conventions and exhibitions are being devoted to the electronic, film and specialised aspects of television – too many for any single event to claim undisputed leadership. But for European broadcasting engineers and engineering management the biennial International Broadcasting Convention (IBC) held in London since 1967 – it alternates with the Montreux technical symposia – has come to occupy a key position, particularly for the quality and discrimination of its technical papers and presentations.

The sixth IBC – at Grosvenor House, Park Lane from September 20 to 24 – has the support of over 60 international firms, is expected to attract some 2,000 delegates and visitors, and has a strong technical programme of almost 60 papers. There are sessions on studio systems; recording; digital techniques; picture origination; new information systems such as Teletext; transmitters; aerials and distribution; and sound systems including sound radio broadcasting. A parallel specialist exhibition and technical session at the Hilton Hotel is devoted to the engineering aspects of electronic news gathering, including hand-held colour cameras, portable video tape recorders used with digital timebase correctors, and light-weight microwave links. Among the associated trade exhibitions will be one by Ampex at the US Trade Center, Langham Place.

For the broadcasters and capital equipment industry, IBC-76 comes at an important yet difficult juncture. In the UK the high-power u.h.f. transmitter programme is virtually complete, with the emphasis shifted now to low-power transposers for gap-filling and with both BBC and IBA reorganising internally their network control systems to concentrate supervision in just a few regional operations centres.

Studio Equipment

At the studios, after seven years of three-channel colour the ITV programme companies and the BBC might be expected to be on the verge of massive re-equipment of their technical areas, but apart from routine replacement and expansion they are anxious first to study the recommendations (expected next year) from the Annan Committee on the future of broadcasting in the UK. A number of large overseas projects in the Middle East and South Africa, and the change to colour in Australia and New Zealand, are now complete or nearing completion.

While there remains the controversial £5-million-plus studio production centre for the Open University to be built at Milton Keynes, other British educational networks have been facing severe cutbacks and some closures. In sound radio, all the 19 authorised Independent Local Radio stations are now in operation; again the Annan Committee is seen as the key to any further expansion.

The first two-year experimental period of Ceefax and

Oracle Teletext, launched at IBC-74, runs out but will undoubtedly be extended. A great deal of operational experience has been gained but there are fewer decoders available to the public than might have been expected (we shall be doing something about that shortly – Editor). The receiver and component industry has clearly run into the classic chicken-and-egg situation in which specialised large scale integrated circuit devices await a proven demand which cannot be firmly gauged until such components become available.

So famous firms will be struggling to find fresh business and to keep a foot in the door of an industry that recognises that new technology involves risks and hidden costs in making operational changes. They will be seeking new outlets in an IBC that marks the 21st anniversary of the start of Independent Television in September 1955 and comes midway between the 40th anniversaries of the unofficial and official opening of high-definition television from Alexandra Palace in August and November 1936.

This year also marks another important anniversary – 20 years since the first demonstration by Ampex of a practical system of videotape recording, in 1956. It was perhaps the single most important innovation (even including colour) to come out of the 40 years of television broadcasting,



The Ampex VPR-1 helican-scan recorder, with the exclusive automatic scan-tracking (AST) system, provides broadcast quality, slow-motion and still-frame playback. AST eliminates tracking and interchange problems. Other features are $\frac{1}{2}$ speed and manual frame-by-frame jogging for simplified editing. The version shown is the table top model.

revolutionising as it did the entire approach to programme production. Few of the current developments compare in importance, though in the long term the advance of digital and computer techniques promises to bring major changes all along the line from picture origination through inter-city and inter-continental distribution links and even to some extent the transmitters. The radiated signal seems certain to remain in analogue form (except for Teletext) for many years to come however: it is impossible to imagine any change from existing transmission standards in this century – and possibly not for many years into the 21st century.

Hardware

At IBC-76 electronic news gathering is not expected to spring very many surprises although it will give European engineers a chance to see much of the hardware that is being used or developed for this purpose in the United States. The Thomson-CSF Microcam and the RCA TK76 cameras have set a weight standard that even the Japanese firms will find difficult to beat. Emphasis will shift to improved cassette and helical-scan recorders and better and more reliable microwave link equipment.

Video recorders of all types continue to make progress. At IBC-76 Ampex will introduce its new 1in. machine as a rival to the Bosch-Fernseh series now licensed to other European and American firms. But the existing investment in standard 2in. quadruplex studio machines is such that it is unrealistic to expect any early or sudden phasing out of the long-established standard, no matter how attractive the operational economics of alternative approaches such as the half-speed quad machines and the full-track and half-track IVC/Cintel/Thomson 9000 series super-high-band machines.

Even if electronic news is still controversial, electronic location-drama and similar applications using high-grade but lightweight production cameras, usually based on 1in. lead-oxide vidicon tubes, have become firmly established and are reflected in the products in most of the major camera ranges. Few entirely new camera techniques seem to be forecast in the engineering papers, but there may be last minute surprises – if only to react to the successes of such “newcomers” in this field as Link and IVC.

Transmission

Pye TWT have a new transmitter drive. Thomson-CSF a new generation of u.h.f. klystrons. Circular polarisation for television broadcasting is being featured at IBC-76 by the American firms Jampro and Harris.

Operational experience with Teletext is reflected in papers from Mullard, ITCA, GEC, BBC and IBA, while the Post Office will talk about Viewdata and from Japan comes a new information system. Of particular interest is a paper by Peter Hutt of the IBA discussing the questions that affect good reception of Teletext and the concept of “eye-height” measurements as a means of checking transmitters, propagation and receiver i.f. characteristics. The question of measurement and specification of Teletext waveforms also receives attention in a BBC presentation.

Digital Techniques

Digital frame stores – with their important application to non-synchronised sources – are represented both in the exhibition and at technical sessions. Their use for standards conversion is featured in the production model of DICE



The Ampex Model AVR-3 is the world's first "intelligent" VTR. The AVR-3 allows broadcasters to record and play back live pictures automatically. When equipped with the optional edit controller the AVR-3 can be programmed to handle a wide range of editing functions otherwise currently possible only with computer editing systems. The AVR-3 is a dual-band machine compatible with existing broadcast equipment.

being shown by Marconi. Digits also turn up in the new Marconi high-stability sync pulse generator and in the IBA's digital automatic measuring equipment (DAME) for monitoring unattended colour transmitters.

From Japan, OKI describe a bit-reduction technique for digital-video based on orthogonal transforms. Also part of the intensive research into digital transmission will be the 120 Mbit/s transmission equipment featured by the BBC and IBA.

More Papers

BBC engineers are also looking afresh at such questions as the electronic subtitling of films, the operational evaluation of cameras, and the potential application of solid-state image sensors. ITN papers describe their very advanced system of computer-generated graphics as well as an economic locking system for outside broadcasts.

Overseas TV broadcasters are tackling such matters as RTE's use of precision-frequency-offset by using reference bursts in the video blanking period (rapidly becoming the busiest part of the TV waveform!), and CBC's elaborate use of computer switching right across Canada. A Yugoslav paper tackles the almost impossible task of trying to describe all the uses of computers in broadcasting (microprocessors are similarly tackled in an IBA paper). There will also be a chance to learn about the new SABC TV centre at Johannesburg.

A considerable number of papers and exhibits are devoted to various aspects of sound radio, which has increased its influence at recent IBCs.

Summary

To sum up, IBC-76 promises to be as technically interesting as ever and a chance to see much new or recent hardware. For the 60 exhibitors on the other hand eyes and ears will be anxiously searching for early warning of any major new overseas plans – or even looking out for any minor re-equipping contracts for the British studios. ■

Video Circuits for Monochrome Portables

S. George

YOU would think that there was not much scope for diversity in such a relatively simple matter as the design of a transistor video circuit for use in a small-screen monochrome portable receiver. A quality picture with the d.c. level maintained is not too important since such sets are often watched under adverse light conditions. Thus a.c. signal coupling has been widely adopted in the past. A very common video arrangement has been to follow the detector with an emitter-follower – so that the comparatively low input impedance of the video output transistor does not load the detector circuit – and a.c. couple the output transistor to the c.r.t. cathode, with contrast control and flyback blanking effected in the output transistor's emitter circuit and the brightness control setting the d.c. level at the cathode of the c.r.t. That said however it seems that as so often designers have decided to go their own ways, and in this article four contrasting examples from current models will be described.

Philips X09T Chassis

The first example, shown in Fig. 1, is used in the Philips X09T chassis – found in the Philips 9in. T-Vette and the Ekco Model T545. This features d.c. coupling from the vision detector right through to the c.r.t. cathode, with a beam limiter between the output transistor's collector and the c.r.t. cathode. For the reason given above, an emitter-follower stage TR7 is included between the vision detector diode and the output transistor TR8. The contrast control is incorporated in a bridge configuration so that its adjustment does not alter the bias applied to the base of the output transistor but only the signal drive. This works as follows. The emitter-follower is biased so that the d.c. voltage across its emitter resistor R304 is the same as the voltage developed at the junction of the potential divider R309/R310 which supplies base bias to the output transistor. Thus d.c. does not flow via the contrast control which merely sets the amount of signal reaching the base of the output transistor. The bridged-T filter R306/C310/C311/L303 is tuned to 6MHz to remove the intercarrier sound signal from the video feed.

The 75V h.t. supply for the output transistor is obtained from a rectifier fed via a winding on the line output transformer. Bias stabilisation in the output stage is provided by feeding a bleed current through its emitter resistor R312 – this flows to the 10.6V rail via the combination R313/R323. The set's l.t. supplies are stabilised by a series regulator transistor which is connected in the negative side of the supply.

Line flyback blanking is effected by feeding positive-going line flyback pulses to the emitter of the output transistor via R315. These momentarily lift the transistor's emitter voltage above its base voltage, thus cutting the transistor off and increasing its collector voltage and the c.r.t.'s cathode voltage almost to the h.t. rail potential to cut off the beam current. This method of flyback blanking has the advantage that it reduces the output transistor's power dissipation, always an important factor but especially so in portable sets

which are often used in areas with high ambient temperatures. Field flyback blanking is done by feeding negative-going pulses to the grid of the c.r.t. Separating the field and line flyback blanking ensures that line pulses do not infiltrate back into the field timebase to cause poor interlace or even line pairing.

The two peaking coils – PR302 in series with the signal feed to the c.r.t. and L302 in shunt – maintain high gain up to the top designed for video frequency, their effect being enhanced by C303 which because of its value leaves the output transistor's emitter resistor R312 undecoupled at the lower frequencies.

As with all u.h.f. receivers using d.c. coupled video circuits, the brightness level is at maximum with no signal, the negative-going video signal driving the output transistor towards cut off. This means that loss of signal anywhere up to the detector would result in maximum beam current. If sustained this would impose a considerable overload on the e.h.t. rectifier and indeed the whole line output stage, though it would be unlikely to harm the tube. In addition, if the set is operated at too high a brightness level picture breathing due to the excessive beam current demand could develop.

Beam Limiting

For these reasons most sets using d.c. coupling to the c.r.t. incorporate a beam limiter diode – CR301 in this circuit. During normal conditions the current drain via R321 and the transistor's collector load resistors R316/R317 results in the diode being forward biased to give d.c. coupling to the cathode of the c.r.t. When the video signal approaches peak white the transistor's collector voltage falls to minimum and the current flowing via R321 is at maximum, producing maximum voltage across it. If its value is correctly chosen in relation to the value of the transistor's collector load resistors the result will be that the diode becomes reverse biased and cuts off. This means that the signal will then be a.c. coupled to the tube via C305. The resultant loss of the d.c. component of the signal automatically reduces the signal level while in addition the reverse voltage developed across the diode and the capacitor is added to the output transistor's collector voltage, raising the tube's cathode by that amount to further reduce the brightness.

R322 protects the output transistor against e.h.t. flashovers in the tube.

ITT VC300 Chassis

A very different approach is used in the ITT VC300 series chassis (the Featherlight portables). The circuit is shown in Fig. 2. An ITT TDA1330 i.c. is used to provide synchronous vision detection and incorporates a video preamplifier, rendering the use of an external emitter-follower unnecessary. From an i.f. input of about 36mV the i.c. can provide a peak-to-peak video signal of 3V. This signal, appearing at pin 4, is fed via the video level potentiometer R50 and the contrast control R52 to the base

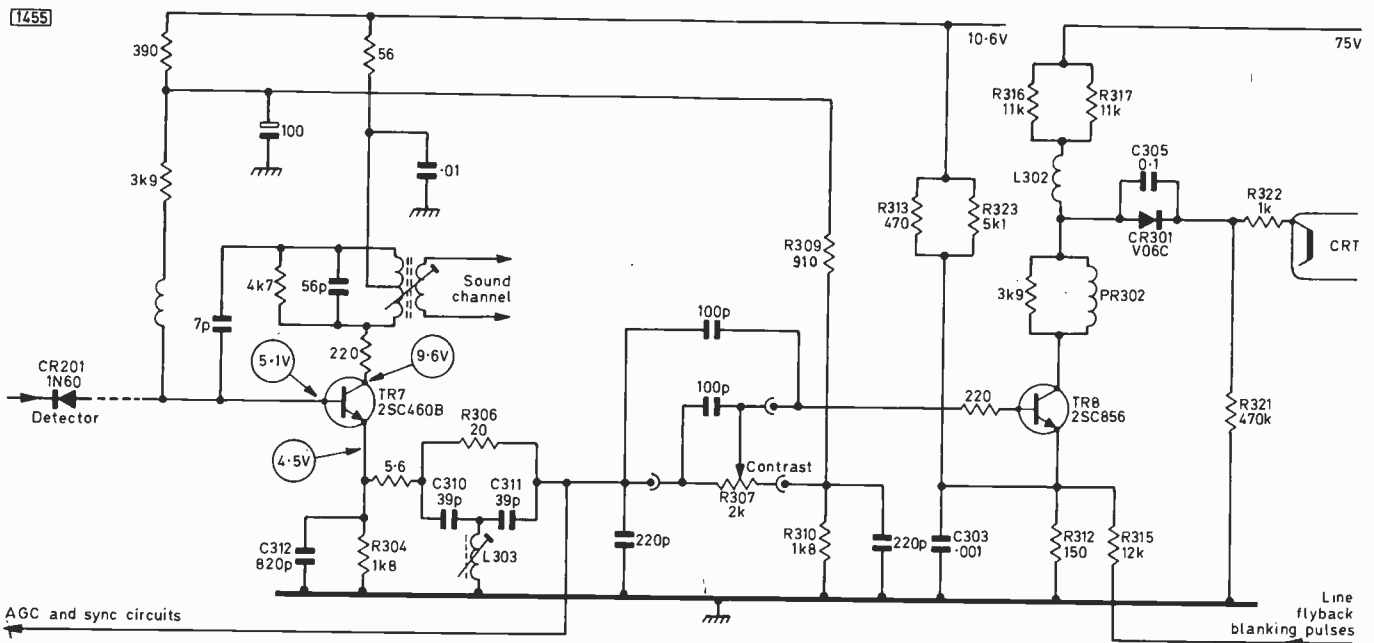


Fig. 1: The video channel in the Philips X09T chassis is d.c. coupled from the video detector diode through to the cathode of the c.r.t. The brightness control sets the c.r.t. grid voltage – where field flyback blanking is also carried out.

of the video output transistor T4. The contrast control operates in the same fashion as in the previous Philips circuit. When R50 is set correctly, adjustment of the contrast control will not affect the d.c. level of the signal and thus the working conditions of the output transistor. The output stage bias is stabilised, as before, by linking the emitter via R56 to the regulated 11V l.t. supply.

The output is a.c. coupled to the cathode of the c.r.t., the brightness control setting the mean d.c. potential at this point. Since both modulation and brilliance level are effected at the c.r.t.'s cathode, the grid is simply d.c. returned to chassis, the diode (D10) here providing line and field flyback blanking, in conjunction with transistor T5, and switch-off spot suppression.

When the receiver is switched on, the positive plate of the electrolytic capacitor C63 is connected to the 90V rail via R60 while its negative plate is returned to chassis via D10 which is conducting. In consequence it rapidly charges, after which the negative potential developed at the anode of the diode settles down to a value determined by the time-constant of C63 and R65. So far as the tube is concerned this negative voltage adds to the mean positive voltage at the cathode, set by the brightness control, to constitute the c.r.t.'s working bias. With a.c. coupling, the working bias

with no signal will result in a beam current of about half the peak value, swinging in either direction when the signal is applied. At switch off D10 remains non-conductive and the discharge path for C63 consists of the high-value resistor R65. The long time-constant of this combination means that the tube's grid is held at a negative potential until the e.h.t. has collapsed, thus preventing the formation of a switch-off spot on the screen.

The flyback blanking pulse amplifier transistor T5 is cut off during the forward line scan since it is without forward base bias. Field flyback pulses via R80 and line flyback pulses via R111 drive it into saturation however, the resulting reduction in its collector voltage from rail potential to a fraction of a volt being applied to the c.r.t. grid via C63 as a pulse which cuts the tube off.

Latest Thorn Chassis

The latest Thorn portable chassis, the 1612, again uses an i.c. for video detection, but this time a TCA270. This feeds an emitter-follower video driver transistor and, as shown in Fig. 3, there is d.c. coupling through to the cathode of the c.r.t. The same form of contrast control as in the previous examples is used, R40/R44 setting the base

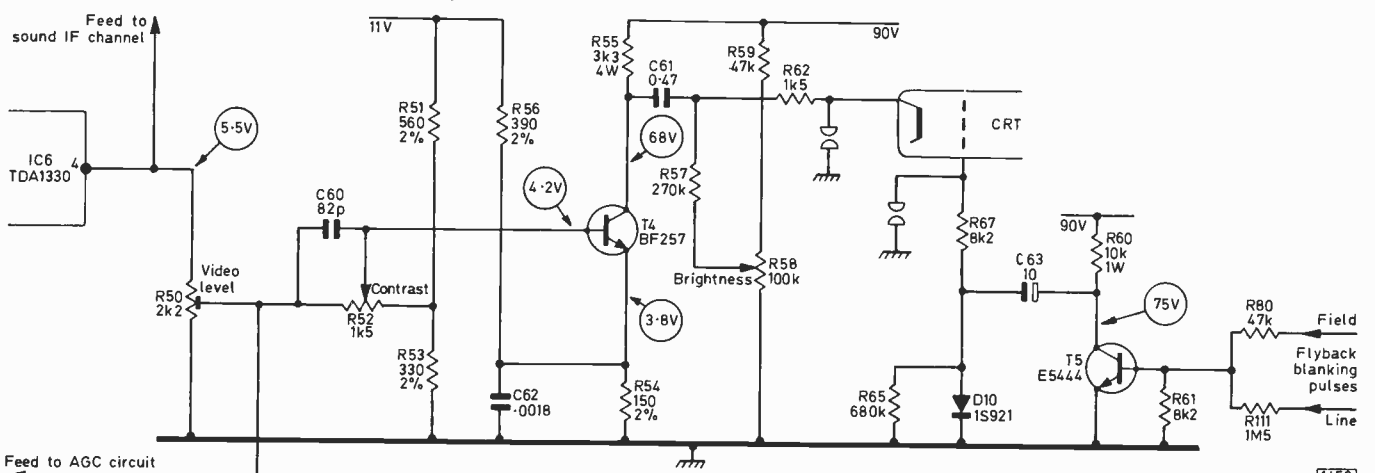


Fig. 2: The simple video channel used in the ITT VC300 chassis, with synchronous detection and video preamplification in the TDA1330 i.c. and a.c. coupling to the c.r.t. cathode. C60 bypasses the contrast control to maintain the h.f. response.

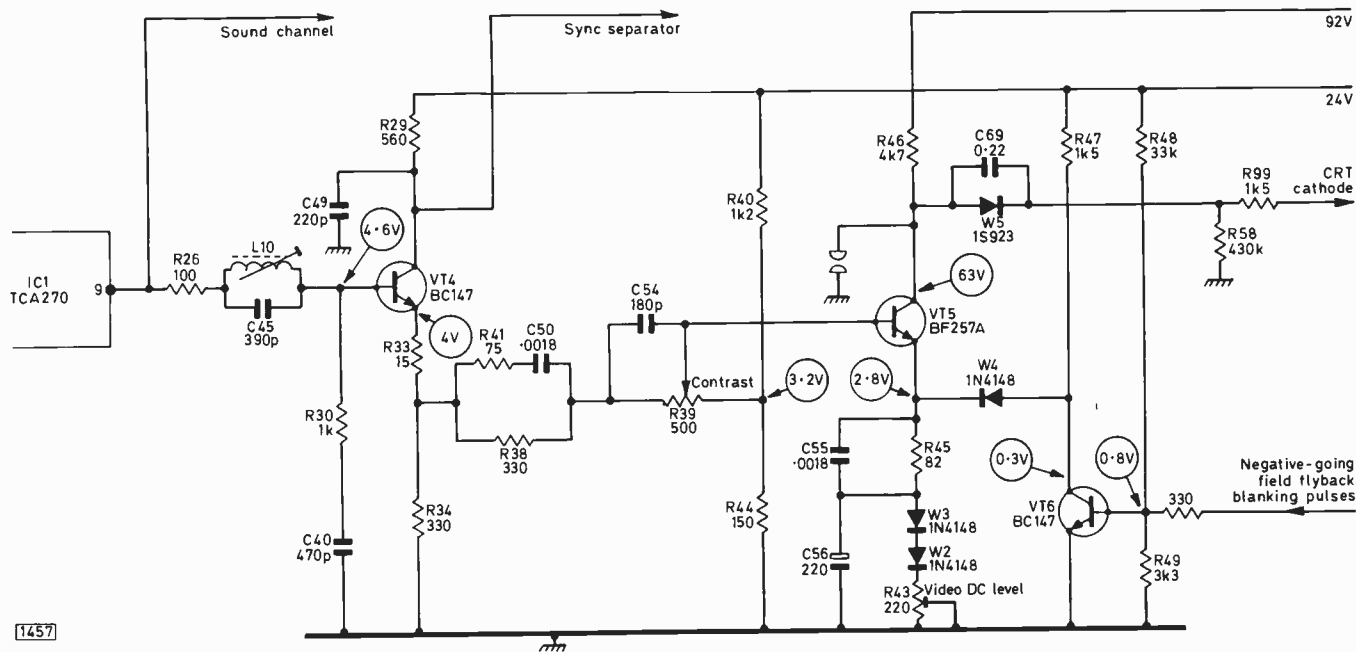


Fig. 3: D.C. coupled video channel used in the Thorn 1612 chassis.

bias applied to the output transistor VT5 while its emitter bias is adjustable by means of the video d.c. level control R43. This should be adjusted to set the picture black level at 80V, using a scope to monitor the c.r.t. cathode waveform, with a test card being received, the contrast control set at maximum and the brightness control at minimum. Alternatively the setting can be made with a 20,000Ω/V meter for 60V at the c.r.t. cathode.

C55 across the cathode bias resistor R45 provides h.f. compensation in the same way as C303 and C62 in the previous examples, the two series-connected diodes W2 and W3 limiting the amplitude of the field flyback blanking pulse applied to the transistor's emitter and also stabilising the emitter voltage. This latter condition arises since a constant voltage is developed across the diodes despite wide current variations.

Unusually for a flyback blanking transistor, VT6 is held saturated until fed with a field flyback blanking pulse. Consequently its collector voltage is only 0.3V and as the output transistor's emitter voltage is 2.8V diode W4 is reverse biased, isolating the two stages. The negative-going field flyback blanking pulse cuts VT6 off, its collector voltage then rising towards the l.t. rail potential so that W4 is forward biased and the emitter voltage of VT5 increased to cut it off and blank the c.r.t.

The brightness control is in the c.r.t. grid circuit, where line flyback blanking is also carried out.

Bush Model BM6510

The three circuits shown so far all use the same bridge type contrast control arrangement. As an example of the type of circuit mentioned in the opening paragraph, with the contrast control operating in the output transistor's emitter circuit, Fig. 4 shows the video channel used in the Bush Model BM6510. There is a.c. coupling from the emitter-follower TR204 to the output transistor TR205 and from the latter to the c.r.t. cathode. An interesting innovation is the use of a ceramic filter to remove the 6MHz intercarrier sound signal from the video signal path.

The output transistor's emitter circuit is quite complex. C254 provides decoupling of the whole network at h.f. C253 decouples R256 at h.f. and m.f. but not at the lowest

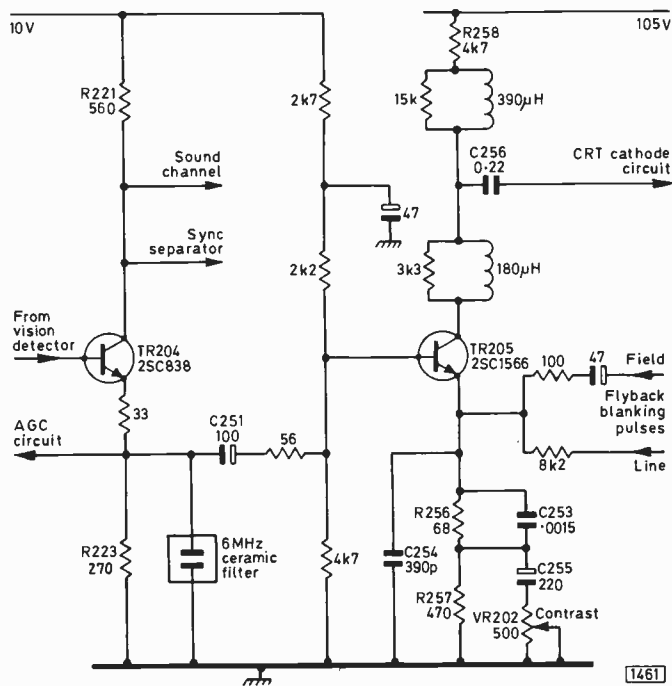


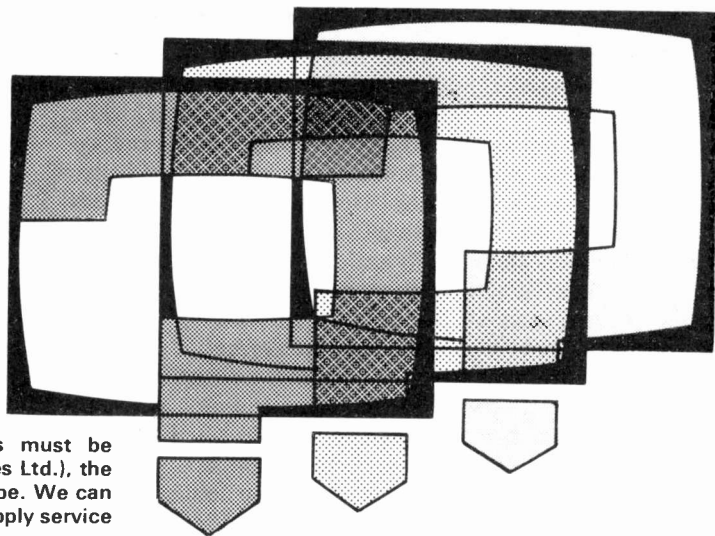
Fig. 4: Video circuit used in the Bush 12in. portable Model BM6510. The brightness control is in the c.r.t.'s cathode circuit.

frequencies, so that the negative feedback introduced by R256 at l.f. reduces the stage gain at these frequencies to in effect enhance the h.f. response. With the slider of the contrast control set so that the control is short-circuited, C255 decouples R257 down to the lowest frequency. As the slider of VR202 is moved towards chassis however so a greater amount of undecoupled (except by C254 at h.f.) resistance is present and the increased negative feedback, by lowering the stage gain, reduces the picture contrast.

The "Television" Circuit

For a complete contrast to these circuits, c.r.t. grid drive is used in the Television monochrome portable project to be published shortly, with a.c. coupling and d.c. restoration. Watch this space!

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KB CK402

There is line flutter which persists for hours at a time and sometimes clears for hours. The line hold control holds over the greater part of its travel, but has no effect on the flutter. The PCF802 line oscillator valve has been replaced and the line oscillator coil adjusted without improving things.

There are several possible causes of the problem. First check all earth joints in the flywheel sync and line oscillator stages. These often go dry due to corrosion. The two flywheel sync discriminator diodes Dh1 and Dh2 (OA91) can cause twitch, as also can the oscillator feedback capacitor Ch18 (800pF). The line oscillator coil itself (Lh6/7) has also been known to give rise to line twitter due to internal corrosion. (ITT CVC2 chassis.)

BUSH TV161

Quite often a spot is left on the tube face for about thirty seconds after the set is switched off. First the picture collapses in the form of a shrinking square, then the spot is left at the centre.

Switch-off spot suppression is effected by returning the brightness control to chassis via a v.d.r. – 2VDR1, type E299/DD/P336. Check this, and the associated resistors 2R40 (330k Ω) and 2R39 (220k Ω). An ageing tube may give a spot glow even if the suppression system is working.

FERRANTI CT1166

There are two faults on this old dual-standard colour set. First, after running normally for a half to two hours there is a tendency to line break up – at first just intermittent jittering of sections of the picture horizontally, then eventually the picture breaks up into a regular pattern of bands which are normal separated by bands which are distorted. The distorted bands slowly narrow and the picture suddenly synchronises. The sequence repeats. Adjusting the line hold has no apparent effect on the picture, whether normal or breaking up. The field hold is steady. The other fault is sound-on-vision when the volume control is turned up higher than normal. This does not disappear on retuning or adjusting the gain, and there is no visible effect when the set is tapped or the luminance output valve is touched.

For the line pulling we suggest you check the reference pulse feedback resistor R205 (47k Ω) to the flywheel line

sync circuit, the two discriminator diodes D40/D41 and the two electrolytics C212 and C216 in the line oscillator circuit. If the fault persists, check the sync coupling capacitor C39 (1 μ F), the sync separator transistor VT6 and its emitter protection diode D3 – these are on the i.f. panel. If the sound-on-vision is not due to microphony of the tuner or the PL802 luminance output pentode, it is likely that one or more of the electrolytics which decouple the negative l.t. rails has deteriorated. These are C305/6/8/9/11/16 on the power/line timebase chassis. (Pye dual-standard colour chassis.)

MARCONIPHONE 4830

The set produced an excellent picture, but this is now masked by a snowy effect, with reduced sensitivity. The external aerial used with the set is providing a good signal – this has been checked with another receiver – and there are apparently no breaks around the coaxial connections inside the set. The fault is not intermittent. There is a pronounced slushing noise with no aerial connected, but this ceases on plugging in the aerial. The vision snow decreases when the aerial is applied, but is still pronounced. The sound volume is not affected to any extent.

The symptoms suggest that the tuner unit (type ELC1043/05) is faulty. First however check IC1 (TCA270Q) and the tuner a.g.c. smoother C43 (47 μ F). The a.g.c. voltage across C43 should be 1.8V with normal signal. (Thorn 1612 chassis.)

COSSOR CT2372A

There is no raster, all the valves lighting up except for the DY86 e.h.t. rectifier. This has been replaced, also the PL36 line output valve and the PY800 boost diode. Should a new line output transformer be fitted?

The line output transformer does often fail on these sets unfortunately. First however check as follows. If the PL36 runs cool, check the system switch and the 2.2k Ω screen grid feed resistor (pin 4). If the PL36 runs over hot, check the boost capacitors (C415/C416, both 0.05 μ F) at the bottom of the timebase panel. Then confirm line drive by checking for a reasonable negative voltage at pin 5 of the PL36. If this is absent (line output stage valves overheating) check the line oscillator valve V404 (ECC82) and associated components as necessary. (Philips 9152A series.)

BUSH CTV25

The brilliance control does not now black out the picture when at minimum, though it used to black out the tube completely. Also the picture isn't as sharp as it used to be and shimmers when the brightness control is turned up fully. Coincident with the development of this fault, blue flashes occur in the tube neck – sometimes these black out the picture and the set has to be switched off and on again to clear the fault. There are flyback lines on the screen when the brightness control is nearly at maximum. The luminance output pentode and all the line output/e.h.t. valves have been replaced, and the tube voltages are correct.

Check the BC108 flyback blanking transistor in the luminance output pentode's cathode circuit, also the associated OA90 protection diode. Check whether 6C16 which decouples the voltage used for clamping in the colour-difference output stages is leaky, then concentrate on the luminance output stage, checking voltages here. Suspects are the grid clamping diodes 6D1/6D2 (OA81), the coupler 6C4 and the fixed resistors in the stage.

FERGUSON 3816

The problem with this set is a clear raster but neither vision nor sound. The tuner has been checked and found to be o.k. but the a.g.c. circuit does not seem to have any effect.

There are a couple of grotty little ceramic disc capacitors in the i.f. strip, used to decouple the emitters of the first two i.f. transistors VT2 and VT3. We have had these go leaky or short-circuit many a time to cause this sort of problem. When this happens the bias on the transistor concerned is removed, turning the transistor hard on. Voltage checks should reveal the source of the trouble therefore. (Thorn 1590 chassis.)

ITT CK501

The picture and sound are all right when the set is first switched on, but after a few seconds the picture becomes noisy, i.e. like a snow storm, the sound remaining o.k. The fault can be cleared by tapping the vision i.f. section or by switching the set off and on again, but after a few seconds the picture becomes noisy again. After switching off and on a few times the picture remains o.k. for as long as the set is left on. At first the tuner was suspected, and the voltage stabiliser was replaced, but with no change in the fault. I've looked for dry-joints around the tuner and i.f. strip and done some soldering. As soon as a meter is connected across the stabiliser the picture momentarily becomes o.k.

The main a.g.c. circuit is working correctly but the trouble is in the tuner a.g.c. system, based on the inverter transistor T14d. We commonly find that a hair-line crack is responsible, usually between R119 (T14d base circuit) on the i.f. strip and the joint with the main printed board. Failing this, R118 which sets the base bias applied to T14d, the transistor itself, or the crimping of the yellow lead to pin 6 of socket A could be responsible. (ITT CVC8 chassis.)

BUSH TV113

The trouble with this set is two pictures alongside each other. The ECC82 line oscillator valve has been changed and the associated resistors and capacitors seem to be in order.

The suspects are the compression trimmer TC1 which is used as the cross-coupling capacitor in the cathode-coupled line multivibrator circuit, the 270k Ω resistor (R96) which links this to the line hold controls, and the flywheel sync discriminator diodes. Try setting the line hold control midway and resetting the trimmer.

FERGUSON 36479

The trouble with this set is vision buzz on 625 lines. The usual remedies – adjusting the 6MHz tuned circuits and checking the ratio detector circuit – have been tried without success.

This chassis is rather prone to vision buzz troubles. There is a manufacturer's suggested modification for the problem, to increase the value of the video output pentode's screen grid feed resistor R43 from 7.5k Ω to 12k Ω . Also ensure, if you can, that the sound attenuator coil L6 is correctly set to 33.5MHz. (Thorn 950 Mk. II chassis.)

GRUNDIG 6010

The set operates perfectly for up to an hour, then the circuit breaker cuts out. On resetting this the set continues to operate for several hours without the circuit breaker operating, but each day the same sequence is repeated, with a single cut out.

We have had a very similar fault on this model – it was traced to dry-jointing of coil KA which is in series with the line output stage input/commutating transformer, on the line scan panel. This was seen to arc at the moment the cut out operated. Check all print joints on the line panel, tapping if necessary to try to provoke the fault, and check the input/commutating transformer for dry-joints. There is a remote possibility that one of the thyristors in the line output stage is faulty.

ITT FEATHERLIGHT SUPER 12

There is lack of vertical scan in this portable set – operating the linearity and height controls opens the scan to a maximum height of half an inch. All else seems to be normal.

Remove, test and replace as necessary the four transistors in the field driver and output stages – T9-T12. Check also the diode (D14) in the output stage, and look for any burnt resistors in the area. Leakage in the output capacitors C70 (1 μ F) or C71 (1,000 μ F) could have brought on the trouble. (ITT VC300 chassis.)

MARCONIPHONE 4714

The trouble with this set is tearing on peak whites. When following the line hold setting up procedure things do exactly as they should, but the problem remains. Slight off tuning (to monochrome) eliminates the fault.

If the i.f. alignment has not been touched the problem is likely to be in the sync separator circuit. Check the value of the sync separator's upper base bias resistor R215 (2.7M Ω), its series diode W201 (BA155), the transistor itself (VT203, BF224) and the following emitter-follower (VT202, E5024). (Thorn 3500 chassis.)

DECCA CS2630

The trouble with this set is a blue background to the picture, even on monochrome.

If the voltage at the c.r.t.'s blue cathode (pin 11) is low, i.e. below the other cathodes (pins 2 and 6), check the blue output transistor TR215 (BF337), the two small presets in the blue output stage (VR316 and VR320), and if all these are o.k. suspect the MC1327 demodulator i.c. If the blue background persists with the c.r.t. blue first anode preset control VR477 turned fully anticlockwise and the blue flying lead to TP210 disconnected the c.r.t. could be faulty. (Decca 30 series chassis.)

PYE CT262

The picture cuts off on all three stations, leaving only a greyish white screen. This happens two or three times in as many hours. The picture may return immediately or remain off for several minutes. Neither the brightness, colour or contrast controls has any effect when the fault is present. The sound remains o.k.

The symptoms indicate loss of l.t. or pulses to the decoder panel. These should be present at SK477 pin 3 and SK479 respectively. (Pye 731 chassis.)

the $8\mu\text{F}$ electrolytic (C701) which smooths the h.t. supply to the sound output stage. It appeared that the capacitor had a dry-joint, so a replacement was fitted.

After doing this the stridence and sibilance symptoms called for more critical listening and it was discovered that peak sound distortion could be dramatically increased by slightly misadjusting the quadrature detector coil connected to the sound i.c. The adjustment was thus optimised for the least distortion on peak modulation.

Although certain programme material tended to emphasise the sibilance the effect was not excessive under normal conditions. Compared with other receivers however the bass reproduction tended to be light with respect to the treble, and having in mind the nature of the sound signal transmitted the technician returned his attention to the sound i.c. section of the circuit, ultimately clearing the fault and obtaining an improved frequency/amplitude characteristic by replacing a component.

What component would have been most likely to have emphasised sibilance and h.f. response by developing a fault? See next month's Television for the answer and for a further item in the Test Case series.

SOLUTION TO TEST CASE 165 Page 613 (last month)

The technician investigating the field fault in the Thorn 3000 chassis made the error of concluding that the electrolytics were in good order after (1) checking by shunting each in turn with a known good component while the suspects were still in circuit and (2) concluding that the $2.2\text{k}\Omega$ resistor in shunt with the $16\mu\text{F}$ electrolytic in the field output circuit was of low value in spite of making the measurement with the resistor still connected across the capacitor. On the other hand he ensured that the output transformer primary was not affecting the measurement by disconnecting the diode (W423)!

The low reading across the $2.2\text{k}\Omega$ resistor was caused by leakage in the $16\mu\text{F}$ electrolytic. This was brought to light when the extracted resistor was found to possess the correct $2.2\text{k}\Omega$ value after all. Replacing the $16\mu\text{F}$ capacitor completely cured the symptom after readjustment of the field circuit presets. The lesson, then, is *never* to measure resistors *in situ* – not even when connected across a capacitor assumed to be of low leakage.

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TELEVISION OCT 1976



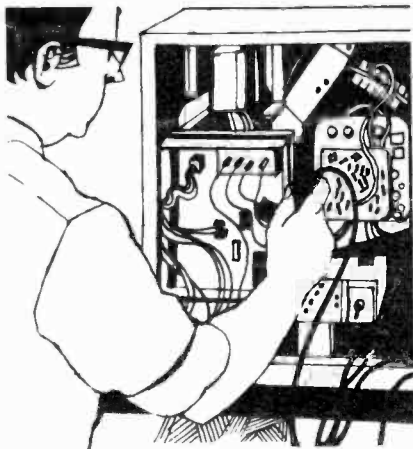
Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

A Ferguson Model 3712 fitted with the Thorn 8000 chassis was brought into the workshop by the field technician with three sound complaints – extreme stridence on high-level high-frequency sounds, particularly during adverts, intermittent background buzz accompanied by a high-pitched whistle, and excessive sibilancy (i.e. hissing on consonant sounds such as 's' and 'z'). The customer was of the critical species, being a keen hi-fi listener!

In the workshop test bay the receiver produced good pictures on all channels and from a first listening the sound seemed to be reasonably normal too. The sound output stage uses a single transistor (MJE340) operating in the class A mode and located on the power supply board. It's driven direct from the intercarrier sound i.c. on the signal board.

While probing with an insulated rod around the audio output transistor with the sound channel running it was discovered that a mild change in quality and the introduction of a vague buzz could be provoked by stressing

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6BC8	0.90	6X4	0.45	E180F	1.15	EF91	0.50	PCF802.54		UCL82	0.45
6BE6	0.40	6X5GT	0.45	E188CC2.50		EF92	0.50	PCF805	1.00	UCL83	0.57
6BH6	0.70	9D7	0.70	EA50	0.40	EF183	0.36	PCF806.53		UF41	0.70
6BJ6	0.65	10C2	0.70	EABC80		EF184	0.36	PCH2001.00		UF42	0.80
6BK7A	0.85	10F1	0.67		0.40	EH90	0.45	PCL82	0.40	UF80	0.40
6BQ7A	0.60	10F18	0.65	EAF42	0.70	EL34	0.90	PCL83	0.49	UF85	0.50
6BR7	1.00	10P13	0.80	EAF801.0.75		EL41	0.57	PCL84	0.46	UF89	0.45
6BR8	1.25	10P14	2.50	EB34	0.30	EL81	0.65	PCL86.54		UL41	0.70
6BW6	1.00	12AT6	0.45	EB91	0.17	EL84	0.34	PCL805.60		UL84	0.43
6BW7	0.65	12AU6	0.50	EBC41	0.75	EL95	0.67	PFL200.70		UM80	0.60
6BZ6	0.60	12AV6	0.60	EBC81	0.45	EL360	1.80	PL36	0.60	UY41	0.50
6C4	0.40	12BA6	0.50	EBF80	0.40	EL506	1.20	PL81	0.49	UY85	0.35
6CB6A	0.50	12BE6	0.55	EBF83	0.45	EM80	0.55	PL81A	0.53	U19	4.00
6CD6G	1.60	12BH7	0.55	EBF89	0.40	EM81	0.60	PL82	0.37	U25	0.71
6CG8A	0.90	12BY7	0.85	EC86	0.84	EM84	0.45	PL83	0.45	U26	0.60
6CL6	0.75	19AQ5	0.65	EC88	0.84	EM87	1.10	PL84	0.50	U191	0.50
6CL8A	0.95	19G6	0.50	EC92	0.55	EY81	0.45	PL504	0.82	U251	1.00
6CM7	1.00	19H1	1.00	ECC33	2.00	EY81	0.45	PL508	1.00	U404	0.75
6CU5	0.90	20P1	1.00	ECC35	2.00	EY83	0.60	PL509	1.55	U801	0.80
6DE7	0.90	20P4	0.84	ECC40	0.90	EY87/6	0.37	PY33/2	0.50	YR105	0.50
6DT6A	0.85	30C15	0.77	ECC81	0.34	EY88	0.55	PY80	0.50	X41	1.00
6E5	1.00	30C17	0.77	ECC82	0.34	EZ40	0.52	PY81	0.40	Z759	5.85

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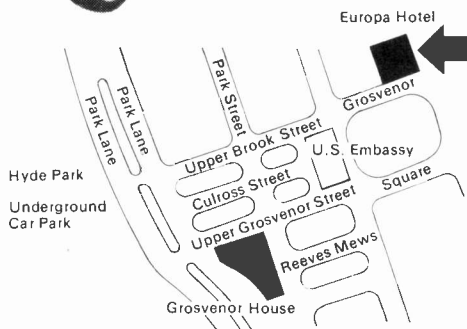
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