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TELEVISION

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MURPHY 849 to 2417, etc. **£6.40**
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PLEASE ADD 12½% VAT TO PRICES (EXCEPT * 8%)

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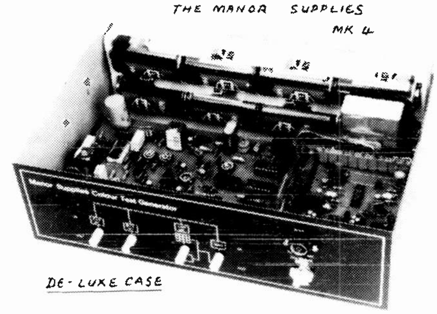
COLOUR BAR GENERATOR

plus CROSS HATCH KIT (Mk. 4)



- ★ Output at UHF, applied to receiver aerial socket.
- ★ In addition to colour bars, all **R–Y, B–Y** and **Lum.** Combinations.
- ★ Plus cross hatch grey scale, peak white and black levels.
- ★ Push button controls, small, compact battery operated.
- ★ Simple design, only five i.c.s. On colour bar P.C.B.

PRICE OF MK4 COLOUR BAR & CROSS HATCH KIT £35.00 + 8% VAT + £1.00 P/Packing.

CASES, ALUMINIUM £2.40, DE-LUXE £4.80, BATT. HOLDERS £1.40. ADD 8% VAT TO ALL PRICES!

ALSO THE MK3 COLOUR BAR GENERATOR KIT FOR ADDITION TO MANOR SUPPLIES CROSS HATCH UNITS. £25.00 + £1.00 p.p. CASE EXTRA £1.40. BATT. HOLDERS £1.40. ADD 8% VAT TO ALL PRICES.

- ★★ Kits include drilled P.C. board, with full circuit data, assembly and setting up instructions.
- ★★ All special parts such as coils and modulator supplied complete and tested, ready for use.
- ★★ Designed to professional standards.
- ★★ Demonstration models at 172 West End Lane, NW6.
- ★★ Every kit fully guaranteed.

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MK4 DE LUXE (BATTERY) BUILT & TESTED £58.00 + 8% VAT + £1.20 P/Packing.
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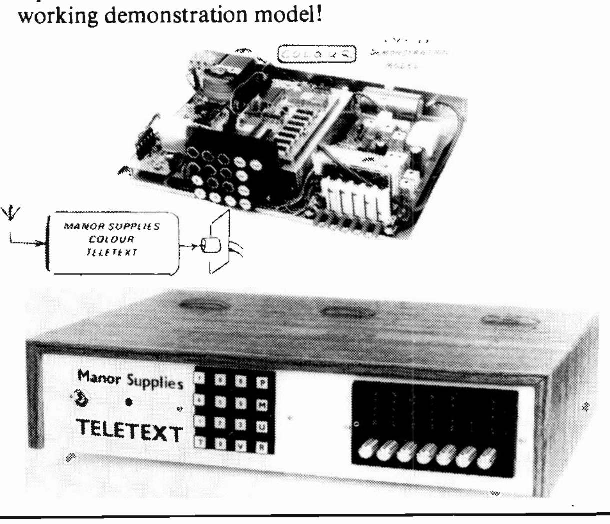

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CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", Fleetway House, Farringdon Street, London EC4A 4AD. All other correspondence should be addressed to the Editor, "Television",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

BINDERS AND INDEXES
Binders (£2.10) and Indexes (45p) can be supplied by the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. Prices include postage and VAT. In the case of overseas orders add 60p to cover despatch and postage.

BACK NUMBERS
Some back issues, mostly those published during the last two years, are available from our Post Sales Department (address above) at 70p inclusive of postage and packing to both home and overseas destinations.

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

this month

OUR NEXT ISSUE DATED NOVEMBER WILL BE PUBLISHED ON OCTOBER 17

EX-EQUIPMENT SPARES

MONO TUBES

(tested)
19" Rimguard **£4.50**
23" Rimguard **£6.00**
20" Rimguard **£6.00**
24" Rimguard **£7.50**
+ £2.50 p.p.

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6 - button integrated all at **£6.50**
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All S/Standard at **£4.00** +
£1. p.p.

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i.e. Philips, Bush etc.
£3.50 + £1 p.p.
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MISC. S/Output Trans.
£1 + VAT + £1 P&P
F/Output Trans.
£1.25 + VAT + £1. P&P
Scancoils £1.50 + VAT + £1. P&P. Other spares available. please write or phone for details.

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PCL82	0.10	PCF802	0.10	PCC86	0.10	EY86/7	0.10	30PL1	0.10	PL509	0.50
PCL83	0.10	PCF805	0.10	PC97	0.10	EY8/7	0.10	30PL13/4	0.10	PY500	0.50
PCL84	0.10	PCF806	0.10	PC900	0.10	DY802	0.10	30P12	0.10	PD500	0.50
PCL85	0.10	PCF808	0.25	EF80	0.10	PY800/1	0.10	30FL1/2	0.25	GY501	.050
PCL86	0.10	PCF80	0.10	EF85	0.10	PL36	0.25	ECC82	0.10	PL802	0.50
PFL200	0.10	PCC189	0.10	EF183	0.10	PL504	0.25	ECC81	0.10	PL508	0.50
PCF801	0.10	PCC86	0.10	EF184	0.10	PL81	0.10	ECH81	0.10	PCH200	0.50
30C1	0.10	30C15	0.10	6BW7	0.10	6/30L2	0.10	ECL80	0.10	PCF200	0.50
30C17	0.10	30C18	0.10	ECC85	0.10	U26	0.10	ECL82	0.10	CEY51	0.15
PL83	0.10	PL84	0.10	EH90	0.10						

Please note there is 25p p.p. per order

D/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	EHT	REG	CON	S/OUTPUT	POWER	L/TB	F/TB
Bush/Murphy	6.50	6.50	6.50	–	–	6.50	1.50	6.50	–	–
GEC/Sobell	6.50	7.50	–	–	–	6.50	–	–	–	7.50
Philips	6.50	9.50	–	–	–	7.50	–	–	–	6.50
Decca	6.50	12.50	12.50	–	–	6.50	2.00 (19" only)	8.00	–	6.00
Thorn 2000	6.50	7.50	7.50	6.50	6.50	7.00	–	8.00	9.50	6.50
Pye	7.50	7.50	9.50	–	–	6.50	–	–	–	4.00
Baird	6.50	8.50	8.50	–	–	6.50	–	–	–	6.00

Postage & Packing £1.25

S/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	VIDEO	CON	POWER	L/TB	F/TB
Bush 184	9.50	–	20.00	–	8.00	6.00	20.00	–
GEC Hybrid	9.50	9.50	15.00	–	6.00	–	–	12.00
Philips G6 S/S	9.50	–	15.00	–	9.00	–	–	10.00
Thorn 3000	10.00	9.00	18.00	10.00	6.00	20.00	20.00	10.00
Pye 691/693	15.00	7.50	18.00	–	15.00	–	28.00	7.50
Thorn 3500	10.00	9.00	18.00	10.00	10.00	20.00	20.50	10.00

Korting and other foreign panels available on request.

Postage & Packing £1.25

COLOUR TUBES

19" 18.00
19" A49.192 £20
20" 20.00
22" 25.00
25" 18.00
26" 32.00

Plus P & P £3.

COLOUR TUNERS

Bush 6.50
GEC 6.50
PhilipsG6 S/S 6.50
Thorn 3000 6.50 (£8 new)
Pye 691/697 7.50
Some new tuners in stock can suppy on request. Many Foreign Tuners also available on request. Plus P & P £1

COLOUR LOPTS

Most lopts available from £7.00. Both British & Foreign makes. Please ring or write.
P & P per lopt £1

MISC.

S/Output transformer from £1.50
F/Output from £1.25
Scancoils from £5.00
P & P £1
Other spares available on request.

CABINETS

Many British & Foreign cabinets available. Please state.
Speakers, masks, etc., available on request. Please phone or write.

T.V.'s (MONO)

Rotaries
GEC 5.00
Thorn 950 5.00
K.B. Trans–tuners 5.00
Pye 5.00
etc.

P/Button
Thorn 1400 9.00
Bush 161 9.00
Baird 9.00
Philips 210 9.00
Pye 9.00
etc.

P/Button	20"	24"
Bush		11.00
GEC		11.00
Philips		11.00
Pye		11.00
etc.		

S/Standard	20"	24"
Bush		15.00
GEC		15.00
Philips		15.00
Pye		15.00
Thorn		15.00
etc.		

COLOUR T.V.'s

D/S Colour
19", 25" from £30
i.e. GEC. Bush Philips, Baird etc.,

S/S Colour
19", 20", 22", 24" from £50
Working from £65
includes many makes as well as foreign models.

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TELEVISION

QUIRKS IN COMPETITION

One of the problems about writing leaders in a monthly magazine is the difficulty in commenting on matters of current concern. It takes some six weeks for the leader to appear after being written – by the time you read this our November issue will be on the point of being passed for press. The problem of course is that the situation can completely change during this long gestation period. We are however going to comment this month on a matter that's worrying the UK TV industry just now – because we know full well from past experience that absolutely nothing will have been done about it. We speak once more on Japanese colour receiver imports.

The latest (May) figures released by BREMA show a slight decline in deliveries of UK produced colour sets compared to a year ago, while during the first five months of the year colour set imports from Japan more than doubled. There is an understanding at industry level that the Japanese share of the UK colour set market should be limited to 10%. But it's a rather informal affair, and the Japanese market share for the first five months has been 16·7%. Something, somewhere, seems to be going alarmingly amiss.

You may say why care? – it's up to the UK industry to compete. And so it is, and so it does. But under what conditions?

By producing sets able to meet performance and safety standards world wide, the Japanese TV industry has built up a reputation for goods which provide excellent performance and reliability. There is no doubt that the UK industry was laggardly in producing sets of equivalent standard. That now seems to have been put right however, today's UK produced colour sets being as good as any. As one small point confirming this, our advisory service has received in recent months only the barest trickle of technical queries relating to faults on current UK produced sets. That was far from being the case a couple of years ago. The trouble now is that it's very difficult to re-establish a reputation once the public has got it firmly in mind that foreign equals reliable. Once bitten, unfortunately . . . But it does need to be emphasised as much as possible by all concerned that today's UK produced, cool running, solid-state TV sets are reliable indeed.

So is it just a matter of salesmanship? This leads us to make one or two points that are not as widely appreciated as they should be. Much of UK manufacturing industry is relatively inefficient by world wide standards: investment and productivity are by comparison low. The UK electronics industry does not fall into this category, but the more interesting point is that neither does the UK's retailing industry. World wide, there are few distribution systems that operate as efficiently as those in the UK. Think of those high street grocers, Marks and Spencers, Boots, Dixons and, in the radio and television field, such operations as those of Currys, Ketts, Comet and so on. And what this means is that the importer has only to land his goods and hey presto they're taken over and sold in a highly efficient manner.

The comparison with Japan is quite remarkable. There we have the most efficient production units in the world – and one of the least efficient distribution systems! The story has often been told of the 1,000% beef mark up in Japan. Since Japan produces little meat, most of what's sold is imported, and between being landed and bought by the consumer it passes through a lengthy chain of hands which between them manage to add 1,000% to the price! And it's much the same with anything else, so that if you want to sell to Japan you've got problems indeed.

It's remarkable how well suited the UK market is to the attentions of large overseas manufacturing concerns, be they Japanese camera or TV setmakers, French car manufacturers or whatever. So it's not really so unreasonable to ask for some sort of quid pro quo. The post-war world has been brought up to believe in the great benefits of free trade, and none of us likes duties, quotas and so on. But if we are not comparing like with like in the free trade system, then compensating action of some sort is necessary.

A careful eye needs to be kept on the flood of imported TV sets, and the government shouldn't hesitate to take such firm action as may be required. Remember how surprised we all were when car imports took 10% of the UK market? They now take over 40%, while the taxpayer has to keep the UK car manufacturing industry going. Rather a roundabout way of ensuring that UK industry survives!

Teletopics

QUOTA SLAPPED ON KOREAN MONO TVs

The government has imposed quotas of 35,000 sets this year and next year on the import of portable monochrome TV sets from South Korea. This follows revelations through the government's surveillance licencing system of plans to increase South Korean monochrome portable set imports from only 4,000 last year to something between 160,000 and possibly as much as 300,000 this year. Some 13,000 sets had arrived when the quota was imposed, and the quota is likely to be filled by sets at present in transit. If there turns out to be an excess, this will be deducted from next year's quota. The current estimated UK market for monochrome portables is around 800,000, and UK setmakers have told the government that to remain viable they must supply about half this total. There are already quotas on imports from Taiwan (70,000), the USSR (20,000) and other state trading countries, and the UK industry has a voluntary understanding limiting imports from Japan to 200,000 and from Singapore to 130,000. These limits already account for over half the estimated market, so that a flood of Korean sets would have had a disastrous effect on UK producers, involving risks to some 2,000 jobs. In answer to protests from importers on restricting their business, the Department of Trade has pointed out that importers should have been fully aware that action would be taken once the threatened flood of imports had been revealed by the surveillance licencing system.

Monochrome portables are being produced at present by Thorn at Enfield and Gosport, by RRI at Plymouth, by GEC at Hirwaun, South Wales and by Decca at Willenhall, Staffordshire.

THORN'S WARNING ON TV GAMES

Thorn have warned that misuse or very extended use of a TV game with a static pattern on either a colour or a monochrome set can result in a shadow pattern of the game becoming a permanent mark on the screen. Their advice is to keep the brightness and contrast as low as possible, to switch off when not actually playing and, where a selection of games is available, to change over from time to time rather than keeping to a favourite one.

BBC ADOPT ENG

The BBC is at present equipping a Range Rover for a one year experiment in electronic news gathering (ENG) by BBC Television News. Extensive tests with a variety of equipment have been carried out during the past two years in the London area. The Range Rover will have a crew of two. A Philips LDK11 camera will be used, and there will be a portable cassette machine for on-site video recording, radio links for the transmission of live news pictures to the BBC Television Centre, and radio-telephone communications. There will be two radio links: a short-range "window" unit which can be operated at the news site, with the camera, to send the picture back to the vehicle; and a second, more powerful link in the vehicle to pass the signals via a base station to the BBC Television Centre. Initially one base station atop a skyscraper block near central London will be used. Other sites have been successfully tested however and may be used subsequently.

RECOMMENDED SERVICE CHARGES WITHDRAWN

The RETRA has announced the withdrawal of its minimum service charge recommendations. This action has been taken in accordance with the provisions of the Restrictive Trades Practices Act of 1976. The association is however to continue, within the limits permitted by the Act, to provide relevant costings and other information to assist members in making their own decisions.

CONGRATULATIONS TO THE BATC!

The British Amateur Television Club celebrates its silver jubilee this November, when the hundredth issue of its magazine *CQ-TV* will be published. This will be a bumper issue in which a new series on CMOS will start, and it's hoped to have ready in time "Project 100" which is intended to set new standards in amateur TV designs. Membership enquiries should be sent to Brian Summers, G8GQS, 13 Church Street, Gainsborough, Lincolnshire. Magazine subscription enquiries should be sent to Alan Pratt, 10 Grammar School Road, Brigg, South Humberside.

NEW TV LICENCE FEES

Just a reminder in case you missed it: the colour TV licence has been increased by £3 to £21 and the monochrome one by £1 to £9.

DUAL-STANDARD VCR

In last month's comments on VCRs we mentioned that Philips consider that a dual-standard (60/130 minutes) version of their VCR system would not be an economic proposition. Grundig however have since announced the introduction of a version of their VCR, Model VCR5000, which will record and replay 60 minute and 130 minute cassettes, with automatic replay selection.

SYCLOPS MARK II

Further details of Thorn's new 9600 chassis – the one with the 110° PIL tube – have now been released. One of the main points of technical interest is the Syclops Mk. II regulated power supply/line output stage arrangement. It will be recalled that the Syclops (SYnchronous Converter and Line OutPut Stage) Mk. I circuit, used in the 9000 chassis, employs a single transistor as the chopper and line output device, driving two transformers – the power supply and line output transformers. Due to the more stringent requirement with 22 and 26in. 110° tubes, a somewhat more involved system is used – it's shown in basic form in Fig. 1. This time there are two power transistors, one to drive the chopper transformer and the other the line output transformer. As before, the chopper ("converter") stage

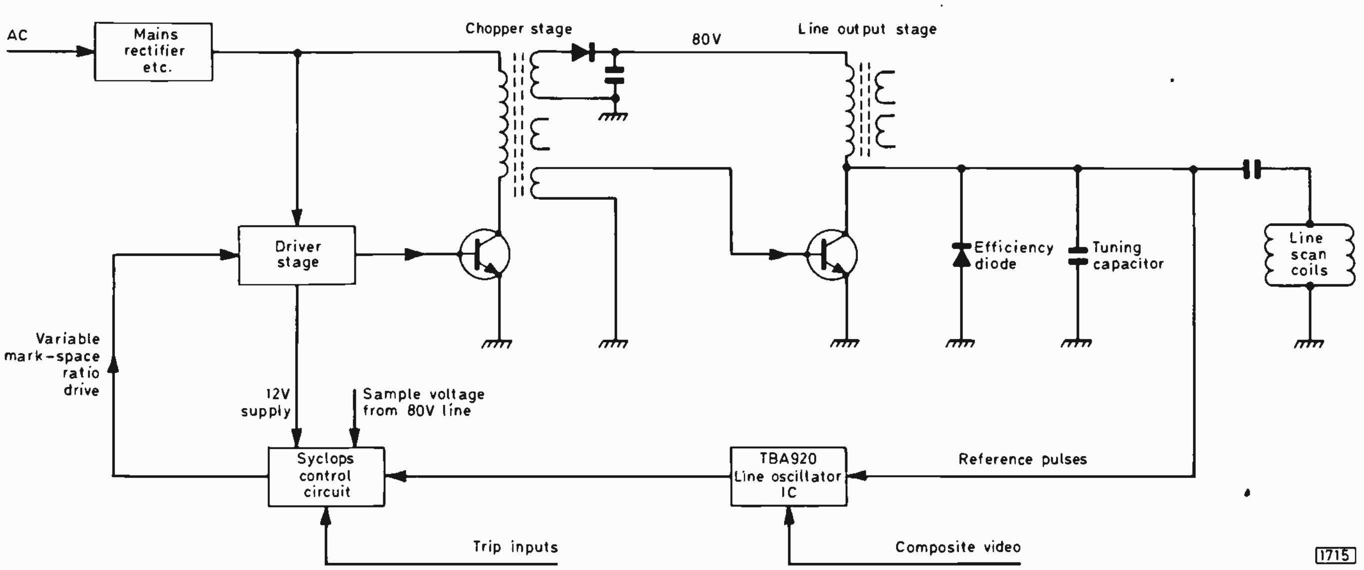

Fig. 1: Basic elements of the Syclops Mk. II regulated power supply/line output stage arrangement.

operates at line frequency, and in the new circuit the line output transistor is driven by a secondary winding on the chopper transformer.

To start the circuit up, the driver stage bleeds current to the Syclops control circuit, which includes a free-running oscillator (a Colpitt's *LC* oscillator). Once the circuit is in the normal operating condition, the free-running oscillator is synchronised to the line oscillator, which uses a conventional TBA920 i.c. arrangement. The mark-space ratio of the drive from the Syclops control circuit varies in order to switch the chopper transistor on for a longer or shorter period during each line scan, thus giving the required regulation. This means of course that the drive to the line output transistor varies in the same way, and it may be thought that this would interfere with the transition conditions – when the efficiency diode hands over to the line output transistor – towards the centre of the scan. This does not occur however since the line output transistor cannot drive the line output stage until the efficiency diode has ceased clamping its collector at −0·6V.

The Syclops control circuit samples the voltage on the 80V h.t. rail, its output varying as required to stabilise this. Trip inputs act on the control circuit to trip the set, limit the output or shut the set down completely under fault conditions.

In order to maintain stable width and height, anti-breathing arrangements are incorporated in both the line and the field timebase. The correction required in the line timebase is applied via the EW modulator – which is of the high-level variety. In the field timebase, a voltage proportional to the e.h.t. – it's obtained from the focus network – is applied as bias to a pair of transistors which act on the field charging circuit.

NEW TRANSMITTERS

The following relay stations are now in operation:

Ballater (Royal Deeside) BBC-1 channel 55, ITV (Grampian Television) channel 59, BBC-2 channel 62. Receiving aerial group C/D.

Grinton Lodge (Swaledale) BBC-1 channel 40, ITV (Tyne Tees Television) channel 43, BBC-2 channel 46. Receiving aerial group B.

Pennar (Gwent) BBC-Wales channel 40, ITV (HTV Wales) channel 43, BBC-2 channel 46. Receiving aerial group B.

Strabane (Northern Ireland) ITV channel 49 (Ulster Television). Receiving aerial group B.

Stranraer (South West Scotland) BBC-1 channel 57, ITV (Border Television) channel 60, BBC-2 channel 63. Receiving aerial group C/D.

All these transmissions are vertically polarised.

MARSHALL'S OPEN IN EDGWARE ROAD

Electronic component suppliers A. Marshall (London) Ltd. are opening a new branch at 325 Edgware Road, London W2, a mile north of Marble Arch. This should be a help to most component shoppers in the London area. The existing branch at 42 Cricklewood Broadway, London NW2 will remain open. It has suffered recently due to the Grunwick postal dispute and Marshall's wish to apologise to those who have received delayed replies to their letters and orders.

THORN'S NEW CHASSIS INCLUDE TELETEXT RECEIVER

Amongst new sets planned by Thorn for later this year is a version of the 9600 chassis incorporating a Teletext decoder. The basic decoder is the Texas Instruments Tifax module, which requires in addition a sophisticated interface module, designed by Thorn, to link it into the basic receiver circuitry. Thorn consider that for Teletext to be successful with domestic viewers remote control of page selection is essential, and have designed an ultrasonic remote control system with provision for up to thirty commands to provide for both the normal receiver control operations and the additional Teletext requirements.

Thorn report that field trials on Teletext receivers have shown that the receiving aerial can be critical to performance. Whilst an aerial that gives good results on colour reception should give no problems with Teletext signals, nevertheless short-term echoes which may not be noticeable on programme reception can cause decoding errors. So the aerial must not only be adequate, it must also be correctly orientated in order to minimise such echoes.

An addition to the 8000 series is the 8004 chassis, used initially in the Ferguson Model 3727. This is an updated version with provision for possible future use of a varicap tuner unit. In addition, the burst gate timing circuit has been modified so that the decoder can handle the slightly different line flyback pulse shapes provided by the 8000 and 8800 series line output transformers.

The new 4200 series chassis is based on the 110° delta-gun 4000 chassis – which remains in production – but incorporates ultrasonic remote control.

A Visit to the Cinema

Les Lawry-Johns

WE had barely finished our lunch, which is a hit or miss affair at the best of times, and were about to have a quick game of draughts with the dog (I open the door, he closes it), when this young fellow rushed in.

"Les,", he said. "Number three has packed up".

Now this may not mean very much to you, but it was rather depressing for me.

The young fellow was from the local cinema, and the local cinema (only one where there used to be four within spitting distance) is one of those jobs which have been converted to three – two down, one up. The projectionist lives in the top one, and when he wants to see his screen he looks straight out of his porthole and there it is. When he wants to see what is going on on the other two screens however, he turns round and looks at two television screens which should give him a fair picture of what is going on in the other two, provided the closed-circuit camera is pointing at the screen in the cinema and not at the courting couples on the seats at the rear.

The camera in each is coupled to a monitor TV set marked No. 2 for cinema 2 and No. 3 for cinema 3 (would you believe).

If one of these TV sets fails to perform, the projectionist has little idea about what is going on in that neck of the woods and the only way he can find out is by rushing down about two hundred stairs or phoning down to see if someone can have a quick peek.

You may ask why each section does not have its own projectionist? If they did, he or she would have nothing to do when all is going according to plan, as the whole thing is automated, the film being on one huge reel laying horizontal on a slowly revolving cakestand and operating on the same principle as a cartridge player except that the film has farther to go (to the projector and back). Markers operate the house lights for intervals, and shut the thing down and start it up at the required time, all without attention.

Until something goes wrong that is: and this is where the projectionist up in the main (manual) box needs to see and hear what is going on.

Monitor Modifications

In this particular set up, the TV monitors are two 24in. Pye sets with modified 368 chassis. Modified is to put it mildly. The tuner and i.f. stages have been removed, and a small video preamplifier fitted to the side of the main panel which you will remember is of the swing-down type. A large mains transformer takes up much of the space on the left side, and supplies the h.t., at about 260V, and the heaters. These are still in series, run from a tapping on the transformer. In our opinion, which in the maker's opinion may be silly, the whole issue is overrun. The h.t. is too high, as is the heater current. The snag is that by the time the sets need their first repair the poor old tube has reached the point where a reduction of heater current results in a very dim picture indeed.

In the past we had given No. 2 the full treatment, with a new tube, reduced h.t., a PY88 in place of the PY800 and a thermistor in the heater line. No. 3 had previously received attention but still retained the original h.t. and the original tube. It was this one which was out of action.

Having carried two heavy cases up some two thousand stairs (it's two hundred when someone else does it) we were naturally puffed when we reached the site, and this was the reason, or part of it, why we were depressed when we first received the call. It's one thing to repair a set, it's quite another to have to suffer on the way.

Operating Box or Projection Suite?

Actually, it's quite interesting to visit these more up to date projection suites. We had considerable experience of them many years ago when they were called operating boxes and each projector had a large turntable at the rear of it on which a large record revolved slowly, the pick up working its way from the centre outwards to produce the sound which if the film had not been cut would synchronise with the picture (are you listening Chas E. Miller?) and which became disused when the sound track made its appearance on the side of the film in the form of a variable area or variable density strip which operated a photoelectric cell to produce superior sound (as time went on) and had the added advantage that if the film was cut the sound track went with it and so the sound stayed in sync with the picture...

The Defunct No. 3

However, to get back to the defunct No. 3 TV. Investigation revealed a blown fuse, an open-circuit h.t. supply diode, and a cooked up surge limiter resistor. Checking the h.t. line showed no shorts, so we fitted a larger (in size and value, to slightly decrease the h.t.) surge limiter, making it 33Ω, and a BY127, plus the fuse of course. We then switched on.

H.T. o.k., no heaters alight. Checking showed that the PL504 was open-circuit. This is the first heater in the circuit, being followed by the PY800 (PY88 in this case, which we fit here to reduce the heater current as it has a higher heater voltage rating). In view of the demise of the rectifier and surge limiter, not to mention the PL504 heater, we hurled the PY88 out as well, condemning it without a second thought as the cause of the trouble with a heater-cathode short.

Fitting new valves brought things to life, and the heater of the DY802 glowed up nicely. Now all this was done way

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AA117	14p	OA91	6p	BA148	16p	IN4148	4p
AA119	8p	OA95	6p	BA154	12p	BY206	30p
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AC127	30p	AF125	23p	BC148	11p	BC301	32p	BF154	30p	BF338	34p
AC12701	50p	AF127	23p	BC149	13p	BC303	59p	BF157	30p	BF458	59p
AC128	23p	AF139	34p	BC153	19p	BC307	11p	BF158	24p	BFX29	29p
AC12801	50p	AF178	53p	BC154	19p	BC308	9p	BF163	24p	BFX84	24p
AC141	24p	AF179	55p	BC157	14p	BC327	12p	BF167	24p	BFX85	25p
AC141K	40p	AF180	53p	BC158	12p	BC328	12p	BF173	24p	BFX88	23p
AC142	24p	AF181	49p	BC159	14p	BC337	15p	BF177	29p	BFX89	30p
AC142K	25p	AF186	39p	BC171	14p	BC547	12p	BF178	32p	BFY50	22p
AC153	23p	AF239	39p	BC172	13p	BD115	64p	BF179	32p	BFY51	22p
AC176	24p	AL102	1.05	BC178	21p	BD116	60p	BF180	34p	BFY52	22p
AC17601	50p	AU107	1.05	BC179	19p	BD124	79p	BF181	32p	BU105/01	1.90
AC187	23p	AU110	1.85	BC182L	10p	BD131	44p	BF182	43p	BU105/02	1.90
AC187K	24p	AU113	2.20	BC182LB	10p	BD132	49p	BF183	43p	BU105/04	2.50
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AC194K	31p	BC113	12p	BC186	24p	BD136	45p	BF195	14p	BU205	1.90
AD140	45p	BC114	19p	BC187	26p	BD137	47p	BF196	14p	BU206	1.90
AD142	50p	BC115	19p	BC203	15p	BD138	49p	BF197	14p	BU208	3.00
AD143	50p	BC116	19p	BC204	15p	BD139	80p	BF198	19p	MJE340	65p
AD145	50p	BC117	19p	BC205	15p	BD144	2.10	BF199	24p	MJE520	80p
AD149	1.00	BC118	28p	BC206	15p	BD155	74p	BF200	34p	AF126	1.10
AD161	45p	BC119	28p	BC207	15p	BD157	74p	BF240	19p	MJE3055	73p
AD162	45p	BC125	21p	BC208	11p	BD183	55p	BF241	21p	MPSU05	65p
AF114	50p	BC126	19p	BC209	15p	BD235	74p	BF256LC	44p	MPSU55	1.25
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22μf	100v	220μf	10v	1000μf	25v
6800μf	25v	0·47μf	50v	1500μf	25v
33μf	450v	1500μf	63v	3300μf	25v
330μf	100v	10μf	350v	1000μf	63v
47μf	450v	0·47μf	100v	2200μf	16v
47μf	63v	3300μf	16v	680μf	50v
22μf	40v	2·2μf	63v	220μf	63v
1μf	100v	2200μf	16v	15μf	450v
6800μf	40v	47μf	350v	15000μf	25v
1500μf	40v	10000μf	25v	680μf	100v
220μf	10v	470μf	6·3v	470μf	100v
470μf	50v	4·7μf	40v		
3300μf	16v	1000μf	100v		
4·7μf	63v	470μf	63v		
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up on the shelf where the sets lived, standing on about two square inches of spare space on the rewind bench to save the trouble of lifting the thing down and lifting it back up again, and with the set turned 90 degrees to gain access to the rear. We thus had to stretch our neck to see what was taking place on the screen. The video input was plugged in but not the audio, so until we looked we didn't know what was taking place.

Now I didn't know that cinema 3 showed mainly sex films, so when I stretched on tip toe to see what the picture was like I was unprepared for what was there right in front of my nose.

Well, you could have knocked me off my perch with a feather. There was I, carefully brought up, looking at young naked females doing things I can't describe in this sort of magazine.

Frank, the projectionist, looked impassively at the screen and said "That's nice Les". I said I supposed so but did this sort of thing go on all the time? "Not that", he said, "I'm talking about the picture, it's good. As for what they're getting up to, that's nothing. You should see the one that's on with it. Proper gets on your nerves, all this bum and tit".

Line Sync Lost

At that moment the picture moved sideways and lost line sync. "It didn't last long, did it", Frank said gloomily. Hanging on with one hand, I reached down to my box with the other and clutched a PCL805. A what?!

Well, with this chassis there are two ECC82 valves as the line and field oscillators, the PCL805 functioning as the field output (pentode) and the flywheel line sync phase splitter (triode).Thus when the line won't lock but drifts back and forth with the hold control, the PCL805 is the first suspect. With the new one in the line locked solid and we were back to the bare facts of life and those naughty girls.

Final Checks

Before wrapping the job up, and while still up on our perch, we checked the audio input and the condition of the PCL82. This and its cathode resistor do not appear to have a normal life span, but we had replaced them not so long since and they seemed to be holding up well enough.

We thankfully replaced the rear cover and turned the set so that Frank could see that the carryings on in cinema 3 were up to the normal high standard. We then packed our gear and plodded down the ten thousand stairs, carefully avoiding cinema 3 on the way out. Outside, the advertising broadsheet read: "See the love life of the most beautiful girls in Europe". Oh dear, and not a male in sight. Are we really necessary, apart from repairing sets that is?

There are Other Monitors

One must not run away with the idea that all cinema TV monitors are the same. Oh no. Only a few weeks ago we had one sent in from another town. This was an all metal job, made by Sony. This used valves but the heaters were in parallel, EY88 etc.... All good fun, but we haven't plucked up enough courage to tackle the cameras. Any volunteers?

Footnote . . .

We understand that cinema projectionists are in very short supply. A short training period and you could be watching three films at once while being paid for it.

VCR Notes

John de Rivaz, B.Sc.(Eng.)

BOUGHT new, even from a discount house, a video cassette is an expensive item. If one pays £20 for it, one has to earn over £30 when paying income tax at the standard rate. There are economies which can be made however. If the intention is to build up a library of recorded material, cassettes on the point of failure could be used, since it's assumed that the private individual will not play them all that often. A new cassette could be used for watching television programmes at times different from the broadcast, and then transferred to library use as it gets old.

It's also possible to buy used cassettes from people selling their VCRs. A used VCR fetches £350 to £400 at the present time, more or less regardless of the number of cassettes supplied with it. Clearly a vendor is better off selling the cassettes separately to another buyer, and advertisements of cassettes for sale appear regularly in *Exchange and Mart*. Advertisements also appear from people willing to buy them. The prices at present seem to be £10 per VC60 (buyers advert), and £12-£14 per VC60 (sellers advert). If the buyer advertises and buys only one cassette he is no better off than if he had paid more and bought from a seller who was advertising, owing to the cost of the advertisement. There's also a company which sells used cassettes obtained from commercial and institutional surplus sources – PTMA Ltd., 57, Manor Park Crescent, Edgware, Middlesex. Availability is strictly limited however.

Dealing with Damaged Cassettes

Broken cassettes fall into various categories. In cases where the tape is broken, folk-lore has it that splicing is impossible "as it would strip the heads at one go".

The instruction manual for the Sony CV2100CE video recorder gives details of how to splice videotape however. The tape is cut perpendicularly (*not* at an angle, as with audio tape) and the two edges carefully butted together. A piece of splicing tape is then used (*not* Sellotape), affixed to the side that does not face the video heads. This appears to work with video cassettes. Note that the stop foil passes the heads, on the opposite side of the tape, and is less flexible than splicing tape. It could be argued that if the butt joint is not good enough some damage could be done to the heads by the edge passing over them. If you are going to try this therefore, make sure it is a good joint.

I have not tried this myself, but have heard of the practice of winding tape from 7in. videotape spools on to a cassette, recording it, then off-winding the tape on to 7in. spools for storage. Although it's said that Philips cassettes contain special tape, it seems that ordinary good quality videotape is also suitable. The point is that 7in. spools of videotape as used on Sony and similar VTRs can be obtained second hand at low cost. It would also be possible to buy a worn out cassette, discard the tape and refill it with tape obtained in this manner. It might also be worthwhile buying a VC30 if you could get one at say £5 and filling it with second-hand Scotch "Guardsman" long-play tape from a 7in. spool to make a VC60. Also, three VC30s could be made into two VC45s and an empty cassette for refilling. There would be a splice in each VC45, of course.

I have never tried using used computer tape on a VCR or VTR, but have it on good authority that this does not work. Many computer data recorders operate on a principle where the tape does not touch the heads, therefore no care is taken to prevent the oxide from flaking off all over the place. Also, I understand that there is a difference in the structure of the tape.

It was at one time said to be possible to buy broken video cassettes from private individuals for as little as 75p. I have never been so fortunate, but clearly they would be a bargain if one could either splice the tape or refill them with new tape.

Another problem that arises with video cassettes is when they jam or start the servo hunting at the start of each recording. This seems to be due to the edges of the tape becoming distorted near the start of the reel. There is usually slightly more than 60 minutes worth of tape on a VC60 (or pro rata on the other sizes). A cure for this therefore is to carefully peel off the stop foil and stick it on again a few feet along the reel. In this way the distorted tape is never used.

The problem that requires the most effort to cure is when the spools catch against the sides of the cassette. In my opinion the manufacturers should have allowed a greater tolerance in the design so that this cannot happen. To cure this, first remove the four screws in the cassette. Then turn it over, holding it together by hand. Only after it has been turned over can it be opened out, hingeing along the label. The sliding door can be removed if it wants to come, carefully saving the spring. If it won't come, keep an eye on it as it soon falls off on its own, and the spring is lost. Note the way the tape is wound, then remove the spools. Observe the inside of the cassette, and note the score marks on the side where it's catching. With a sharp wood chisel or knife, carefully scrape away part of the plastic where the score mark is, thus enlarging the inside of the cassette. This process places an electrostatic charge on the particles removed, so they tend to stick to everything. Care should be taken to prevent any of these remaining on the inside of the cassette when it's reassembled. Reassemble the cassette and try it. It may be necessary to repeat the procedure if enough plastic has not been removed.

Two-hour VCRs

According to a recent announcement Philips are shortly to introduce a new VCR which will play a VC60 cassette for two hours – the N1700. It uses video heads inclined at an angle to each other in order to reduce crosstalk between the tracks, but it's not compatible with existing VCRs although it uses the same sized cassettes. There are clearly a number of possibilities to be explored here, and I shall be reporting further in a future article. Briefly, the options are to buy an N1700 head and modify an N1500 machine to use it, or to modify an N1500 machine to operate on the skipped field principle. This latter option suggests the possibility of operating at normal, half, quarter or one-eighth speed. There would be reduced vertical resolution at half speed, then progressively more jerky movement with the same resolution thereafter. The sound quality would also be very poor at the slowest speed. The practicality of any of this I have yet to discover. The problem at present is to get a variable-speed motor to drive the tape in an N1500. The N1502 machine with its d.c. motors would be a better machine to work on from this point of view, though as its electronics are modularised (!) the other modifications required may be more difficult.

Picture Sharpening

Since the appearance of the article on the picture sharpening circuit in the July issue I have discovered that the N1502 contains a module which does the same thing using a superior principle involving two coils and a delay line. This can be bought from CES for £9.08 at the time of writing, so the earlier circuit is not really worth the bother of making up. Briefly, the N1502 picture sharpening module uses a dual-differentiation system producing more genuine output pulses which do not require approximate processing with a diode centre-clipping circuit. The 120nS delay line ensures that the output is in time with the video signal and is added at the correct point. It fits in the same place as the earlier module and its pin connections are shown in Fig. 1. The level does have to be turned down in the N1500 however as otherwise it upsets the sync pulses. It has been found to give better results than the design reported on in the previous article.

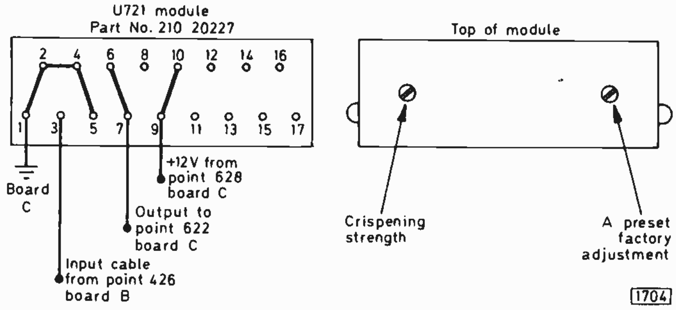

Fig. 1: Details of the U721 picture sharpening module used in the Philips N1502 VCR.

VCR Modifications

D. K. Matthewson, B.Sc.

THE following modification to a Philips N1500 videocassette recorder was undertaken because of two apparently unrelated problems. First, a German friend had sent us several videocassettes which, although they played quite happily on the N1500, apparently had no sound track. When played on the editing version of the machine however (Model N1520) the sound came up on track two, the non-preferred audio track. This meant that although we could play the tapes we couldn't edit, with the corresponding sound track, the sections we wanted.

A few letters to Germany plus a bit of detective work elicited the fact that the tapes had originally been recorded on a Grundig machine with switchable sound tracks. This is apparently quite a common machine in Germany. And of course our friend had recorded all the tapes on track two.

The second problem was that we very often edit on the N1520 tapes of material shot outdoors, and need to be able to mix the outdoor sound with studio commentary. Whilst this can be done by remixing, it's our standard practice to dub the studio commentary on track two and play both tracks back together to obtain the desired effect. Now this is fine if the tape is to be played back on another N1520, but if you play it back on an N1500/1/1460 etc. you can get only one sound track.

The solution seemed to be to fit an N1520 head to the N1500. If the two sound tracks were wired in series, you'd record on both tracks simultaneously and both tracks would play back o.k. Would the head fit? The audio head used in both machines also incorporates the sync read/write head, and they are identical apart from the extra sound head gap. The mounting brackets are rather different however.

It's easy to remove the head – there's one screw in the base. The new head then has to be placed on the correct bracket, the sync leads connected, both audio leads connected in series and the head realigned so that it will play back correctly. This is rather fiddly, as azimuth, height etc. all have to be adjusted. The CES line-up tape makes matters easier but is by no means essential – any prerecorded tape will do.

All in all a quick (one hour) job, enabling both sound tracks to be replayed together. The N1520 audio/sync head costs just less than £20 at the time of writing. Fig. 1 shows the details.

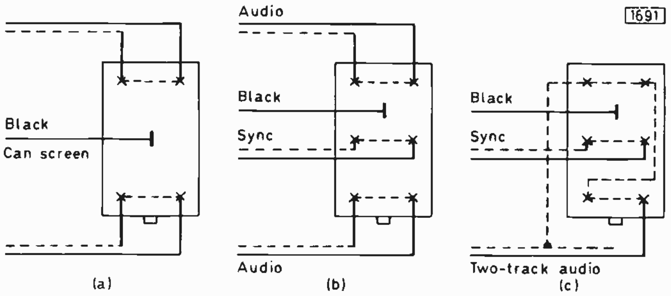

Fig. 1: Philips VCR audio/sync head connections. (a) Model N1500. (b) Model N1520. (c) Modified head arrangement to give two-track audio recording and playback on Models N1500/N1501. Viewed from the back (tag) side. There is single screw fixing at the base. The part number of the N1520 audio/sync head is 4822-249-10082.

Colour Fault

The colour information is recorded on the tape with a subcarrier frequency of 562·5kHz. Due to a fault in the 1:36 divider chain module (U66) or the sync/discriminator module (U67) the subcarrier oscillator may be free-running. You may still be able to record and play back in colour, but there will be no or unlocked colour when the cassette is played back on another machine. This can cause confusion!

Edit Clearing

The N1520 has an electromechanical system to clear the edit buttons after an edit or when the machine is switched off. This is ideal in theory, but in practice it's susceptible to spurious pulses and mechanical shock. As a result the edit buttons often release during an edit. This can be frustrating at the least, and at the worst can erase the sound, vision and control track on a master tape, thus ruining it. The cure is to disconnect the leads to the edit button clearing relay (relay 59). The buttons then have to be cleared by hand – press any non-selected one gently. At the most one can then do only the wrong type of edit (sound dub instead of insert etc.) and not ruin the master control track.

She would hit it with this duck . . .

A saga of awkward field faults

Nick Lyons

IT'S odd how faults seem to come in groups. The last plague here was tuners, this time it's awkward field faults. The following for instance...

The credit for the worst bit of devilment must go to a monochrome Bush set fitted with the A774 chassis. After switch on and warm up a horizontal white line appeared. After a further two or three minutes the field scan started to pulsate up to 25 per cent of full height about once every two seconds, with very loud purring noises from the field output transformer during these periods. Well, I'll try anything once, so in went a new PCL805 (see Fig. 1). As you've guessed of course, no difference. On hingeing the chassis down further it could be seen that the pentode's cathode decoupling electrolytic 3C18 had oozed its guts out on to the board. When this was replaced the condition changed to two second pulsing with a very short gap between each pulse and louder sounds from the field output transformer. Now triode anode voltage was not in abundance and bore a resemblance to the pentode cathode voltage: the field charging capacitor 3C14 was short-circuit. After I replaced this the set pulled out its ace card: a reasonably linear picture with good lock at 25 *fields*. It just seemed to be missing out alternate fields or putting them somewhere I couldn't see. All the controls had an effect on this, but none would cure it. Eventually the ugly scene was cured by replacing the two feedback capacitors 3C16 and 3C17. What I can't figure out is this: how could the customer have possibly watched the set with any of those capacitors gone, the chance of them all having failed at once being pretty remote?

The second prize goes to a Philips monochrome set with the 170 chassis. On this one the top three-quarters of the picture was normal and all the controls had reasonable spread, the trouble being that the bottom quarter of the picture was laid over the top three-quarters and stretched to the same height, the lines being evenly if widely spaced. I stared in horror, then tried a new PCL805. No success of course. Now these sets use two valves in the field timebase, the oscillator consisting of the triode section of the PCL805 plus a separate EF80. A new EF80 made no difference, but on measuring its anode voltage the scan collapsed and the Avo read nil. What had happened was that the 33kΩ anode load resistor R448 had gone high to the tune of quite a few MΩ, but had been just low enough to keep the circuit going until the Avo loaded it. It seems a good idea to fit a rather more robust replacement.

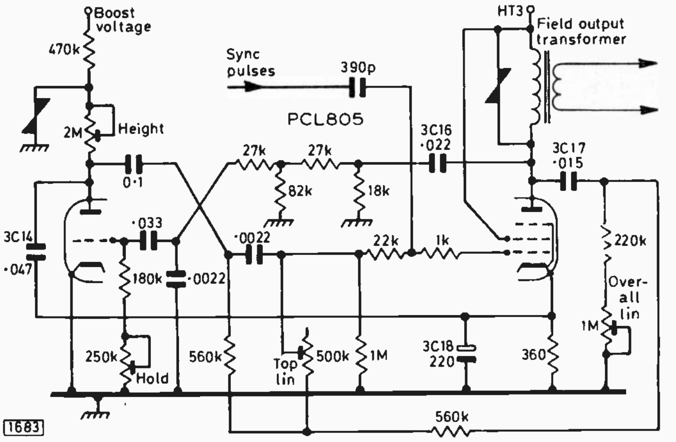

Fig. 1: Field timebase circuit used in the Rank A774 hybrid monochrome chassis.

Next a fault which will be recognised by all seasoned campaigners, intermittent field roll on a Bush Model TV161. The rolling was usually triggered off by the blank rasters between programmes. Now the video level and contrast control setting have a critical effect on sync performance in these sets, any shortcomings being shown up as field slip. So before going further, the video output stage was checked. All was o.k. here, so we moved to the sync separator section of the PFL200 where the screen grid decoupling electrolytic 2C48 was found to be open-circuit. Note that this is a critical point on this chassis: the sync separator's screen grid voltage is obtained from an *RC* filter fed from a point along the heater chain. The heater chain is fed via a diode dropper, and the idea is that in the event of the diode going short-circuit the *RC* filter cannot handle the ripple and field sync is lost, calling attention to the trouble before the valves are damaged by being over run. When field hold troubles are present on these sets therefore 2C48 (8μF), 2R43 (22kΩ) and the diode dropper 3SR2 (originally a BY101) should always be checked.

Still with Rank, the next set to come along was a Bush TV135R with critical field hold, excessive height and bad bottom cramping. On moving the overall linearity control there was vast height, field rolling and a sizzling noise from the control. It seemed that something was wrong in the field linearity feedback loop, and it turned out that one of the capacitors, 3C32 (0·01μF) which is beneath the valve, was open-circuit. This had led to excessive voltages in the stage, for on replacement the control stopped arcing. It might be wise to replace all the capacitors in this area therefore in the event of one failing.

So to the duck. The customer complained that the picture collapsed to a thin white line (ITT CVC5 chassis), but if she hit the top sharply with the duck the picture came on again. Now before you phone the RSPCA, the duck was a solid glass ornament kept on the top of the set: sharply was the operative word, for the wood looked well dented. This time it was valve trouble, a microphonic PCL805 field oscillator/output valve. I advised the customer to refrain from set bashing – lest it damaged the ornament....

Next a Pye monochrome set fitted with the 169 chassis. This refused to lock, due to the hold control having insufficient range of travel. The trouble turned out to be

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TV Servicing: Beginners Start Here . . .

Part 1

S. Simon

MANY of our readers – new ones, we hasten to add! – seem to find difficulty in grasping the basic principles of servicing. This is sometimes so despite many hours spent reading textbooks which use the accepted methods of explaining the fundamentals of the subject. It's quite likely that many people give up trying, and remain on the outside. They may continue to look at this subject which they'd like to understand, but lack the time and patience to start at the beginning and work their way up the somewhat tedious slope to the point where they can tackle servicing jobs without confusion – and perhaps danger. Is there anything that can be done to help? Well, we're going to have a try, the object being to present the subject in a very practical way. The reader can then return to his textbooks if he wishes, and should find them rather more interesting and instructive.

Juice

Let's start with "juice", the thing that makes electrical devices work. Without it the car won't start, even if you push it or crank it with a starting handle. The reason is the same as when you turn the tap on and nothing comes out – there's nothing to push it (the juice, not the car, though it amounts to the same thing if you think about it).

The answer's easy you may say, pressure. Quite so, but it's really *difference* of pressure that counts: raise the pressure at one end more than the other and away you go, out comes the water, on goes the kettle and provided the gas board is doing its job we can all have a nice cup of tea.

If you happen to have an electric kettle, the onus is on the power station boys to maintain the pressure between the ends of the kettle's element so that enough juice flows through it to heat it up. The juice in this case is a current of electrons, which can be quite fickle. They'll move through some materials even when the pressure applied is low – such materials are of course conductors. Other materials resist the flow of electrons even when the pressure is very high. Such materials as mica provide insulation when placed between points of different electrical pressure, stopping the electrons going where we don't want them to go.

Look again at the car battery. Inside are a number of spongy bits of lead which are marked – or negative, and an equal number of bits of lead peroxide which are marked + or positive. In their initial state the negative plates are grey and the positive plates brown. Being close together and likely to buckle, they're separated by pieces of insulation which, you'll never believe, are called separators. Fill the container with a nasty fluid called dilute sulphuric acid and you've got a complete "cell". The sulphuric acid acts as a conductor of electrons, and is thus known as an electrolyte. One such cell provides – when in good condition – a difference of electrical pressure of a little over two volts. Put three in a container and connect them end to end (+ to –) and we end up with a battery providing 6V between its ends. The battery's electrical pressure difference – between the two connections – lasts for quite a time, waiting to disturb the structure of any material connected between its contacts.

Put a piece of fuse wire across the connections and you will see just how it's disturbed: it will first buckle, then as the current of electrons through it increases it will overheat, become white hot and then break. In other words, the potential difference – measured in volts (V) – between the two ends of the battery was sufficient to push enough current through the wire for the fuse to fail.

Electrical Resistance

With a perfect conductor (something that doesn't exist) the electrons would move evenly, without bother, and no heat would be generated by their passage. Put it this way: there would be no *resistance* to the flow of current. All practical conductors offer some degree of resistance to the flow of current however. Thus if we take a long enough length of wire, coil it and pass an electrical current through it we'll get heat but the wire won't melt – there's sufficient resistance present to prevent enough current flowing for the heat generated to reach the wire's melting point. We'd have a crude cigar lighter! There's a better way of going about this of course, to use a material which offers a higher resistance than ordinary wire. We thus get the heat – or light – we require without the need to use an excessive length of wire. Resistance is measured in ohms (Ω), and the current flowing in amperes (A).

Ohm's Law

Let's see how this can be put to practical effect. Say we have a bulb whose wire element has a resistance of three ohms and we connect it across a 12V battery. It'll heat up brightly, passing a current of 4A – the current flowing (I) is equal to the voltage applied divided by the resistance (see Fig. 1). The heat dissipated by the bulb can also be calculated – by multiplying the current in amperes by the voltage. In this case then we have 4 × 12 which gives a fair old heat of 48 watts (W). There is generally – a few materials have unusual electrical characteristics – this direct

$$V = I \times R \qquad I = \frac{V}{R} \qquad R = \frac{V}{I}$$

$$W = V \times I,\ I^2 \times R,\ \text{or}\ \frac{V^2}{R}$$

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Fig. 1: Ohm's law for d.c. circuits.

relationship between current, voltage, resistance and dissipated power. It's known as Ohm's Law. So you need know only two and the others follow.

Now say we've a current of 3A flowing through a device which has a resistance of three ohms (3Ω). The voltage across it will be 9V. But if the battery supplying it is a 12V one, what's happened to the other 3V? Obviously the connecting wire used between the battery and the device is offering an appreciable resistance of its own, maybe because it's too thin, so that the other 3V is developed across the wire. The same current (3A) is flowing through the wire and the device, while the resistance offered by the wire is equal to the voltage (3V) divided by the current. So it's resistance works out at one ohm. And while the device is dissipating 27W (3A × 9V), the connecting leads will be dissipating 9W (3A × 3V). If you think this is leading up to something, you're dead right.

Speaker Resistance

Take that nice unit audio of yours, you know, the one with the quoted output of 36W. Say it's a fairly old one using valves. There'd probably be alternative connections for either a 15Ω or a 3Ω loudspeaker. Say you also have a nice 3Ω loudspeaker which is capable of handling 36W of heat (power, that is). Let's also say that you want the speaker to be some distance from the amplifier, and that you are unwise enough to use thin leads. The speaker won't give 36W, because the cable might have a total resistance of 1Ω, thus developing some of the available voltage across it. So this voltage is not available to the loudspeaker, where it's wanted. You'd do much better using a 15Ω speaker, so that the vast majority of the voltage would appear across the speaker. The current required would now be a lot less, because of the higher resistance, and the use of thin leads would not be such a serious drawback.

So much then for Ohm's Law, which is such a handy rule to use when dealing with resistors and common appliances.

Series Circuits

We have noticed that when things are in series with each other the current flowing through them is the same, but that if their resistances vary the voltage across each will differ – the total adding up to the supply voltage. As a little exercise, work out how many bulbs there should be in a string of fairy lights, and what happens when one fails (to put the rest out of course) and is then replaced with one of a higher resistance taken from a chain with fewer lamps, say twelve in series instead of the twenty four in the initial chain.

The Heater Chain

What have fairy lights got to do with television? Well, until the advent of all solid-state sets it was – and still is – the normal practice to wire all the valve heaters, plus the c.r.t. heater, in series, the current required usually being 0·3A or 300mA depending on how you wish to express it. Obviously some valves are required to do more work than others. Consequently the heater resistances will vary, the valves handling small signal currents having low resistance heaters which will develop say 6·3V (dividing the current into this voltage gives you a resistance value of 21Ω), while others which are required to develop power to drive say the loudspeaker or the scan coils will have higher resistance heaters so that a greater voltage is developed (or dropped, as it's commonly termed) across them. As an example of the latter, the PL509 colour receiver line output valve has a 40V heater which, with 0·3A flowing through it, dissipates 12W. The set designer adds up the voltages required by the valves in the chain, then decides how to supply them.

The Mains Dropper Resistor

At one time some parts of the country had d.c. mains supplies, and there were slightly different supply voltages. So the mains input was fed to a fairly large wirewound resistor which had tappings on it so that it could cater for the various supply voltages it might be required to accommodate (normally 200, 220 and 240V). This is still the practice with a.c. mains supplies, which we'll come to in a minute. The value of the resistor was made such that it dropped the mains voltage to the voltage required by the heater chain. The well known mains dropper!

Say the total valve heater voltages add up to 150V, and the mains supply is 240V. The dropper resistor has to develop 90V, and dividing this by 0·3A gives us a value of 300Ω. It's dissipation would be 90 × 0·3, i.e. 27W, so the minimum rating required would be 30W, and the heat it develops is something which the setmaker must take into account – the life of other components is considerably shortened if subjected to its heat.

In practice the dropper's value is a lot less than 300Ω, sometimes because the valves require a total of more than 150V but more often because a device which we shall come to later is connected in series with the dropper and reduces the voltage applied to the dropper. The provision for d.c. working is not now required, except in the case of portables which usually operate from a 12V source, say a car battery, as well as the mains. The normal household TV set can be restricted to a.c. operation therefore.

AC and All That

It was discovered many years ago that a piece of wire passed quickly through a strong magnetic field results in the electrons in the wire being set agog: they rush in one direction (assuming that the wire is part of a complete circuit). As the conductor cuts across the lines of magnetic

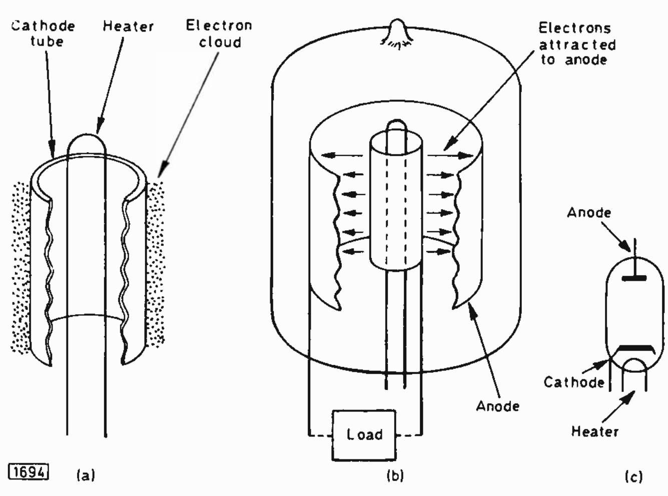


Fig. 2: The thermionic valve rectifier. (a) When heated, some materials give off electrons. (b) If a heated cathode (source of electrons) is surrounded by a metal cylinder (the anode), the anode/cathode/heater assembly being contained in an evacuated container (almost always glass), and the anode and cathode are connected together via an external circuit, an electrical current will flow between the cathode and anode when the anode is positive with respect to the cathode. (c) Circuit symbol for a diode valve.

force, a voltage is induced across it and in consequence current flows through it. If the wire is passed back again, the direction of current flow reverses. If coils of wire are used with the connections to them reversed each time the wire cuts the lines of magnetic force the output obtained will be in the same direction all the time and you have a d.c. generator.

If we can go back to our car battery for a moment, this will provide a supply of current for only a certain length of time (so many ampere-hours). It's chemical structure changes as it gradually discharges, the brown lead peroxide plates tending to become spongy (grey) like the negative plates. Because of this the potential difference (voltage) across the battery drops and it cannot maintain a supply of current. Pressing the starter button then gives you wer wer instead of weee... We then want to do something which will reverse the chemical process – by passing juice back through the battery.

To do this we must supply it from a generator which provides a potential in excess of the battery's potential. If the discharged battery has say 10V across its contacts instead of 12V, we must supply it from a generator providing say 14V in order to get a potential difference of 4V with which to provide a charging current. The value of this charging current will depend on the resistance of the battery's cells. Say the resistance is 1Ω. The charging current will thus be 4A, which is o.k. for a trickle but would take about ten hours to charge a 40 ampere-hour battery. The internal resistance is in fact a lot less, more like 0·1Ω, as there are many plates connected in parallel. So the charging current is 40A, not 4A. These figures are not to be taken too seriously: they are used for conveninece as they save the writer having to think...

Returning to our electromagnetic generator, suppose that we don't reverse the connections each time the current direction reverses. As the coil rotates, during each cycle of 360° there is a complete reversal of current. During the first half cycle (180°) the voltage induced across the coil rises to a maximum at 90°, falls to zero at 180°, then rises to maximum in the opposite direction at 270°, finally falling to zero again at 360°. If the voltage is positive during the first half cycle it will be negative during the second half – and while it's negative it won't do the battery we're charging much good! What we have to do is to rectify the supply so that the negative half-cycles are either not passed on or reversed in some way. This takes us away from the motor car which has served as a simple example so far, and from now on we'll be concerned with the normal household mains supply, which is alternating (a.c.) and produced basically as described above.

Transformers

The overwhelming advantage of an a.c. supply is that it can be transformed from one voltage to another without too much trouble. When a current passes through a conductor (that piece of wire again) a magnetic field is set up around it – the converse of the business of using a magnetic field to generate a voltage across the conductor. If the current flows in one direction only (d.c.), the magnetic field is stationary. But if the current is a.c., constantly reversing, the magnetic field constantly builds up and collapses. Place another coil close to one carrying a.c., and the varying magnetic field around the first will induce a flow of current in the second, at the same frequency of course (reversals per second). The coupling can be enhanced by winding both coils on an iron former or core, and here we have the transformer. If the original coil (the primary) has say a hundred turns and 100V across it, the secondary winding can have any number of turns to produce whatever voltage is required, two hundred in this case producing approximately 200V, ten turns 10V and so on.

The normal a.c. mains supply changes direction fifty times per second, and the core material used for transformers at this frequency usually consists of a number of thin metal stampings clamped together. A solid iron core would have its electron structure so disturbed by the rapidly varying magnetic fields that it would become hysterical and introduce losses. Using a laminated core of separate strips reduces the hysteria – as long as the frequency is kept low.

As the frequency rises, the losses become greater and a different core material is necessary. One approach is to used powdered iron, which results in what's called an iron dust core. This retains its efficiency with changes of magnetic field occurring at up to millions of times a second (megacycles per second, Mc/s, or MHz). With this facility at our disposal the whole world is transformed into a glittering fairyland of light and power and communication extending out to the stars . . . my, we are getting lyrical (good grief, editor).

We saw earlier that when a current is passed through a conductor a voltage is developed across it because it has some electrical resistance, and that power is the product of current and voltage. Raise the voltage and less current is required for the same power. With less current we can use thinner conductors. So power can be transported across the country at high voltage and transformed down again to a less dangerous voltage at the other end.

Supplying a Transistor Radio

By transforming it down yet further we can power our transistor radio – the batteries for it are becoming more and more expensive and as it's used in the home most of the time it's handy to be able to plug it into the nearest mains socket.

The usual supply for transistor radio sets however is either a single battery of cells, say a 9V PP9 or similar which consists of six 1·5V cells in series wrapped up in one pack, or a number of separate cells to give the required voltage, for example four HP7 to give 6V or perhaps six SP11 to give 9V. Some larger receivers may have different combinations. Some Roberts receivers for example use two large lantern batteries of the 996 type (these are 6V batteries having coiled spring end contacts) which are effectively wired in series to provide 12V. Others may use two PP9 (9V) batteries wired in parallel (positive to positive, negative to negative) to provide 9V at a higher capacity.

If we wish to supply a radio from the mains we must first know the voltage at which it is designed to work, and then wind a transformer to give an a.c. output of just under this. Obviously the smooth d.c. output of a battery needs little doctoring in order to supply the radio (in actual fact it does need a little, and we will consider this later), but the output of the transformer will be rapidly reversing at 50 cycles per second (50Hz) so we will have to do something about it.

Rectification

The most obvious way of doing this is to connect in series with one lead a device which will allow current to pass through in one direction but will act as a barrier in the other direction. There are many such *rectifiers* of current. Some years ago valves were used for this purpose – and it is quite likely that you may still have a radio using valves.

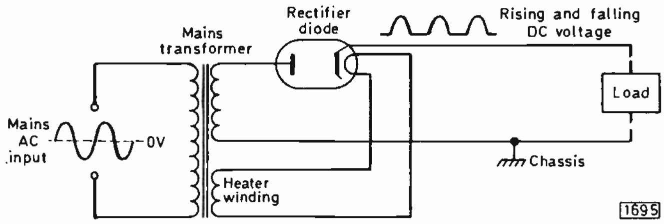


Fig. 3: Use of a diode valve as a rectifier. The output to the load from the arrangement shown would consist of a series of positive-going pulses, with gaps between them where the negative-going excursions of the a.c. input have been suppressed. The transformer can be used to reduce the mains voltage from a high to low value.

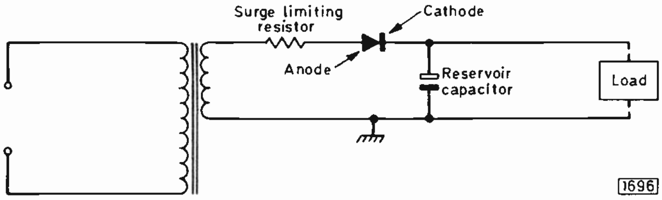


Fig. 4: Nowadays, a semiconductor diode is used to provide rectification. The addition of a reservoir capacitor across the rectifier's output smooths out the pulse voltage coming from the rectifier, but there is still a fair amount of ripple on the output because the load circuit discharges the reservoir capacitor during the periods when the rectifier is not conducting. The surge limiting resistor is necessary to protect the diode, limiting the current flow as the reservoir capacitor charges on first applying a.c. to the input.

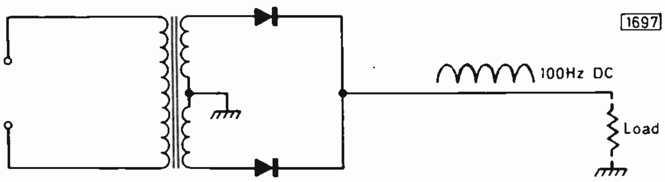


Fig 5: This full-wave circuit provides a 100Hz output, the two rectifier diodes conducting on the alternate positive- and negative-going excursions of the a.c. input. This enables a smaller value reservoir capacitor to be used than in the half-wave rectifier circuit previously shown.

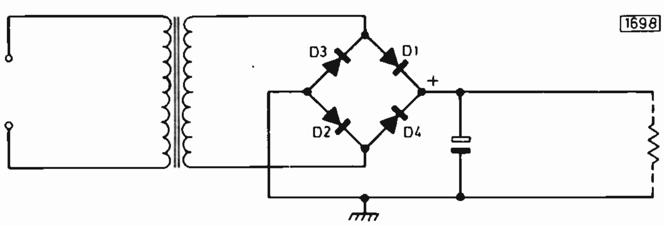


Fig. 6: An alternative method of obtaining full-wave rectification is the bridge rectifier circuit shown here. The advantage is that an earthed centre-tap is not required on the transformer's secondary winding. When the top of the transformer's secondary winding is positive with respect to the other end, diodes D1 and D2 conduct: on the negative-going excursions of the a.c. input waveform diodes D3 and D4 conduct. By reversing the connections to the diodes, the load would be presented with a negative instead of a positive rectified output.

Briefly, the mode of operation of a valve is as follows (see Fig. 2). Some materials get very agitated when heated, electrons flying off at a goodly rate. The usual idea is to coat a hollow tube on the outside with some such material (say barium) and to heat it up using a heating element on the inside. If this arrangement is exposed to the atmosphere, not much happens as the electrons thus emitted will be immediately absorbed by the surrounding atoms. If the emitting surface (the cathode) is placed in a container which is pumped out to a high degree of vacuum however the electrons can leave the surface and form a cloud round it. If we also place in this container or envelope a piece of metal which has lost a lot of electrons, i.e. it is positively charged, it will draw the electrons to it, thus providing a flow of current provided there is an external return path.

Now let's get this quite clear, because we all tend to get confused due to our early learning which taught us that current flows from positive to negative, and we grew up with this firmly in our tiny minds. We say that there is a potential difference between two bodies one of which has more electrons than the other. That which has less electrons is termed positive in respect to the other, and if a path is provided between them the current flow will be from negative to positive until they are equalised and there is no difference of potential.

If we apply our a.c. to the positive plate or anode, and the other end of the secondary winding is connected (see Fig. 3) via a circuit lead back to the cathode, the resulting current will be unidirectional but rising and falling. This is not at all what we want, so we now need a gadget which will charge up as the voltage rises and discharge slowly as the voltage falls, thus evening out the humps. A capacitor does this, and in co-operation with other components will reduce the ripples and provide an output which is more akin to that provided by a battery (see Fig. 4).

Now it's not convenient to use a valve rectifier nowadays because of its bulk and its heating requirement. Fortunately there are plenty of other materials which exhibit unidirectional properties. Some don't like doing this very much, and offer a certain amount of resistance (this can be quite useful at times); others offer little resistance and are therefore very efficient. The valve rectifier referred to above is called a diode as it has two active elements or electrodes, the anode and cathode. The term diode is also applied to the other, solid-state unidirectional devices. The silicon diode is a very efficient rectifier, taking up little space and dropping only 0·7V at varying currents (this property can be made use of in other applications). We'll return to its mode of operation when we come to semiconductor devices later.

Full-wave Rectifier Circuits

The disadvantage of using one diode to rectify the mains supply is that it passes one half cycle only – it's called a half-wave rectifier. If we are using a transformer we can wind the secondary in two halves, each supplying a separate diode so that when one is shut off the other is working. This gives full-wave rectification (see Fig. 5). The reservoir or tank capacitor then doesn't have to work so hard at filling in the troughs which occur each time a single diode shuts

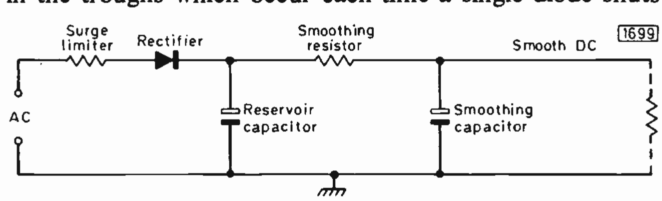


Fig. 7: A single reservoir capacitor will often provide a smooth enough output with a full-wave rectifier. In the case of a half-wave rectifier however it is essential to provide extra filtering to obtain a smooth d.c. output. The smoothing resistor and capacitor shown here provide the necessary filtering. In this example the rectifier diode is fed directly from the mains instead of via a step-down transformer, so a supply of some 250V will appear once the reservoir capacitor has been charged by the rectifier.

off: its value or capacitance can thus be reduced, which in turn relieves the diode whose job it is to charge it up.

Another cunning and commonly used approach employs a single secondary winding connected to four diodes (see Fig. 6). This again relieves the smoothing requirement and the tranformer design. It's known as a bridge circuit, and the four diodes may be contained in one envelope with four lead outs: two go to the a.c. winding, one is the supply and the other one the return – these are marked + and –. The a.c. inputs are marked with a wavy line to indicate the sinewave input required.

So here we have several ways of supplying our transistor radio from the mains. Larger units which take and deliver more power require refinements which regulate the voltage, keeping it within certain limits despite large current swings.

Smoothing

With even the simplest arrangements something more than a reservoir capacitor is usually required. Returning to Fig. 4, the rectifier diode will conduct and charge the reservoir capacitor when its anode is positive with respect to its cathode – in other words during the positive-going excursions of the a.c. waveform fed to it. But if you think for a moment you will notice that as the reservoir capacitor charges, so the rectifier's cathode will be presented with an increasingly positive voltage and it will conduct for shorter and shorter periods – till it's conducting on only the peaks of the input waveform. What's happening is that the reservoir capacitor is supplying the load for most of the time, the rectifier simply topping it up as necessary. One important point follows from this: the value of the reservoir capacitor must be adequate for it to fulfill its supply function, but on the other hand it must not be of so large a value that it draws excessive current via the rectifier and transformer.

So the rectifier is non-conducting for quite a proportion of the time. During these periods the capacitor discharges and in consequence the voltage across it falls. The supply consists of d.c. with what's called a ripple voltage on it. Again not what we want. To get the smooth d.c. we require, we add a smoothing resistor and capacitor as shown in Fig. 7. With a bridge rectifier circuit you can generally get away with just a reservoir capacitor

TV Heater Circuits

In the early days of television it was common for TV sets to use large mains transformers. This bulky and expensive component was soon dispensed with however, and as mentioned earlier the valves in a valved set have their heaters connected in series, with a large wirewound resistor used to drop the voltage from that provided by the mains supply to the value required by the heater chain. The arrangement is shown in Fig. 8. Later still when sets were no longer required to be able to operate from a d.c. mains supply it became possible to employ a rectifier in series with the heaters – in addition of course to the rectifier required to provide a supply for the rest of the set (the h.t. supply). The heater supply rectifier considerably reduces the voltage fed to the heater chain (it doesn't halve the voltage however), so that a smaller value of dropper resistor can be used. The advantages are reduced cost and less heat. Fig. 9 shows the basic arrangement.

By this time transistors were beginning to do many of the jobs previously done in a TV receiver by valves. So with fewer valves in the heater chain the dropper resistor still had to have a fairly high value, and a figure of 150Ω or so will be found in many receivers of quite recent origin.

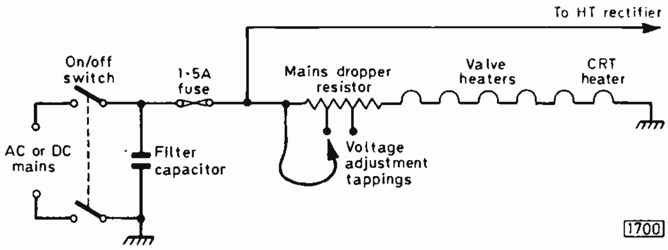


Fig. 8: A simple mains input and valve heater supply circuit for a valve TV set. Variations will be found in practice. The fuse for example may be connected at the input to the on/off switch rather than at its output and, as shown in Fig. 9, the filter capacitor may well come after the fuse.

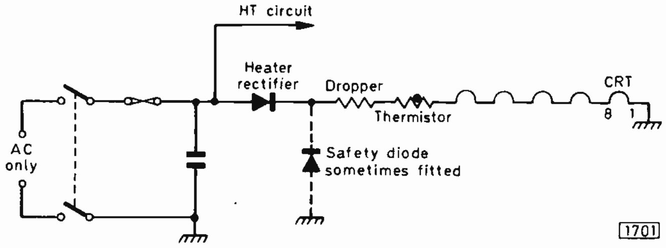


Fig. 9: An alternative mains input/heater supply circuit, using a diode to reduce the voltage applied to the heaters. In hybrid receivers, i.e. those using a mixture of valves and transistors, the l.t. supply for the transistors may be obtained from a filter connected to the chassis end of the heater chain – in this case tube pin 1 or 8 will not be connected to chassis.

Thermistors

We have omitted to mention one item commonly found in heater supply circuits – the thermistor. This is one of those devices which don't obey Ohm's Law: it's resistance varies as its temperature changes. This is also true, though to a very much lesser extent, of ordinary conductors: as they heat up, their resistance rises, reaching a stable state after some minutes or so. The problem with a heater chain is that when the set is switched on the heaters will be cold and there will be a hefty surge of current. The problem is overcome by adding in series with the heater chain a thermistor with a negative temperature coefficient – that is, it has a high resistance when cold and a greatly reduced resistance when hot. In this way the initial current surge and strain on the heaters is avoided. There are many different types of negative temperature coefficient thermistors – also some which have the opposite characteristic, i.e. positive temperature coefficient thermistors whose resistance value increases with heat – handy when you need a quick burst of current which rapidly falls to a very small figure, as in a colour receiver degaussing circuit.

Capacitive Dropper

There is another, though rarely used (it's more expensive than the diode dropper approach) way of reducing the voltage to the heater chain without dissipating heat. This is to use a capacitor in series with the heater supply. We've not said much so far about capacitors, so we can only briefly outline the action here. When a capacitor starts to charge, it takes a heavy current and the voltage across it is low. As it charges, so the current it draws falls and the voltage across it rises. This means that the current flowing leads the voltage by 90°. At any one moment therefore the current and voltage are out of phase with each other and the dissipation (wattage) is low. The current flowing is limited by the resistance of the heaters in series with the capacitor, and the circuit's operation can be worked out to very narrow limits. The capacitor must be of a special type and of precise value. Certain Thorn models some years back employed this type of heater supply.

What Goes Wrong...

Having discussed the methods used to supply valve heaters, let's go on to consider the faults that occur from time to time. These are faults which do commonly occur, not ones that could happen under unusual conditions. And if you think we're concentrating rather a lot on power supply circuitry, well this is the part of the set that most frequently gives trouble.

For the moment we are not concerned with any part of the set that's not involved with the supply to the heaters, so our interest (refer again to Figs. 8 and 9) is in the mains input, the on/off switch, the mains fuse, the heater circuit diode if used, the dropper resistor (which may have tappings for voltage adjustment), and the valve heater chain and c.r.t. heater, which is probably the last in the chain, one side of its heater being returned to the chassis or metal work which constitutes one side of the mains supply. To those not conversant with normal TV practice, this latter statement may come as something of a surprise. It may seem dangerous to directly connect one side of the mains supply to the metal work of an electrical device without being absolutely sure that the side so connected is neutral (not live). It is.

Whilst most sets are operated with the supply lead connected to a three pin plug, the brown (or red) lead to the live terminal and the blue (or black) lead to neutral, there is no absolute guarantee that the supply socket has been wired properly. Then there are times when a receiver is operated from a two point supply source, such as a two pin socket of a light fitting. So there is always the chance that the receiver metalwork could be connected direct to the live mains. The normal user is in no danger if the set is in its original condition, as there are no external metal parts connected to the internal metalwork. Once the rear cover is taken off however there is risk.

One may reason that there may be no metal pipes around and that the floor is wood so where is the immediate danger? Quite apart from any other possibility, it is highly likely that the aerial is lashed to or secured to the building, and that the aerial plug itself is therefore earthed. It is quite common for the rear cover to be removed and the aerial plug then inserted in order to carry out an internal adjustment. Whilst the aerial socket is electrically isolated from the rest of the receiver, it is easy to touch the chassis with one hand while inserting the plug (or otherwise holding it) with the other. If the chassis is live one would obviously receive a shock in these circumstances. Again, it is easy for the aerial plug to accidentally touch the metal work, which should immediately result in the supply fuse blowing if the chassis is live.

The Neon Tester

A neon screwdriver can be purchased for a few pence from any electrical shop, and is one of the most useful gadgets it is possible to imagine for anyone dealing with electrical appliances. It will always tell you where the live conductors are, where the juice is, and where it is not. It records, in short, a difference of potential. This is something to bear in mind. If for example the blade is touched to a live chassis, it will light because the person holding it is virtually at earth potential (when we say it, we mean the handle end which has a metal top: we do not mean the blade). As we are dealing with very high resistances there is no need to worry about the risk of shock, and there is a 1MΩ (approximately) resistor inside the tool in series with the neon.

The tool is held in one hand, so that what one does with the other decides the actual difference of potential. If the other hand touches the chassis for example, the neon should not light as there should not be any difference of potential across it. If the other hand is touching nothing the neon will light when contacting a point at a reasonable voltage (say the mains) as the body is still more or less at earth potential through the feet, the floor etc. Now let us use it properly.

Fault Finding with a Neon

With the TV set switched on, touch the neon to chassis to ensure that it does not light (i.e. the chassis is not live). We said we were interested in only the mains input, the on/off switch, the fuse etc. In some sets the mains is first taken to the fuse, in others it goes to the on/off switch first. If it goes to the fuse first, the neon should light when touched to the fuse holder. If the light is very dim touch the other hand to chassis to decrease the resistance, remembering that we have already established that the chassis is at earth potential. The neon will then give a more positive glow. It should of course glow at both ends of the fuse if this is intact.

From this point we can go to the switch: the neon will glow when touching each of the live pair of contacts (the other pair of contacts breaks the neutral supply to chassis) provided the switch is working and indeed has been switched on.

From this point the supply may go to a dropper tag first or to a diode, depending upon the design of the set. Unless one has a fair knowledge of the particular set, or has sufficient experience to recognise the mode of operation, verify how the circuit is wired by referring to the circuit diagram.

Let us imagine that the fault we are concerned with is that the valve heaters don't glow when the set is switched on. Now there are basically only two faults which can affect an electrical circuit: a short-circuit or an open-circuit. Take as an illustration a 60W light bulb hanging from a ceiling rose via a piece of twisted flex. Say that in the first place the bulb fails due to the filament fracturing, as is all too common. This is an open-circut and no current flows until a bulb with an intact filament is fitted. On replacing the bulb however the flex will be twisted, and due to the length of time it has been subjected to the rising heat of the bulb the insulation may crumble and the exposed wires touch. This is a short-circuit, and the amount of current that will flow will depend upon the rating of the supply fuse.

Blown Mains Fuse

Returning to the TV set, the neon can be used as already described to trace the mains input. Now all receiver inputs have a mains filter capacitor (see Figs. 8/9) which is wired across the mains after the on/off switch or the fuse, though you occasionally find that someone has removed it. The capacitor has more than one purpose, not the least of which is to absorb any "spikes" on the mains input – these can apply a very high voltage for the merest fraction of a second and could cause damage if allowed to enter the set proper. The capacitor is usually rated at 250V a.c. or more, and has a capacitance value of anything from about 0·05μF to 1μF. It is extremely common for this capacitor to short, blowing the set's fuse or the supply plug fuse if the set's fuse is after the filter capacitor.

If the neon does not light at any point in the set, a check on the supply plug or source is called for. Normally however the mains will be present at the set and the neon will probably light at one end of the fuse if not at the other. If this is so, examine the fuse to see whether it came to a gentle or violent end. If the internal structure is not blackened and the break can be seen, it's likely that the set has presented it with an overload which exceeded its rating by a reasonable amount. Normal fault finding procedures will then establish the cause. If the fuse is blackened however, it's likely that it has met a violent end and the mains supply filter capacitor should be the first suspect.

Open-circuit Dropper

Assuming that the fuse is intact however, we could then proceed to the dropper to see if the neon lights at its supply point tag. If it does, apply the neon to the next tag and so on to the point where the supply to the valve heaters is taken off.

It's quite likely that the neon will not light at this point, and this indicates that either the dropper's wire is fractured between the two tags (which is the more common) or that this end is too near to chassis potential to cause the neon to light. This latter situation is not common because the resulting heavy flow of current is likely to have blown the fuse.

At this point we check the value of the dropper (if indeed it has failed) to see if we can fit a replacement section of the same or a very near value, or whether we should replace the whole dropper complete. Assuming that we decide to fit a replacement section, there are two main factors to consider. The replacement must be large enough to dissipate the power without distress, and it must be fitted in a manner which will take into consideration the effect of the dissipated heat on the connection. Where possible, the connections should be bolted: where this is not practical, the stout connecting wire must be well wrapped and soldered with high melting point solder.

Open-circuit Heater

Having repaired the break the valves should light up. On the other hand, if the neon lights at all sections of the dropper which concern the heater supply, it's highly likely that the break is later in the chain and that one of the valve heaters has failed. Whilst any one could be at fault, it's common to find that the first valve in the chain is the one responsible. The reason for this will be discussed later. It's also prudent to check the c.r.t. (or tube as it's commonly known) base heater pins (usually 1 and 8, either side of the locating spiggot). If the neon lights at one but not the other, the fault changes to a major disaster as a new tube is indicated.

Very Live Chassis!

What happens when the neon lights at all points including the metal work? This means that the chassis is not returned to the neutral side of the mains supply, and the on/off switch is a possible culprit if the mains plug is correctly wired and the mains lead is intact along its length.

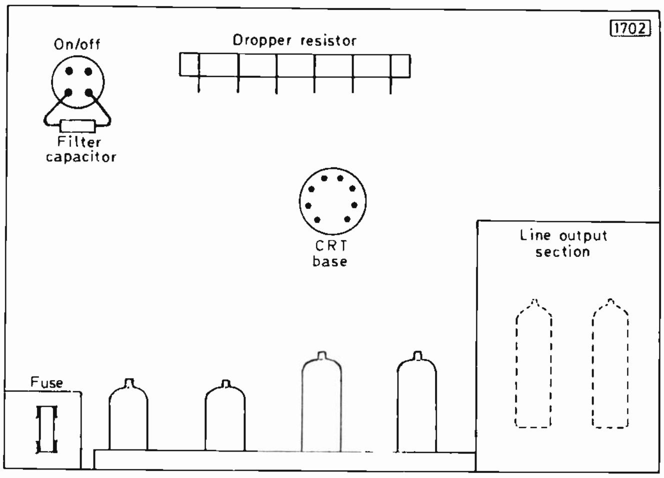


Fig. 10: The arrangement you may well see on taking the back off a typical valve monochrome set. The mains dropper resistor is generally mounted towards the top centre: less often it's mounted vertically at one side or the other, being cooled by acting as a "chimney". Some sections of the dropper are concerned with the h.t. supply.

Habits of the Neon

A word of warning here. A neon can be misleading and its habits should be understood before any reliance is placed upon it for any purpose other than identifying live mains. For example, it will often light at two tags on a dropper when in fact there is a break between them, but there will then be a good deal of difference between the intensity of the neon's glow. Again, there is a difference between the glow due to a.c. mains and that due to d.c. If there is any doubt, the indications given by the neon should be backed by precise readings on a voltmeter. We have stressed the use of a neon only to show what can be done with even this most simple of tools.

Defective Heater Rectifier

The case outlined above has assumed the use of a simple a.c. heater circuit chain (Fig. 8). In fact it's very likely that a diode will be found in the supply to the valves (Fig. 9), and the added possibility of this being either short- or open-circuit must be taken into consideration.

If it has gone short-circuit the heater current will be excessive and if this condition is allowed to continue the valves and the tube will be damaged. To guard against this fault being allowed to continue, or in some cases allowed to start (the over-running, not the short), several alternative dodges may be employed. Some makers use a second diode which is so wired – see Fig. 9 again – that it cannot conduct when the supply is held at d.c., but which conducts if the supply diode shorts thus putting a.c. on to it. As soon as the safety diode conducts, the heavy flow of current blows the supply fuse. The snag with this system is that the safety diode itself can become defective and blow the fuse, even though the rest of the circuit is blameless. Another approach uses the d.c. voltage at a point along the heater line to supply one other part of the circuit of the set, so that if the supply becomes a.c. this other circuit will be upset and the set cannot function normally. There are several variations on this theme, which we need not consider at this point.

TO BE CONTINUED

Test Report: Jostykit HF385 VHF/UHF Amplifier

Roger Bunney

WHILE looking through a recent Jostykit advertisement I came across the HF385 v.h.f./u.h.f. aerial amplifier, something of obvious interest to the DX enthusiast and with other applications as well. The price is attractive, £5·80 plus 25p post and packing, so I decided to send off for a sample. Within four days a small package arrived, containing all the components, printed circuit board and even solder, in fact everything required to build the amplifier, plus a twenty page booklet describing each move precisely to make matters clear to even the least experienced constructor.

It's a two transistor (both type BF479) amplifier with two inputs (see Fig. 1). The u.h.f. signal passes through both stages but the v.h.f. one passes through the second stage only. The unit in fact combines the advantages of low-noise amplification over a wide bandwidth (40-820MHz) with that of a diplexer. An intriguing feature of the design is the use of printed strip lines for most of the inductive parts of the circuit, thus avoiding the problem of coil winding. Apart from an encapsulated v.h.f. coil, the only coil winding required is to thread two turns of enamelled wire through two ferrite beads.

Construction

Construction of the kit is simplicity itself. With the aid of the instructional booklet it's difficult to imagine anyone going wrong. Building the amplifier passes a pleasant evening, with the knowledge that on completion the unit will work immediately (yes, it did!). My only minor suggestion here would be perhaps to reverse steps 10 and 11, i.e. solder the transistors to the board last. It's instructional to hold the board up to the light to examine the positions of the strip lines relative to the crosshatch patterns on the component side of the board.

Gain

On completion, the unit was tested to see how well it came up to the performance claimed. The v.h.f. section was tested first, with the u.h.f. section terminated with the 68Ω resistor provided. The voltage gain exceeded that quoted and shown on the gain/frequency graph in the booklet. The figures I obtained showed a fall off at 250MHz, but this is of minor consequence in Europe since the TV channels do not extend so far – in S. Africa however the Band III ch. 13 has carrier frequencies of 247·43MHz vision and 253·43MHz sound. The following gain measurements were made: 20·04dB at 45MHz; 20dB at 50MHz; 20dB at 100MHz; 16·2dB at 150MHz; 16·2dB at 200MHz; 7·9dB at 250MHz.

At u.h.f. the gain figures obtained precisely followed the gain/frequency graph provided, with 21·9dB at 500MHz; 23·9dB at 600MHz; then falling to 9·5dB at 800MHz.

Maximum gain was obtained with an 11V, 35mA supply, with a fall off towards 15V. The higher voltage may be necessary however where long cable runs are required. There is an optional power supply (NT410) and a masthead box/mounting (B850).

While testing I found that the gain fluctuated if the strip lines are close to other wires or objects. For this reason the Jostykit B850 housing should be used.

The method I used to test the gain was very simple. The

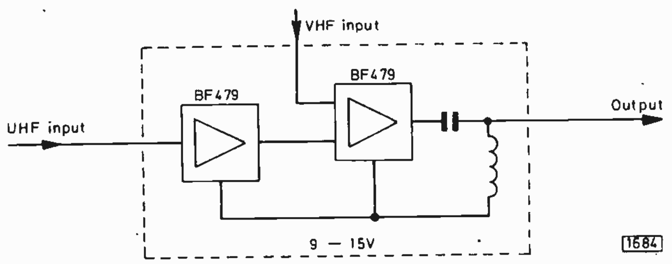


Fig 1: Block diagram of the Jostykit HF385 v.h.f./u.h.f. masthead preamplifier.

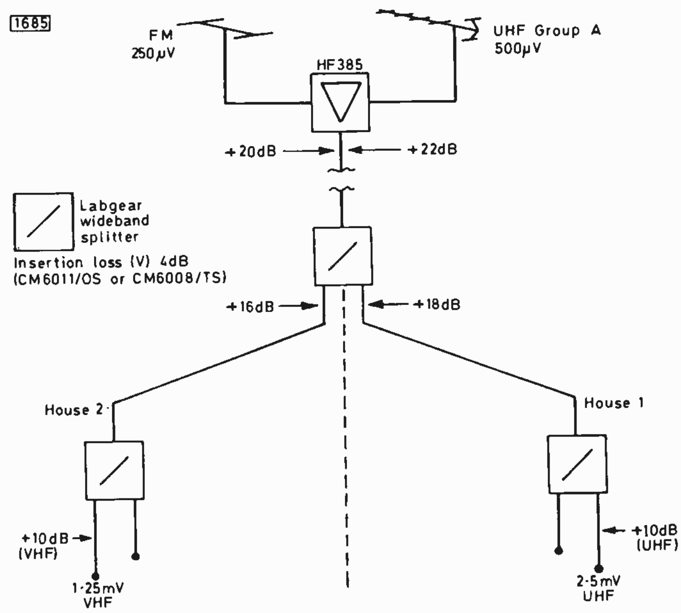
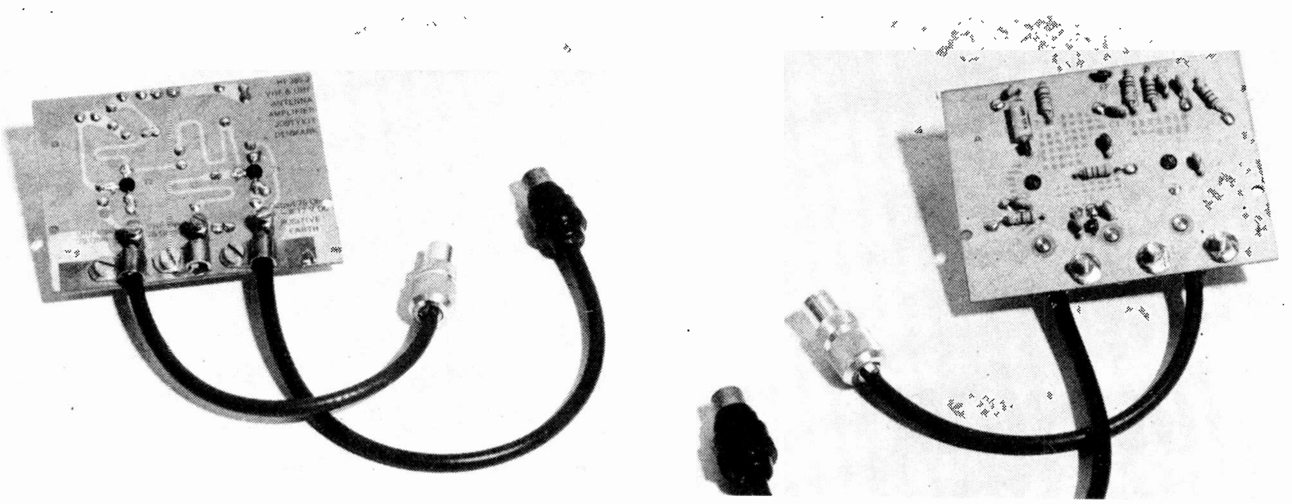


Fig. 2: Supplying two separate houses or flats with v.h.f. and u.h.f. signals, using the HF385 aerial preamplifier to combine the signals from a v.h.f. (f.m. radio) and a u.h.f. TV aerial. To reduce the cost of the installation, diplexers could be used instead of splitters. To simplify the calculations cable losses have been ignored: they must be taken into account of course in a practical installation.



Component and print sides of the Jostykit HF385 v.h.f./u.h.f. amplifier board after completion of assembly.

output from a signal generator, terminated with a 75Ω resistor, was fed via a switching unit to a TES field strength meter. The switching enabled comparison to be made between the direct and the amplified signals. The gain could thus be calculated, based on a signal generator output level of 50 or 100 μV. Unfortunately no equipment for measuring noise was available.

Use as active diplexer

The unit can be used as an active diplexer, combining 75Ω u.h.f. and v.h.f. inputs for feeding to a single down-lead. For normal domestic use in the UK one would combine the local u.h.f. channels and the v.h.f. f.m. radio service at the masthead, diplexing in the reverse sense at the receivers. The amplifier could also be used (see Fig. 2) to provide signals for two or three houses or flats, with splitting via a simple star network and reverse diplexing at each output, or with conventional distribution equipment. Cable runs would need to be as short as possible for such an undertaking, especially with the higher u.h.f. channels.

Practical results

Practical tests produced quite dramatic improvement of weak signals. In comparison with a well known wideband two-stage u.h.f. unit, the Jostykit amplifier was noticeably better: at my home in Romsey a very weak "syncs only in the noise" Brest (French second chain) ch. E21 signal was increased to give an acceptable though noisy picture.

The performance figures quoted by Jostykit are as follows: supply voltage and current 9-15V at 35-50mA; v.h.f. bandwidth 40-250MHz, gain 12-18dB; u.h.f. bandwidth 400-820MHz, gain 21-9dB; VSWR 0·7; cross-modulation 50dB; input noise 5·6dB.

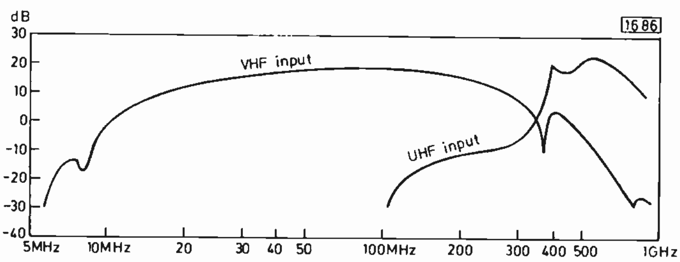


Fig. 3: The frequency responses (u.h.f. and v.h.f.) quoted for the Jostykit HF385 preamplifier. Practical tests confirmed the accuracy of these figures.

Jostykit say that they have sold many hundreds of these amplifiers without receiving a single complaint of faulty operation. The kits are available throughout Western Europe. For further details on Jostykit units write with s.a.e. to Jostykit (UK) Ltd., PO Box 68, 16 Borough Road, Middlesbrough, Cleveland TS1 5DQ.

Conclusion

In conclusion, I found construction a pleasant task and now have at a reasonable price a unit which gives useful gain at both v.h.f. and u.h.f. The amplifier can be recommended therefore. My only minor reservation is that I would have preferred a unit with lower gain in Band IV, gradually rising through its bandwidth and perhaps falling away at around 800MHz. ■

FIELD FAULTS

– continued from page 632

both R108 (1·5MΩ) and R107 (1MΩ) having gone high. One's in series with the hold control, across the h.t. rail, the other being in series with the slider. The field timebase is rather unusual in this chassis, consisting of a PCL85 and a BC147 transistor as the other half of the oscillator. To prevent further trouble it's worth checking the voltages around the transistor in case one of the associated resistors is creeping in value.

Finally, a transistor fault. Now if there's one set that plagues my life more than the Bush TV125 it's the Philips 320 solid-state monochrome series. There was no field scan, R2561 which feeds the field output stage having done what it is supposed to do, going open-circuit when one of the field output transistors had gone short-circuit – the BD132. When one transistor in this area fails I always replace all three – the BD131 and BD132 output pair, and the BC107 driver – because it's difficult to tell until it's too late whether one of the others has been damaged by the original fault. Also, always replace the mica washers. They do sometimes puncture, while the dried up grease on some of them impairs rather than aids thermal conductivity. There's a preset control (R2554) to adjust the output stage bias: this may need resetting after the output transistors have been changed. ■

The Television MONOCHROME PORTABLE

Part 1

Keith Cummins

IT'S over seven years now since the appearance in these pages of the constructor's single-standard 625-line receiver. That was a successful project and several thousand of the sets were built. Constructors experienced little difficulty in getting good results from the basically straightforward design, which was up-dated in various ways during the following years. With its mains transformer, the design had obvious appeal as a CCTV monitor, and suitable circuitry was published in the August 1971 issue. The 625-line receiver used a surplus transistor tuner unit and i.f. strip: apart from the a.g.c. circuit, the rest of the circuit employed valves – in the audio, video and timebase sections.

Times have changed since then, and now almost all monochrome and colour sets are fully solid-state. We've not only gone through the period of transistorisation: integrated circuits have subsequently taken over a lot of TV receiver circuitry. Time then for a project which makes use of these new techniques, this time a small-screen set which can be used as a portable – it operates from the mains or a 12V car battery – or as a second set. It's still possible to follow one of the features of the previous exercise however. The tuner is bought in, though this time it's a varicap one of course, and since i.f. modules of excellent quality (from the Philips G8 chassis) are readily available we have a ready made i.f. strip. We'll start off by outlining the basic design considerations.

Design Considerations

First, integrity of design. The set should reflect fundamental good engineering practice at all stages.

Secondly, safety. A mains transformer is employed, enabling the chassis to be earthed.

Thirdly, video presentation. The receiver should be capable of accurate video presentation, particularly stability of the black level.

Fourthly, being a portable which may well be operated under adverse reception conditions, noise-cancelling techniques are desirable.

Fifthly, ease of setting up. Time and effort are saved by using readily available tuner units and i.f. modules. The presets provide easy setting up, and there's just a single intercarrier sound adjustment.

Sixthly, component availability. The critical components, i.e. the scan coils, the line output transformer and the line driver transformer are all available from Manor Supplies. In our prototypes we've used the largest possible size screen for a mains/battery portable, 15in., the idea being that if you've got a good picture why not make the most if it? There is no reason why 12 or 14in. tubes should not be used however, with possibly some slight adjustment of the electrode voltages. The prototypes use type A38-160W c.r.t.s.

Seventhly, reliability. The components must be adequately rated, and heat kept to as low a level as possible. We've used a fair sized cabinet, which means no hot spots and plenty of room in which to work – though there's little to mount in the cabinet itself. This brings us to the final consideration.

Finally, ease of construction. Apart from the front-mounted components and some of the power supply components, everything's on a single printed panel. The layout is quite open, with everything easily accessible, and the presets can be adjusted from the rear through holes in the board – with everything except the back in place!

Having established the principles of the design, we can go on to consider the various sections in detail.

Being a portable, operation naturally has to be from the mains or a 12V car battery. Consequently the basic source of power in the set is an 11V rail. A series regulator is used to stabilise this, the transistor chosen to provide the stabilising action being a pnp type. This has a lower saturation voltage than a silicon type, enabling the supply voltage to fall lower before the regulation fails.

Protective Features

All service engineers regularly encounter portable TV sets which have suffered considerable damage through the application of d.c. which is incorrectly polarised. One easy way of avoiding this is to use a diode in series with the supply. This introduces an undesirable voltage drop however. A diode placed across the supply will behave as a short-circuit if the polarity of the input is incorrect, blowing the fuse. It often destroys itself in the process. These techniques are not really suitable however, since you don't want to have to go to the trouble of taking the back off and obtaining and fitting replacement parts. So the set's protected against the eventuality by a different technique.

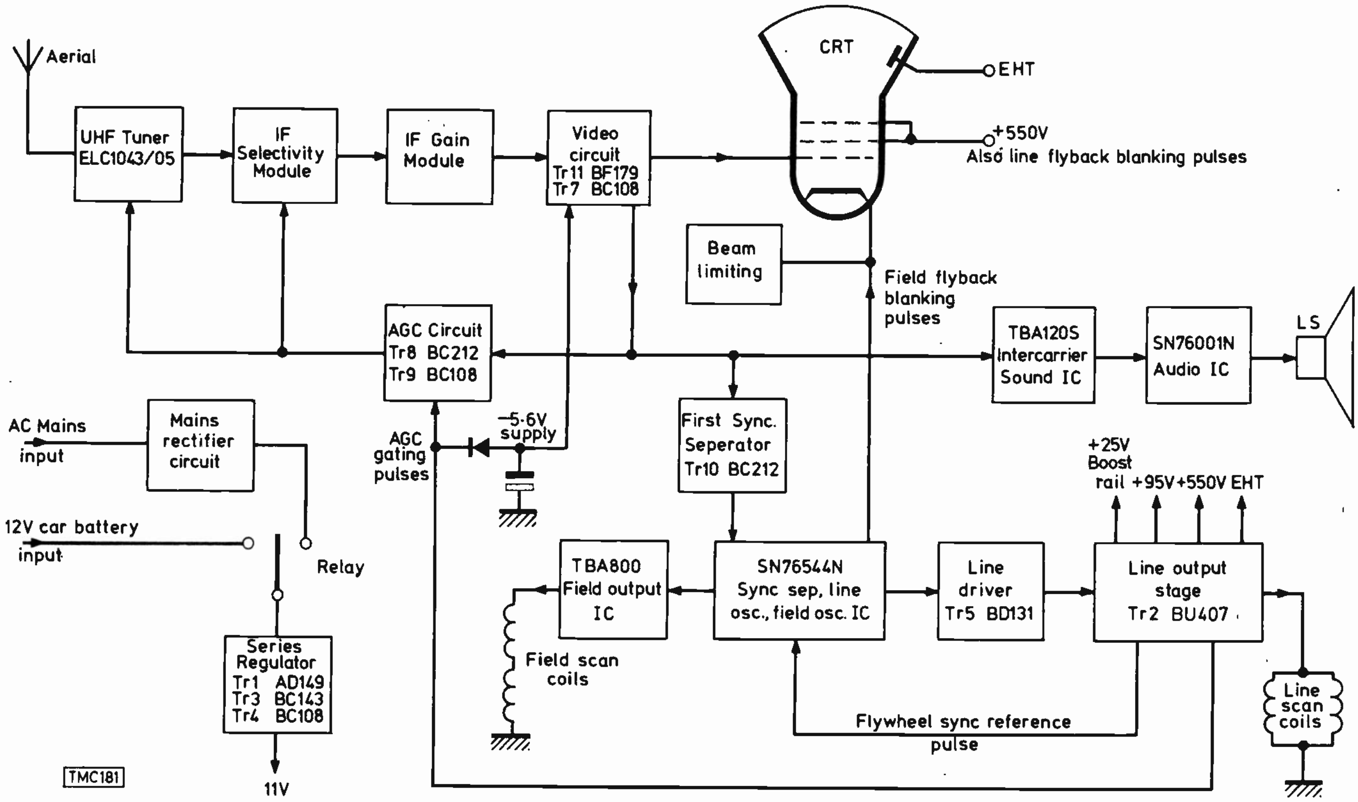


Fig. 1: Block diagram of the Television monochrome portable.

When a d.c. supply is connected with the correct polarity, a relay is energised to disconnect the regulator circuit from the mains power supply system. Should a d.c. supply be connected the wrong way round, the relay does not energise and the set is protected since it is not connected to the battery. In this case a red light-emitting diode lights up, indicating that the power is available but reversed.

A disadvantage of using a series regulator circuit is that if the regulator transistor goes short-circuit between its emitter and collector the supply rail in the set rises excessively. Protection is provided against this contingency. If excess voltage (more than 11·5V) appears on the supply rail, a thyristor fires and the fuse blows (the so-called crowbar technique).

Overall Scheme

The well-established Mullard ELC1043/05 varicap tuner unit is used, followed by i.f. selectivity and gain modules. These are available from Manor Supplies, and are of the type used in the Philips G8 chassis. Regular readers will recall that they've been featured in previous projects by Caleb Bradley and Roger Bunney.

The video, a.g.c. and line driver/output circuits are transistorised, a gated a.g.c. circuit being employed. The sound circuits and the rest of the timebase sections are greatly simplified by using integrated circuits.

A Texas SN76544N i.c. contains the sync separator, noise gate, line oscillator with a.f.c., and the field oscillator. Some peripheral components are required, but basically this i.c. provides outputs at both line and field rate. On the line side, conventional transistor driver and output circuits are then used, while on the field side the output to drive the field scan coils is provided by an SGS TBA800 i.c.

The sound circuitry is taken care of by a pair of i.c.s. The intercarrier amplifiers/limiters and 6MHz synchronous detector are contained in a TBA120S, an i.c. which has become something of an industry standard. It also provides audio preamplification, with a d.c. volume control. The input comes via a ceramic filter, which has the advantage of not requiring any adjustment. In fact the only adjustment required here is to the quadrature coil associated with the discriminator, and no difficulty should be experienced in setting this up. Ample audio output is provided by a Texas SN76001N i.c.

Precautions

As with all such projects, the importance of patience and accuracy in construction cannot be too highly stressed.

In this project we are using transistors and integrated circuits, which are most intolerant of incorrect connections, short-circuits, dry-joints etc. So I'll say again what I have said on previous occasions: be careful! Important procedures for setting up will be laid down: ignore these at your peril. Transistors must be treated carefully, and give little or nothing in the way of warning signs before they are destroyed. The only things that light up in this receiver are the indicator diodes and the tube. Due care should ensure that you don't add anything else to this list!

The design of the receiver has to take into account not only the technical requirements but also certain practical and aesthetic considerations. It was decided to use as large a screen as possible, and an ample cabinet – to protect the tube, give easy access, run cool and because we think it looks nice! Details of how to make the cabinet will be given, but if you have your own ideas, well and good. Remember the need for adequate ventilation however.

It's a well-known fact that heat is the arch enemy of reliability in TV receivers. Our design provides plenty of heat-sinking capability and freedom of air movement in a receiver whose power consumption is in any case only 28W maximum. Consequently we are expecting the set to operate with a high degree of reliability.

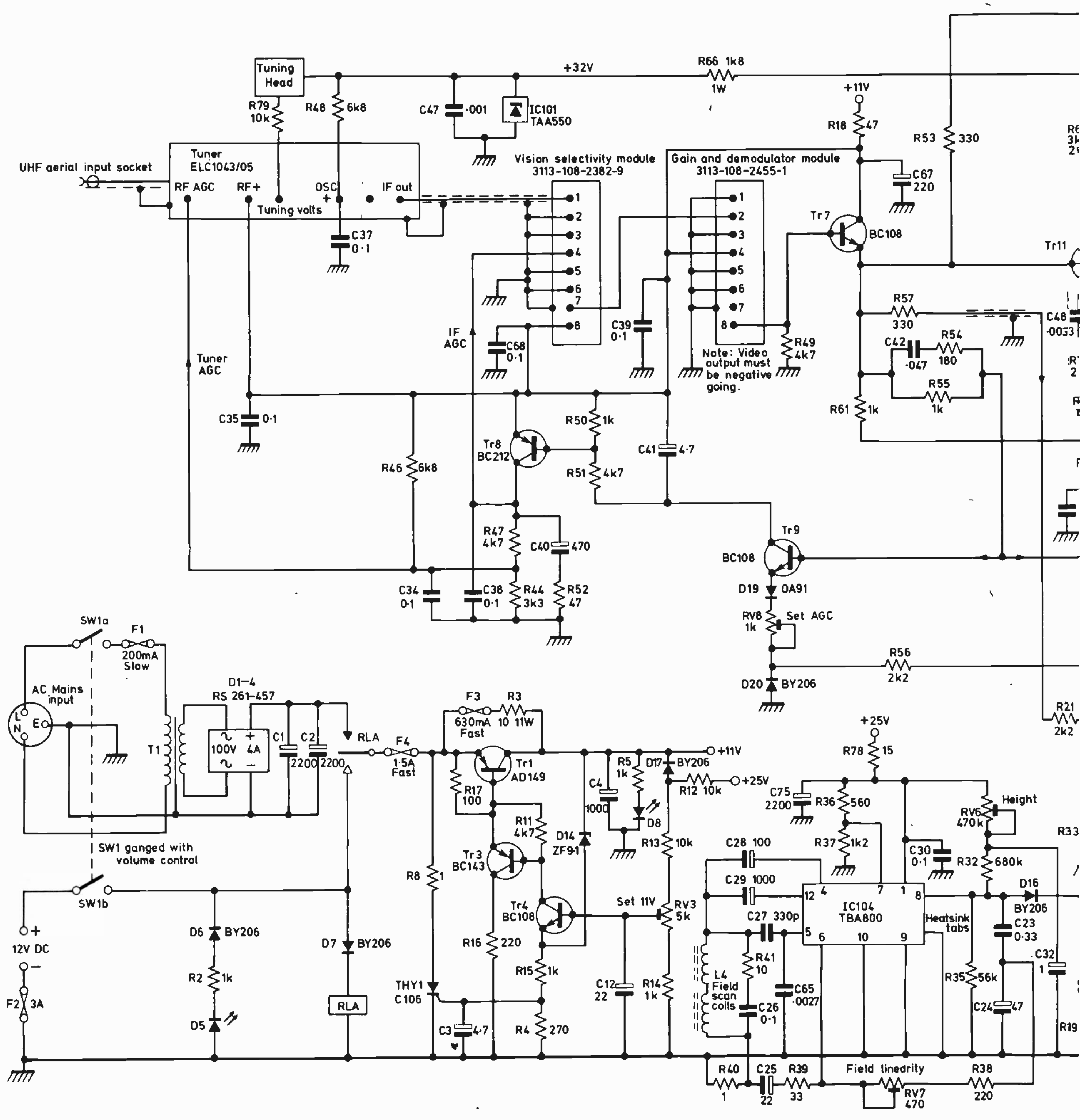


Fig. 2: Circuit diagram: the selectivity and

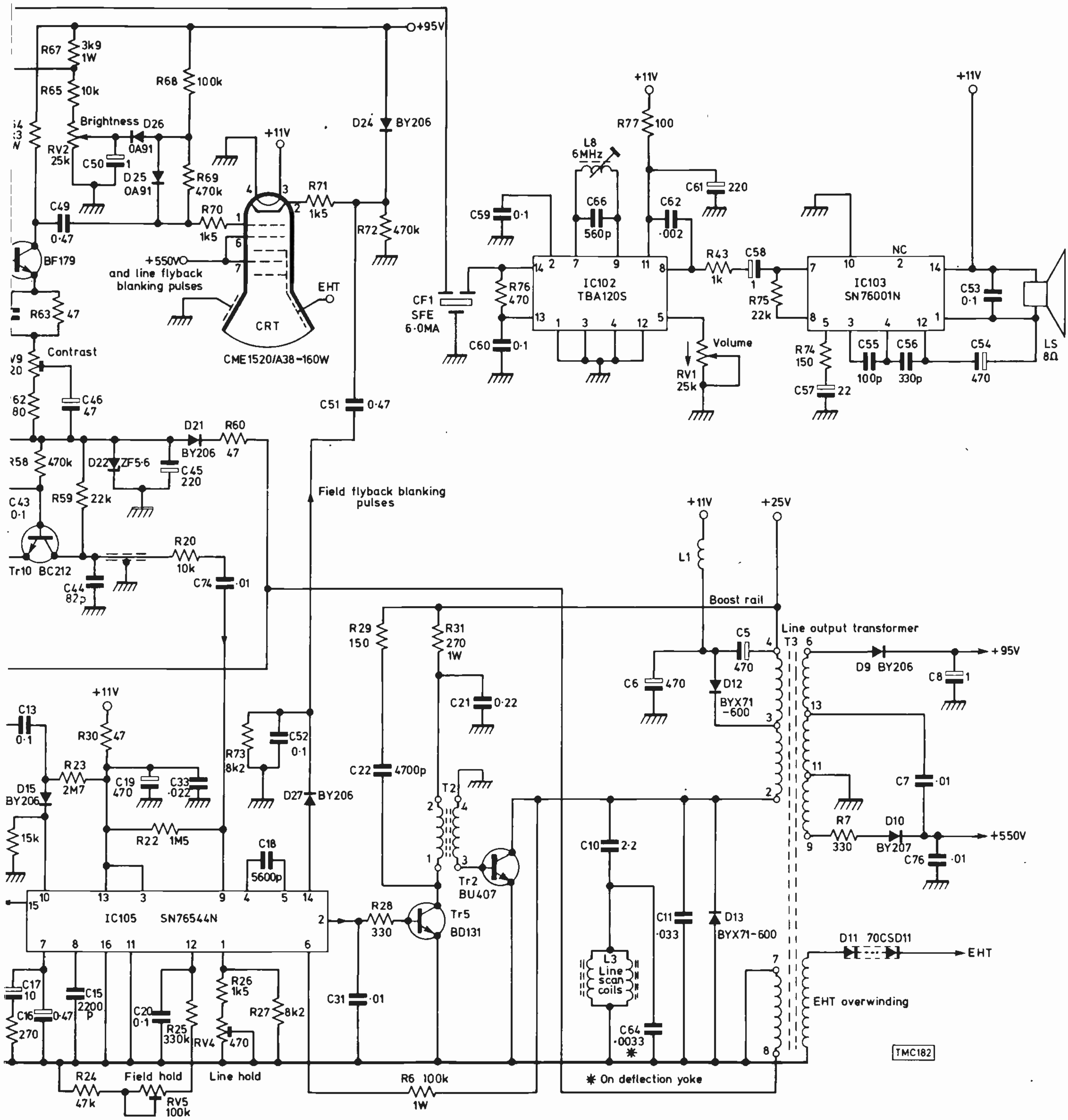
Power Supply Circuitry

The power supply arrangements are the heart of any set. In this one they are quite complicated and thus worthy of detailed description. The receiver needs a stabilised supply of +11V. This voltage *must* be stabilised, since it affects the amplitude of both the line and field scans and the e.h.t. – the solid-state circuits employed in these areas have no inherent amplitude stabilising facilities, and depend for their correct operation upon a constant supply rail.

For mains (a.c.) operation a transformer is used to reduce the input voltage. The a.c. is then rectified by a bridge rectifier, the resultant d.c. output being smoothed by two 2,200μF capacitors connected in parallel. The d.c. contains a 100Hz ripple component (since full-wave rectification is employed) and is fed to the normally-closed contact of relay A.

Protective Relay

This relay's coil is fed from a diode connected to the 12V d.c. input socket. If d.c. is applied, in the correct polarity, diode D7 conducts and relay A is energised. The relay output is then connected to the battery supply instead of the mains power unit. If a reverse polarity connection is made



i.f. gain modules are preassembled.

to the d.c. socket, the relay is not energised since D7 does not conduct, and the d.c. is not connected to the remainder of the receiver. Diode D6 conducts however, with the result that the light-emitting diode D5 operates. The resultant red light warns the user that the power supply is reversed. The double-pole on-off switch uses one section to switch the live side of the mains and the other to switch the battery supply.

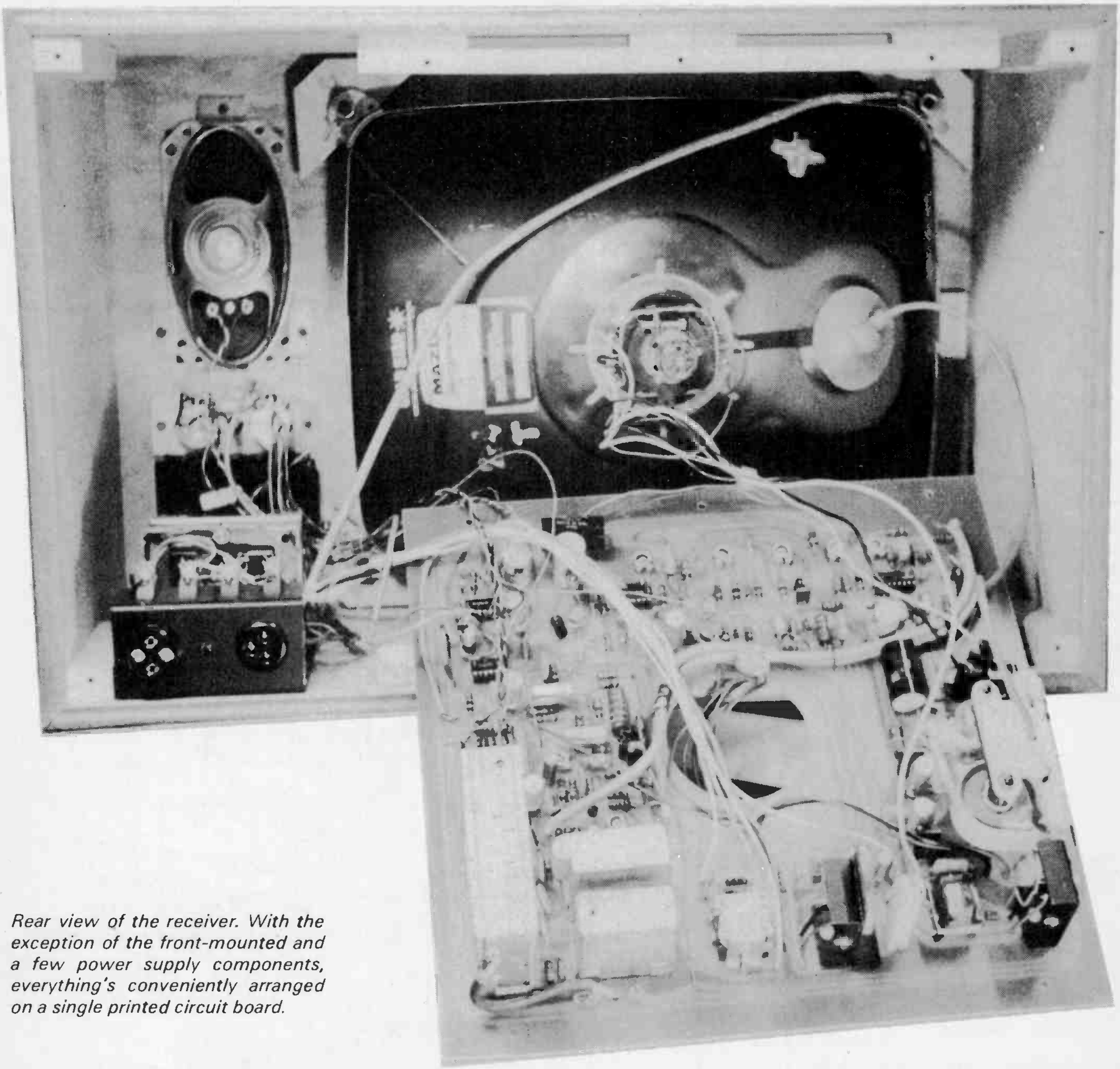
Battery Fuse

The battery fuse is placed in the negative lead which connects to receiver earth. This method of protection was chosen so that, if the "earths" of the receiver and the car are of opposite polarity, the fuse will blow should the TV aerial touch the metal-work of the car. Failure to observe this precaution could result in considerable damage to the receiver and its leads as a result of tens of amps flowing through them unchecked.

Mains and DC Fuses

The mains transformer has a 200mA fuse in series with the live feed to its primary winding.

As overall protection, a 1·5A fuse (F4) is included in



Rear view of the receiver. With the exception of the front-mounted and a few power supply components, everything's conveniently arranged on a single printed circuit board.

series with the d.c. feed from RLA to the voltage stabiliser section of the receiver.

Crowbar Circuit

The d.c. from F4 is applied to the emitter of Tr1, the shunt resistor R3 with its protection fuse F3, and via R8 to the crowbar thyristor THY1. If the crowbar thyristor fires, the excessive current flowing through R8 blows fuse F4, thus disconnecting the d.c. supply to the voltage regulator and leaving the set "dead".

Regulator Circuit

When the receiver is switched on, the smoothing capacitor C4 charges via R3 and in consequence the l.t. supply rail voltage rises. The line timebase then starts to operate, and the boost rail voltage (provided by C5/D12) rises. The presence of the boost supply results in the voltage at the anode side of D17 rising, as a result of current flow in R12. This current also flows through the potential divider network R13, RV3 and R14. Thus the base of Tr4, which is connected to the wiper of RV3, moves positively. Tr4 now conducts, its emitter current flowing via R4 and R15. The consequent voltage developed across R4 is not sufficient to fire the crowbar thyristor THY1.

The collector current in Tr4 flows via the base circuit of Tr3, a pnp driver stage for the main series regulator Tr1. Tr3 behaves as an emitter-follower, providing sufficient current gain to drive Tr1 adequately. Tr1 turns on, and its collector current augments that already flowing through R3, the 11V rail rising further. As the boost rail moves towards

Table 1

Voltage at Tr1 emitter	*Total regulator dissipation*	*Dissipation in Tr1*
17	9W	5·4W
16	7·5W	5·0W
15	6W	4·4W
14	4·5W	3·6W
13	3W	2.6W
12	1·5W	1·4W

its normal working level D17 conducts, clamping the top end of R13 to the 11V rail. As soon as the 11V rail passes 9·1V, the zener diode D14 conducts and any further increase of the 11V rail is conveyed directly to the emitter of Tr4. The voltage at the wiper of RV3 is still rising, though not so fast because of the potential divider action. RV3 is set up so that when the 11V rail reaches its correct voltage, the emitter of Tr4 approaches its base voltage, causing its collector current to fall. This results in less current flow in Tr3 and ultimately in Tr1, so the voltage stabilises at this point.

Advantages

The circuit has several advantages over more conventional stabilisers. Should a short-circuit develop on the output, causing the 11V rail to drop dramatically, no current can flow in the error amplifier Tr4, with the result that Tr3 and Tr1 are turned off. Thus the regulator transistor is not damaged, and the current flow is restricted to a maximum of 1·5A through R3. This state of affairs will not last long however, since F3 will be overloaded and blow as a result.

In the unlikely event of Tr1 developing an internal emitter-collector short-circuit, the rail voltage will rise in excess of 11V. The current flow through the path R4, R15 and D14 will now be large enough to develop across R4 a voltage which is sufficient to fire the thyristor. This will immediately blow the fuse as previously explained. It is most important that this facility is provided, since excessive rail voltage could damage the tube heater, line output transformer, e.h.t. rectifier and the output integrated circuits.

The observant reader will have noticed that the shunt resistor R3 is necessary to get the circuit started, since if there is no voltage on the 11V line the regulator cannot begin to turn on.

Line Output Stage Monitor

Should a fault develop whereby the boost voltage is missing or low, the circuit will not start up correctly and the "catching" action of D17 will not occur. As a result, the 11V rail will not rise to its correct voltage and the power supply will operate at "half-cock". This situation is most advantageous since it can reduce the amount of damage caused by a line output stage fault.

Regulator Dissipation

The amount of dissipation in Tr1 does not vary as much as might be expected with varying input voltages. An increased input voltage results in a greater voltage being developed across Tr1, but if the 11V is to remain constant the current in Tr1 will be less since a greater current is flowing through R3. The currents in the two paths, Tr1 and R3, must always add up to a constant value, whatever the input voltage applied to the stabiliser.

Quoting figures, if the input voltage is 15V, the voltage across the stabiliser circuit will be 4V. The dissipation in R3 is $4^2/10$, i.e. 1·6W. Since R3 is passing 400mA, and the total set current is about 1·5A, some 1,100mA is flowing through Tr1, whose dissipation is therefore $1{\cdot}1 \times 4 = 4{\cdot}4$W.

Table 1 shows how the transistor dissipation compares with the total dissipation of both the transistor and the shunt resistor over a range of input voltages. From these figures it will be seen that the receiver can be operated from batteries in the "on charge" condition. It is most unlikely that the 17V input level will be exceeded, and such usage is not recommended.

It should also be pointed out that low current drain, due to a fault condition, may result in excessive output voltage as a result of minimal voltage drop across R3 once Tr1 has cut off. In this case, the crowbar thyristor will fire. Thus the firing of the crowbar need not always indicate a defective regulator transistor.

Dealing with Ripple

The reader may wonder why a nominal rectifier output of 15V is employed when the receiver is used on the mains. Surely this implies a waste of power in the regulator, and couldn't this be eased by having an input nearer to the required 11V? The situation is not as simple as this.

The rectified a.c. contains a ripple voltage which has to be smoothed out by the stabiliser, and it's important that the downward excursion of the ripple does not lower the voltage to the stabiliser to a point where the latter can no longer operate. Such a situation would result in "bumps" appearing on the 11V supply at the 100Hz rate. These "bumps" would coincide with the downward ripple of course, and produce hum and picture distortion. By choosing a nominal 15V supply, we ensure that the stabiliser can cope with the ripple content.

In order that the stabiliser has a high a.c. gain, with consequent efficient smoothing action, the base of the error amplifier transistor Tr4 is decoupled to earth by a capacitor, so increasing the a.c. loop gain as seen from Tr4 emitter.

The use of the green "on" indicating l.e.d. is optional.

CONTINUED NEXT MONTH

Servicing the Rank Z718 Chassis

John Coombes

THE Rank Z718 chassis, with its Toshiba RIS in-line gun c.r.t., has been the basic colour chassis in the RRI range for the past couple of years or so. There are versions fitted with 18, 20, 22 and 26in. c.r.t.s, model numbers including the Bush BC6100, BC6111, BC6200, BC6300, BC6338, BC6437 and BC6438, and the Murphy MC6103, MC6201, MC6301, MC6332 and MC6402.

Circuit Features

The chassis has some unusual circuit features. The h.t. line is not stabilised for example, width stabilisation being built into the line output stage, from which most of the receiver supplies are obtained, instead. There is a balanced, two-transistor line output stage (BU205 transistors in the 18in. sets, BU208s in the larger screen models), operated from the unstabilised 260V h.t. line. The h.t. supply/line timebase arrangements were outlined last month (see pages 580-1). Note that due to the use of a bridge mains rectifier the chassis is at roughly half mains potential. The field timebase is one of the most complex we've come across, using no fewer than ten transistors. A separate three-transistor circuit drives the field convergence circuit.

The signal circuits are rather more conventional, though there is an unusual audio output circuit. The decoder is of the Mullard three-chip variety (TBA560C/TBA540/TCA800). Also on the decoder board are the RGB channels and, in one corner, the audio circuit. The d.c.-coupled RGB circuits consist of a BC252B pnp emitter-follower driving a BF259 (later BF338) npn output transistor. The emitters of the RGB output transistors are returned to chassis via a pnp transistor (3VT10, BC328 – earlier BC252C) whose base bias sets the black level (3RV13). Fig. 1 shows the arrangement.

Decoder Faults

One of the most common decoder faults is loss of one colour or another. Check the appropriate output transistor (3VT7 red, 3VT8 green, 3VT9 blue). The transistors tend to go open-circuit. Less often one of the driver transistors (3VT4 red, 3VT5 green, 3VT6 blue) goes open-circuit to give the same effect (open-circuit base to collector). To date I've not come across any of these transistors going short-circuit.

The other main cause of trouble in the decoder is the three i.c.s. The TCA800 demodulator/PAL switch/matrix i.c. (3SIC3) can be responsible for loss of one colour or complete loss of colour. The TBA540 reference oscillator i.c. (3SIC2) can also be responsible for loss of colour. The usual fault caused by the TBA560C luminance/chrominance signal processing i.c. (3SIC1) is a blank raster, with the sound all right. Now this same fault can be caused by the vision demodulator i.c. The clue is that when the TBA560C is responsible for this fault the contrast, brightness and colour controls have no effect whatsoever

Loss of luminance only, with just chrominance in the background, occurs when the luminance delay line 3DL1 goes open-circuit.

Intermittent loss of brightness is very often due to the preset brightness control 3RV11 having a faulty track. The preset contrast control 3RV12 (omitted in later models) can be responsible for a very faint picture, due to a poor or open-circuit track.

Audio Circuit

The audio circuit is shown in Fig. 2. 3VT11 is a straightforward preamplifier with a.c.-coupled input and output. 3VT12 is the driver stage, which is d.c.-coupled to the Darlington pair class A output stage consisting of 3VT13 and 3VT14. 3VT15 provides a constant-current supply for the output stage, its base voltage being controlled by 3VT16 which compares the voltage across 3R88 with the voltage at its base (set by 3RV9). The 80Ω loudspeaker is a.c. coupled (3C58) across the output transistors.

Loss of sound is very often due to one of the BD166 transistors (3VT15 and 3VT14). Often one goes open-circuit and the other short-circuit. If just one goes open-circuit the result is very bad distortion. If the sound can still be heard when the volume control is turned right down (it acts on the TBA120SB intercarrier sound i.c.) the preset volume control 3RV10 needs adjustment. 3VT16 is also commonly responsible for distorted sound. To set up 3RV9, connect a voltmeter on the 2·5V range across 3R88 and adjust 3RV9 for a reading of 0·44V (200mA through the output stage).

The IF Strip

The i.f. unit is mounted on the decoder panel. The main source of trouble here is the TCA270Q vision demodulator i.c. (2SIC1). It can cause loss of sync, or a blank raster with the sound all right. In either case the trouble can usually be proved by applying to the i.c. a quick spray of freezer, when the fault should clear for a minute or two.

There are three i.f. transistors, the first two (2VT1 and 2VT2) being type BF198 and the final one (2VT3) type BF199. Any one of these transistors can go open-circuit, but it's usually 2VT2 that's at fault. The result is a very snowy picture or no picture at all, just grain. The same fault can be due to a faulty tuner or even the aerial. Voltage checks on the transistors will reveal which, if any, is defective.

Power Supply Circuit

The power supply circuit is shown in Fig. 3. There are one or two points worth noting here. First, the output from the bridge rectifier is applied directly to choke 7L1, so that we have a choke-input rather than a capacitor-input filter. This gives improved regulation – important since the h.t. line is not stabilised. Tappings on the choke enable the d.c. output to be controlled. This arrangement provides a watt-less dropper – the effective inductance present controls the conduction point of the rectifier diodes and thus the output. Finally, the output is taken from a tap before the end of the choke in order to provide hum cancellation.

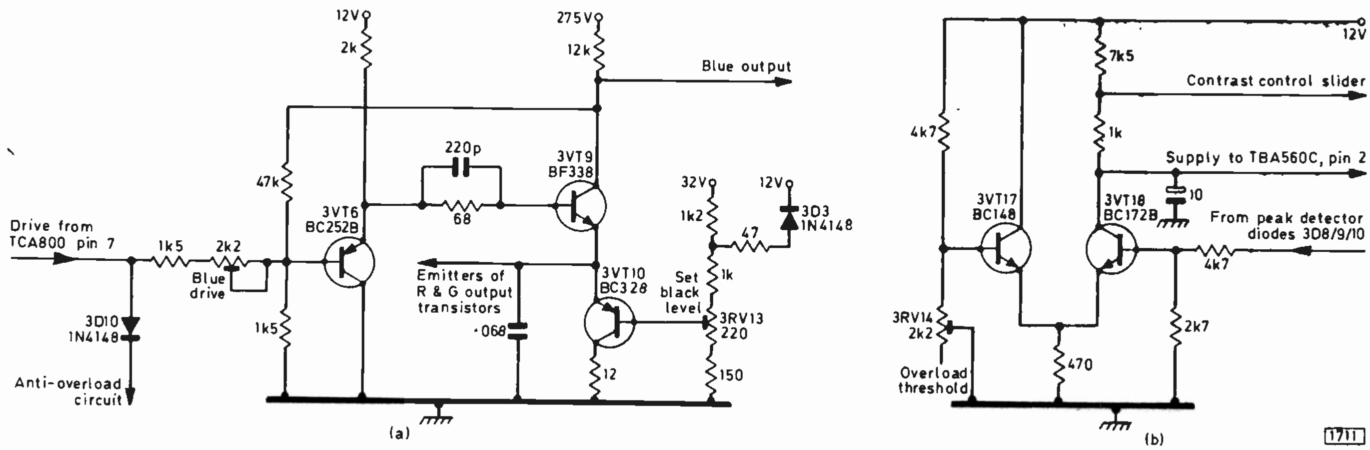


Fig. 1: (a) One of the RGB channels. The emitters of all three output transistors are returned to chassis via 3VT10. 3VT10's base bias is set by 3RV13, which thus controls the current in the three output transistors. It's used to set the black level. 3D10 at the input is a peak detector – there are similar diodes in the other two channels – and is linked to the anti-overload circuit shown at (b). The output from the three peak detector diodes is applied to the base of 3VT18 which, together with 3VT17, forms a differential amplifier. Should the voltage at the base of 3VT18 exceed that at the base of 3VT17 (set by 3RV14), 3VT18 will start to conduct, reducing the voltage fed from the slider of the contrast control to pin 2 of the TBA560C signal processing i.c. in the decoder. There is also beam limiting at the grid of the c.r.t.

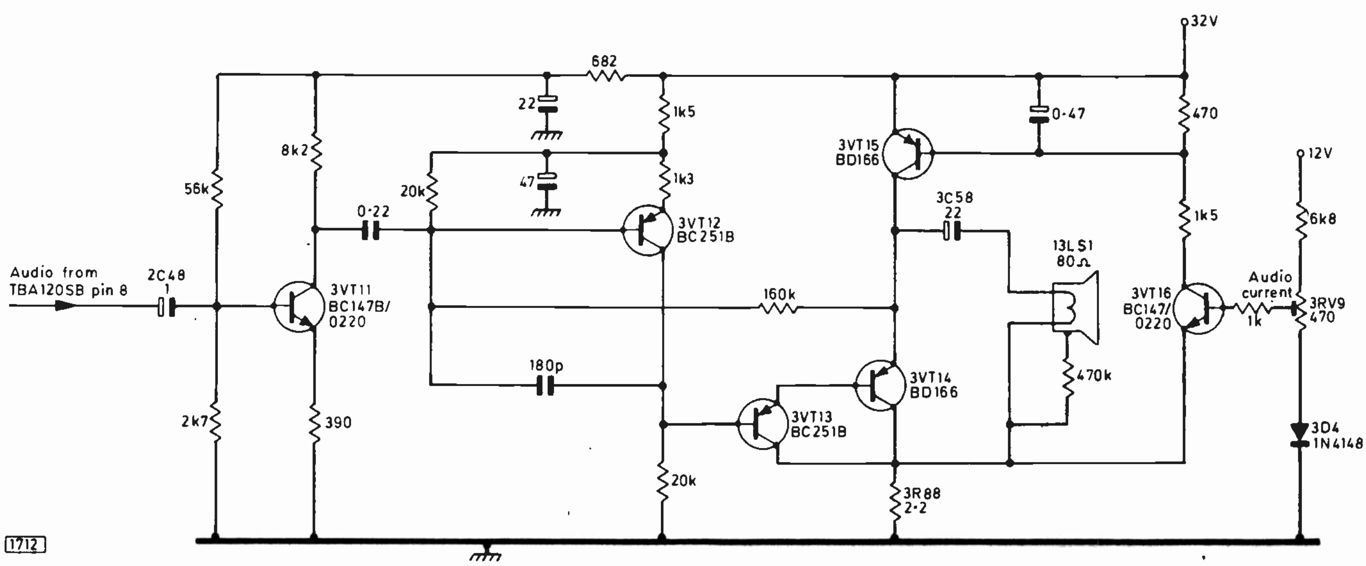


Fig. 2: The unusual looking audio circuit. 3VT15 provides a constant-current supply for the class A audio output transistor 3VT14. The base bias applied to 3VT15 is controlled by 3VT16, which senses the voltage across 3R88.

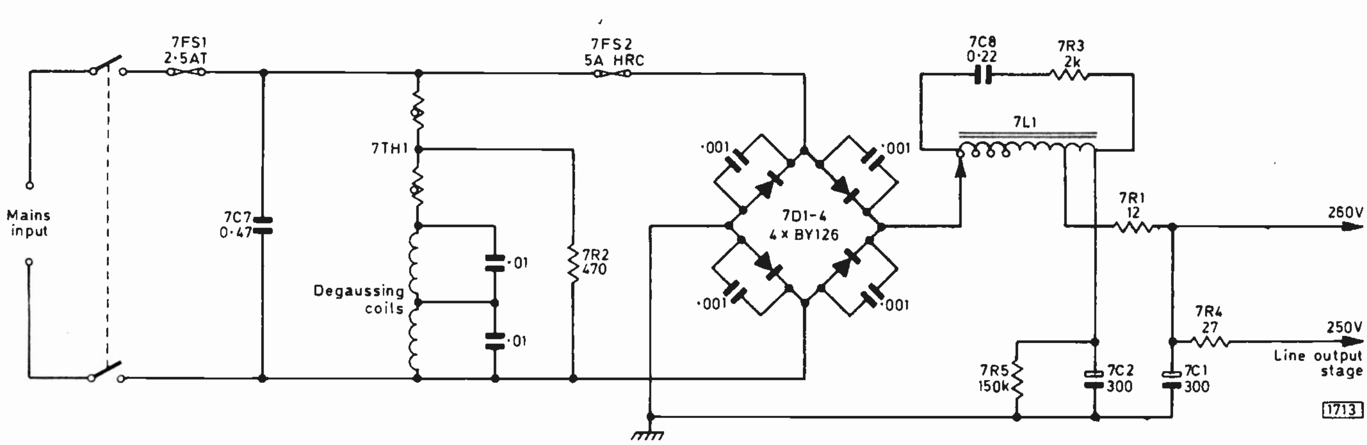


Fig. 3: The unregulated h.t. circuit provides a 250V supply (265V in larger screen models) for the line output stage and a 260V supply (275V in larger screen models) for the RGB output stages and to start up the line oscillator and driver stages. These voltages apply at zero beam current.

A fault in the line output stage will often result in 7R1 going open-circuit. The h.t. will also be absent if the smoothing electrolytic 7C1 is short-circuit. In either case there's no sound or vision of course – even the tube heater will not be alight, since it's fed from a winding on the line output transformer.

Any of the four rectifier diodes 7D1-4 can go short-circuit, blowing the 5A high-rupture capacity fuse 7FS2 (for safety reasons the replacement must be of the same type). The fuse also blows when one of the protection capacitors 7C3-6 (0·001μF) goes short-circuit.

When the 0·47μF mains filter capacitor 7C7 goes short-

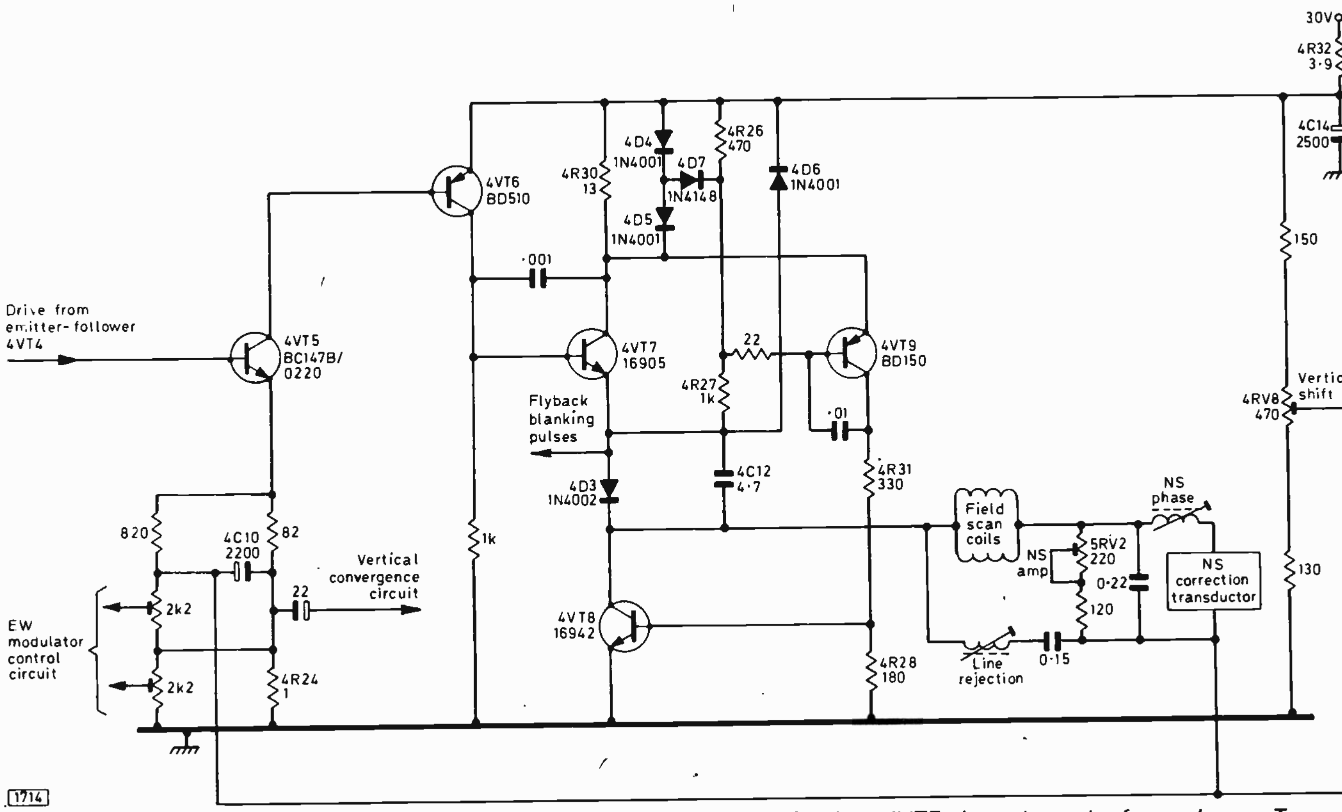


Fig. 4: Another unusual feature is the field output stage. The driver 4VT6 drives 4VT7 throughout the forward scan. Towards screen centre, 4VT9 begins to conduct, driving 4VT8 so that both 4VT7 and 4VT8 conduct during the second half of the scan. The a.c. path through the scan coils is completed by 4C10 and 4R24. 4C10 charges during the first half of the scan, and is discharged via 4VT8 during the second half of the scan.

circuit the 2·5A delay fuse 7FS1 blows. Once again the correct type of fuse must be fitted, in order to comply with BEAB requirements.

The mains switch tends to go open-circuit. It's part of the volume control assembly, and the whole unit must be replaced.

The Line Timebase

Excessive current in the line output stage results in the overload trip operating. This removes the input to the line driver transistor 5VT1 and the consequence is no results (take care though, the h.t. is still there!). The usual cause of this situation is the line output transistors. Sometimes they go short-circuit, but very often they have a fault which does not show up when they are checked with a multimeter. So check them with a transistor tester or by substitution.

I've had only two other faults in this area. First, 5R6 which provides the supply for the line driver stage burnt out. The supply is taken from the centre point between the two line output transistors. After a very careful check it seemed that the cause of the fault was defective line output transistors. In later models this resistor is a fusible type. The other fault was a defective tripler – a nice spark at the line output transformer side but no e.h.t. at the other.

To make the overload trip more effective, 5R17 was changed from 5·6kΩ to 560Ω in later sets. This alteration must not be made unless 4R32, which filters the supply to the field output stage, has been changed from a wirewound to a self-fusing type.

Scan Drive Panel

The scan drive panel is the one that seems to give most trouble. This contains the complete field timebase, the c.r.t. first anode supply circuit with its constant-current supply, the TBA950 sync separator/line oscillator i.c. (4SIC1), the width modulator control circuit and the 12V stabiliser.

One of the more common causes of trouble is the TBA950. If this fails to provide an output to the line driver stage the result is a dead set – with nothing except the h.t. present. Some of the associated components can be responsible for this situation however, i.e. 4C18 (10μF) and 4R81 (100Ω) in the start-up circuit, and the associated zener diode 4D12 which can go short-circuit. Note that 4R81 must be replaced with the correct type in order to meet BEAB requirements.

Another problem is the c.r.t. first anode preset controls. These are 10MΩ in early sets, 2·2MΩ in later ones – with changes to the other resistor values in the network. They seem to go faulty in two ways. First a dirty track, which results in too much of one colour. Adjusting the control will restore a good grey-scale, but replacement of the control is essential for a satisfactory repair. Secondly, the controls can go open-circuit or very high resistance (150MΩ or so). This results in too much of one colour and cannot be put right by adjusting the control, so a replacement is again essential. A dirty track can be temporarily cleaned by spraying with a contact cleaner aerosol.

Field Timebase

The most common field output stage fault (see Fig. 4) is field collapse. The usual cause is the field output transistors 4VT7 (16905) and 4VT8 (BD179, later type 16942) going short-circuit.

The other main cause of this trouble is the circuitry which controls the crossover point of the output circuit. Briefly, 4VT7 conducts throughout the scan, with 4VT8 conducting only during the second part of the scan. 4VT9, which is biased by diodes 4D4 and 4D5, controls the point at which 4VT8 begins to conduct. These diodes tend to go short-circuit, causing field collapse. Associated faults are 4R30, which is in series with the field output transistors, getting burnt up, sometimes because 4VT9 is short-circuit.

Intermittent field collapse has been traced to dry-joints on the NS pincushion distortion correction transductor 5T4, which is mounted on the line output panel. 4VT7 has been known to play about, giving intermittent severely reduced height.

Modifications

There have been quite a lot of modifications to this chassis since its first introduction. Some have already been mentioned. Others worth noting are as follows.

In earlier models, the supply to the TBA950 was via a transistor which provided a constant-current source. Due to the additional current required to get some of these i.c.s going, the constant-current supply was later deleted.

Two modifications were introduced to avoid damage due to c.r.t. flashovers. First, a ferrite core (part number 3421.0177) is now fitted on the lead from pin 12 of 4Z2, adjacent to 4D3, to protect the field output transistors. Secondly, a 100Ω resistor has been added in series with the collector of 4VT17 in the width modulator control circuit. This resistor is a BEAB approved type.

To prevent line switching marks appearing, 5C5 (47pF) which was connected between the collector of the line driver transistor 5VT1 and chassis has been deleted, a 100pF capacitor being connected between the collector and base of 5VT1 instead.

Some sets are fitted with standard c.r.t.s, others with quick-heat types. Whenever a c.r.t. is replaced, it's advisable to check the heater voltage. This is essential if a standard tube is used in place of a quick-heat type or vice versa. The voltage is set by 5L14 on the line output panel, and the procedure, which involves the use of either an oscilloscope or a true r.m.s. meter, is given in the manual.

Servicing Hints

To allow the scan coils to be pulled back far enough when adjusting the purity, it is sometimes necessary to slide the convergence yoke back ¼in. or so.

If the degaussing coils have to be disconnected whilst working on the chassis, fit a shorting link in place of them – otherwise 7R2 will burn up.

Removing socket 3Z6 (back of the decoder panel) disconnects the supplies to the tuner, i.f. strip, decoder, RGB and audio circuits. This is a help when tracing short-circuits on the supply lines.

No Results

If you switch on and there are no results, though the h.t. is present, fault diagnosis becomes rather tricky. Both the line oscillator i.c. and the line driver stage have start-up circuits, since during normal operation they are supplied from the line output stage, which cannot come into operation until it is presented with a drive waveform. The start-up circuits consist of capacitors (4C18 and 5C3 respectively) which charge from the h.t. rail at switch-on. So, is the line oscillator or line driver failing to start or otherwise faulty, or is the overload protection circuit coming into operation thereby removing the drive from the line output stage and thus tripping the set? The obvious thing to do first is to check for shorts on the supply lines. If all is well, the line oscillator can be supplied by connecting 9V from the junction of 4C18/4R81 to chassis, the line driver can be supplied by disconnecting 5R6 and connecting a 2·2kΩ 10W resistor across 5C3, and the overload trip can be made inoperative by turning the preset control 5RV3 anticlockwise or short-circuiting 5R17 – it's wise to add extra resistance in series with the feed to the line output stage before taking this latter course however. As mentioned earlier, tripping is usually due to the line output transistors. ■

LETTERS

OFFERING RECONDITIONED TV SETS

You may be interested in some further experiences on the theme of "becoming a service specialist". When I moved to the west country in 1970 I'd no intention of starting a business, having had enough of being self-employed in Kent during the previous seven years. So I advertised for part-time TV servicing work in a local paper, and as a result got two part-time jobs. I soon realised however that I preferred to be self-employed, so I put another advertisement in the local paper offering TV repairs to the public and sat back waiting for the telephone to ring. It didn't, so I tried another angle.

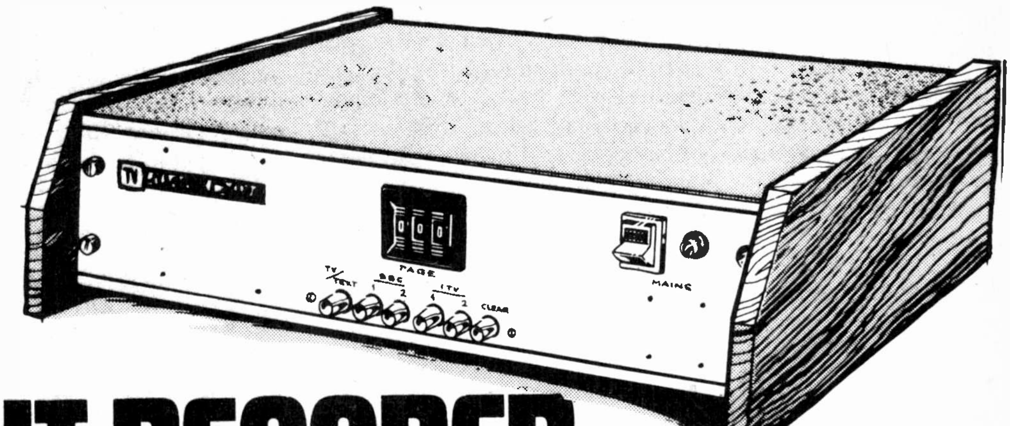
I purchased a quantity of secondhand TVs, overhauled them, and put another advertisement in the paper offering reconditioned TVs with twelve months' guarantee, also no deposit rentals. This time the phone did ring, and within eighteen months I'd enough business to be able to give up the part-time jobs. But still nobody came to me for TV repairs – except those to whom I'd sold sets of course. Only now, seven years later, am I getting any amount of chargeable repair work.

My experience in building up the business has been that customer goodwill is of the essence. It's better to sell a good set with a guarantee at a price that takes into account such under guarantee servicing as may be needed, than to sell a cheap set with no guarantee. Also, don't work on the assumption that every job must pay. The goodwill created by the odd free job when circumstances dictate goes a long way when you're building up a business: the profitable jobs and sales will follow. Finally a fast and efficient service is essential if you are to keep your customers happy. I hope this information will be of help to other readers. – **Peter Nutkins,** *Higher Spence, Wootton Fitzpaine, Charmouth, Dorset.*

TV POWER SUPPLIES TOO COMPLEX?

Thank you for the excellent article on power supply developments, the first part of which appeared in the July issue. I can't help feeling however that power supply technology has wandered into the realm of "frenzied complexity". What's happened to the simple, reliable supplies with mains transformers and series regulators?

Don't get me wrong – I'm not old-fashioned or a "valves for ever" man! Indeed I welcome technical advance and improvements in television design. Experience has shown however that increased complexity doesn't make a successful marriage with reliability – and similarly with cost reduction designs and reliability. So what's happened? Have I missed the point? Probably: I can't think too clearly nowadays, being much too busy in the workshop replacing Syclops panels, thyristors and kick-start capacitors! – **P. R. Smith, T. Eng. (CEI),** *New Dimension Television, Stockport, Cheshire.*



THE TV TELETEXT DECODER Part 8

Steve A. MONEY T. Eng. (CEI)

BUILT-IN teletext decoders, such as those using the TIFAX module, obtain their data signals directly from the video circuits of the receiver into which they are fitted. In the case of the *Television* decoder, the only input is the u.h.f. signal from the aerial. Therefore, the decoder unit must contain its own receiver circuits to enable the desired TV channel to be selected and the corresponding video, sound and text signals to be received. The fourth plug-in circuit card in the decoder unit carries the u.h.f. tuner, i.f. amplifier, synchronisation and data recovery circuits which will now be described. Fig. 1 shows an overall block diagram for this card whilst Fig. 4 gives the complete circuit diagram.

In the first article of the series it was stated that correct reception of teletext should be possible provided that good colour pictures are being received. The average viewer's idea of what a good colour picture is can, however, be amazingly uncritical. A picture that might be considered quite acceptable from the point of view of watching a TV programme may not be at all compatible with error-free text reception.

Many of the problems with text reception are caused by inadequate performance of the i.f. amplifier section of the receiver. Incorrectly adjusted frequency or phase response in this amplifier may not seriously affect the picture but can distort the data signals and produce errors in the displayed text. In the *Television* design a Surface Acoustic Wave (SAW) filter is used to control the phase and frequency response of the i.f. amplifier and gives optimum performance on both picture and data signals. The use of a modern integrated circuit for this amplifier also ensures a good a.g.c. performance and good overall circuit stability.

RECEIVER CIRCUIT

The signal from the aerial is fed via a short length of coaxial cable to a Mullard ELC1043/05 u.h.f. tuner. The output from the tuner is fed to an i.c. preamplifier which compensates for the loss introduced by the SAW filter (around 16dB). This device also provides optimum matching for the filter.

One of the major problems confronting a constructor building his own i.f. amplifier is that of obtaining the correct bandpass and phase response characteristics. If *LC* tuned circuits are used this can involve some complex alignment procedures. By using a SAW filter, alignment becomes very simple.

The SAW filter itself consists of a flat substrate of piezo-electric material on to which are deposited two sets of metal electrodes. The general arrangement is as shown in Fig. 2. Each set of electrodes consists of a series of interleaved fingers. If an r.f. signal is applied across the left-hand set of electrodes it will cause an ultrasonic wave to be generated. This travels across the surface of the substrate, and as it passes the other set of electrodes it produces an r.f. signal which is modified by the filter's bandpass characteristics. The frequency response is governed by the spacing and degree of overlap of the fingers in each set of electrodes. By carefully choosing the geometry of the electrodes, the band-pass can be arranged to have almost any desired shape. The filter unit is made by using photoetching techniques similar to those used for making integrated circuits, so that once the geometry has been calculated it is possible to mass produce ready aligned filter units.

For the UK PAL colour system, with its 6MHz sound subcarrier, the Plessey type SW150 SAW filter gives the correct i.f. response, with some 23dB of sound rejection and with the colour subcarrier at 3dB down from the midband response. The vision carrier will also be set at its correct −6dB level and the device gives a linear phase response.

For the bulk of the i.f. gain a TDA440 is used. This device gives high gain and includes a synchronous detector to give linear video characteristics. Built into the chip is an a.g.c. stage which controls the gain of the i.f. amplifier and also provides a delayed a.g.c. output to control the tuner. Unfortunately this a.g.c. output is in the wrong sense for use with an ELC1043 tuner, so an inverting stage using a BC212 pnp transistor is used to produce the correct a.g.c. action.

Only one *LC* tuned circuit is needed with the TDA440. This provides the vision carrier reference for the detector. Two potentiometer adjustments are provided, one of which is used to set the a.g.c. delay whilst the other controls the peak white video level.

The TDA440 does not provide an a.f.c. signal, so this is obtained by feeding a small part of the detected carrier reference signal to a separate a.f.c. circuit. The a.f.c. circuit uses an SN76660 sound i.f. integrated circuit which is made to operate as an f.m. detector at 39·5MHz. The a.f.c. reference is provided by a tuned circuit connected to the detector stage of the SN76660 and tuned to 39·5MHz.

The video signal from the TDA440 is fed to a phase splitter which provides positive-going video for the modulator and the data circuits, whilst negative video drives the sync separation circuits. Normally the amplitude of the video output from the phase splitter will be about 3V from peak white to the sync tips. This signal level would be too

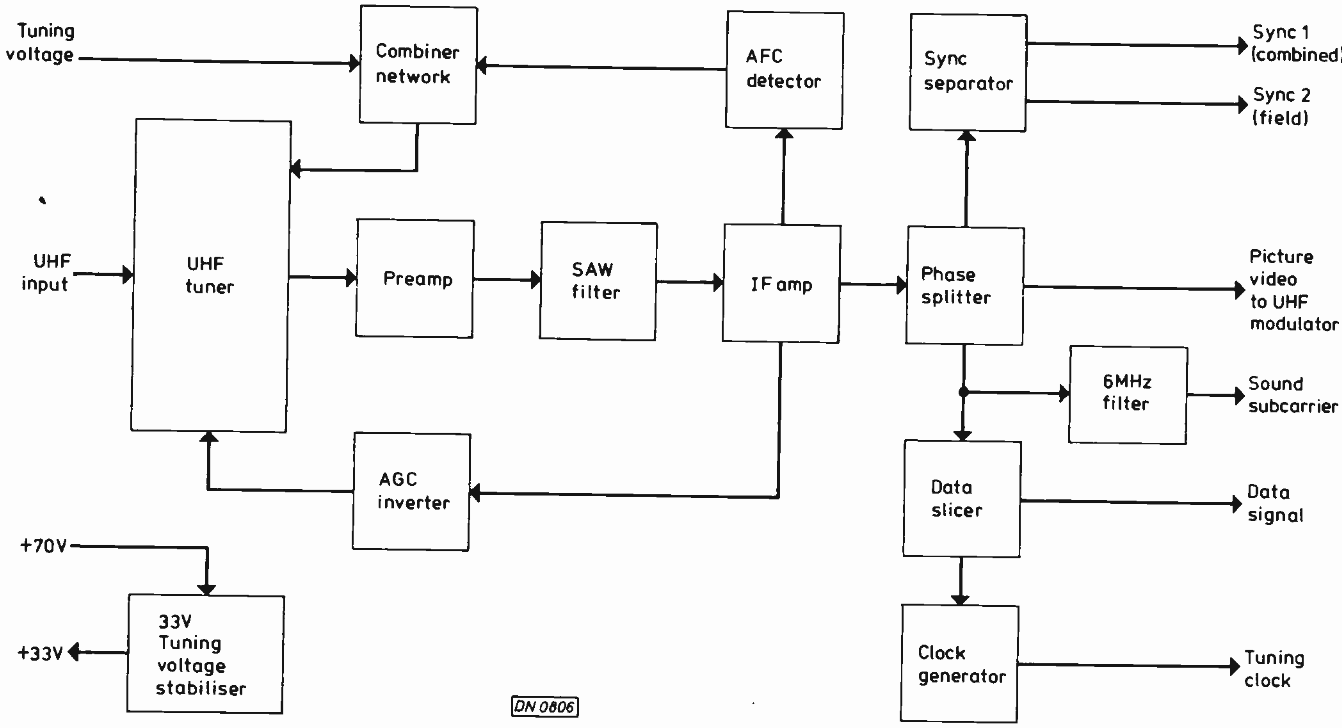


Fig. 1: Block diagram of the receiver/data recovery circuits.

high to ensure linear operation of the u.h.f. modulator when the decoder is operating in the picture display mode. The picture drive for the modulator is therefore taken from a tap on the emitter load of the phase splitter to provide the required level of video drive.

SOUND CHANNEL

When the decoder is in the picture mode, the video drive to the modulator will contain a reduced level of sound subcarrier. It has been found that this amount of subcarrier can provide adquate sound performance on most TV receivers.

In the text mode however, there would normally be no sound subcarrier in the output signal and this would give excessive noise output on the receiver sound channel. To avoid this situation, some of the sound subcarrier is extracted from the phase splitter output via a 6MHz ceramic filter and the resultant subcarrier output from the filter is then added to the text video signal before it is fed to the modulator. This effectively reinjects the programme sound when text is being displayed.

SYNC SEPARATOR

Negative-going video signals from the phase splitter are fed to a simple transistor clipper stage which removes the picture component and produces negative-going sync pulses at its collector. This signal is taken out as SYNC1. The negative sync pulses are then inverted and passed via an integrator network to extract the field sync pulses, which are amplified and fed out as negative pulses on SYNC2. For these circuits three of the transistors in a CA3046 transistor array are used.

DATA SLICER

Teletext data signals start off as a series of square-edged pulse waveforms. In order to fit the signals into the bandwidth of a TV channel, the higher frequency components of the data waveform are fitered out so that the edges of the pulses become rounded off. During the process of transmission and reception further rounding off takes place.

The first stage in the process of data recovery is to convert the received data into a squared-up waveform at the normal logic levels required for the decoding logic. This is

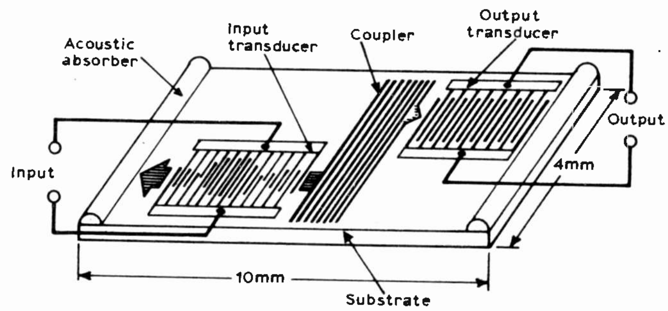
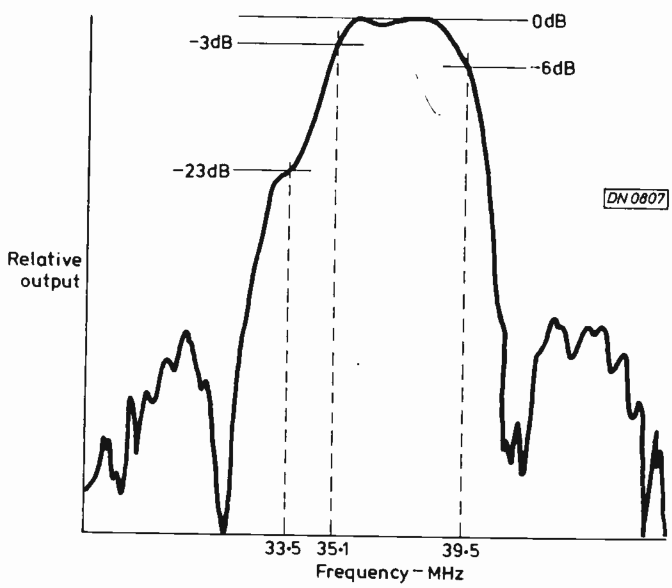


Fig. 2: (a) SAW filter structure.



(b) Typical response curve for the SW150 SWAF.

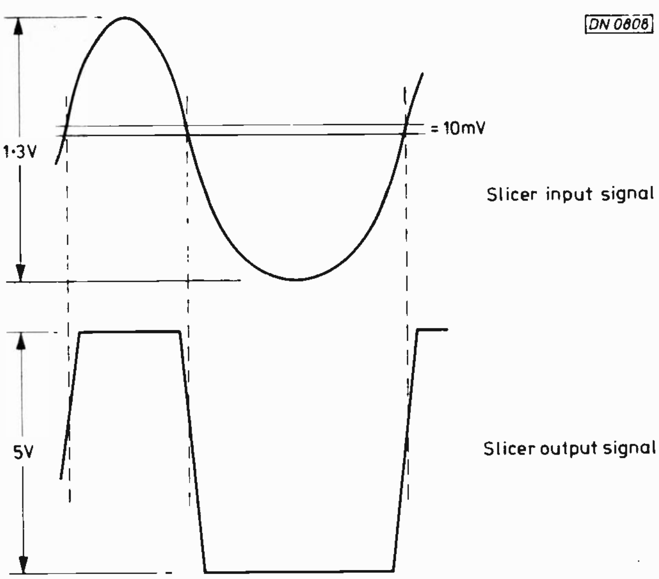


Fig. 3: Operation of the data slicer.

done by passing the video signal through a very high gain amplifier so that a few millivolts change in signal input level will cause the amplifier output to switch between the two logic levels. In effect this amplifier will be taking a thin slice out of the video signal and amplifying it to give a large squarewave output. This is shown in Fig. 3. The rounding off of the data signals will have had least effect at a point roughly half way up the data signal, where the signal transitions will be occurring with nearly the same pattern as the original signal. Therefore the level at which the slice through the data signal is taken is usually set at a point half way up the data signal.

For the data slicer, a 710 high speed comparator is used. This device has a pair of inputs, one providing an inverted output and the other a non-inverted output. The output is determined by the difference in level between the two input signals and, since the internal gain is about 1000, a difference of only ±5mV between the inputs swings the output from one logic level to the other. The inverting input is fed from a fixed d.c. voltage level which can be set up by means of a potentiometer, whilst the video signal is fed to the non-inverting input. The data output signal will be in the correct phase therefore, and the slice level can be set for best results by adjusting the d.c. input voltage.

For teletext, the data amplitude is $\frac{2}{3}$ of the black-to-white amplitude of the picture signal. This decoder will thus give about 1·3V peak-to-peak data signal, so that the slice width is about 1% of the total signal. Normally the setting of the slice level will not be too critical unless the received signal is rather noisy. The sound subcarrier (6MHz) is sufficiently close to the clock rate of the data to cause trouble in the slicer. A sound rejector is therefore included in the input to the data slicer to remove most of the sound subcarrier. Output signals from the slicer are fed via an emitter-follower buffer stage to the input logic card.

CLOCK GENERATOR

The next stage is to generate a decoding clock at 6·9725MHz to act as a timing reference for the decoding circuits.

The data signals are transmitted in Non Return to Zero (NRZ) form. They do not therefore provide a decoding clock signal. If a series of three or four 1 bits follow one another in the signal pattern the data level will stay at 1 for three or four bit periods, but for proper decoding the decoder logic must sample the incoming signal during each bit period. Some form of clock signal is needed therefore to provide a timing reference. If this timing clock is not accurately synchronised to the incoming signal, errors can be produced in the decoded bit pattern. This is especially true if the timing clock takes samples of the signal near the transitions between one bit and the next in the received signal.

To help in synchronising the decoding clock, the first two data words in every text row consist of alternate 1 and 0

★ Components list

Resistors: $\frac{1}{4}$W ±5% except where stated.

R1 68Ω
R2 12k
R3 3k3
R4 120
R5 220
R6 2k2
R7 100
R8 680
R9 68k
R10 1M
R11 100k
R12 100
R13 470
R14 2k2
R15 1k
R16 1k5
R17 1k
R18 3k3
R19 330
R20 330
R21 560k
R22 1k
R23 15k
R24 1k
R25 8k2
R26 18k
R27 1k
R28 220
R29 100
R30 100
R31 1k
R32 220
R33 1k
R34 4k7
R35 1k
R36 1k
R37 6k8 $\frac{1}{2}$W

Capacitors:

C1 22μ 25V
C2 2n2
C3 22μ 25V
C4 2n2
C5 2n2
C6 2n2
C7 10μ 35V
C8 2n2
C9 4μ7 35V
C10 100n
C11 4p7
C12 100n
C13 4p7
C14 100n
C15 100n
C16 220p
C17 10μ 35V
C18 100n
C19 100n
C20 68p
C21 68p
C22 4n7
C23 15p
C24 100n
C25 100n

All electrolytics are tantalum bead. All others are ceramic plate except coil tuning capacitors which should be polystyrene.

Semiconductors:

IC1 SL439
IC2 TDA440
IC3 SN76660
IC4 CA3046
IC5 LM710-14
IC6 LM710-14
Tr1 BC212L
Tr2 BSX20
Tr3 BSX20
D1 ZTK33B
D2 OA91
D3 OA91

Miscellaneous:

ELC1043/05 tuner
SW150 Surface acoustic wave filter
SFE6.0MA 6MHz ceramic filter
Coils: L1 8 turns 28swg ccw
L2 4 turns 28swg ccw
L3 25 turns 36swg ecw
L4 35 turns 36swg ecw

All wound on 4mm former with base and screening can complete with cores. All coil assemblies incorporate other components (see circuit diagram).

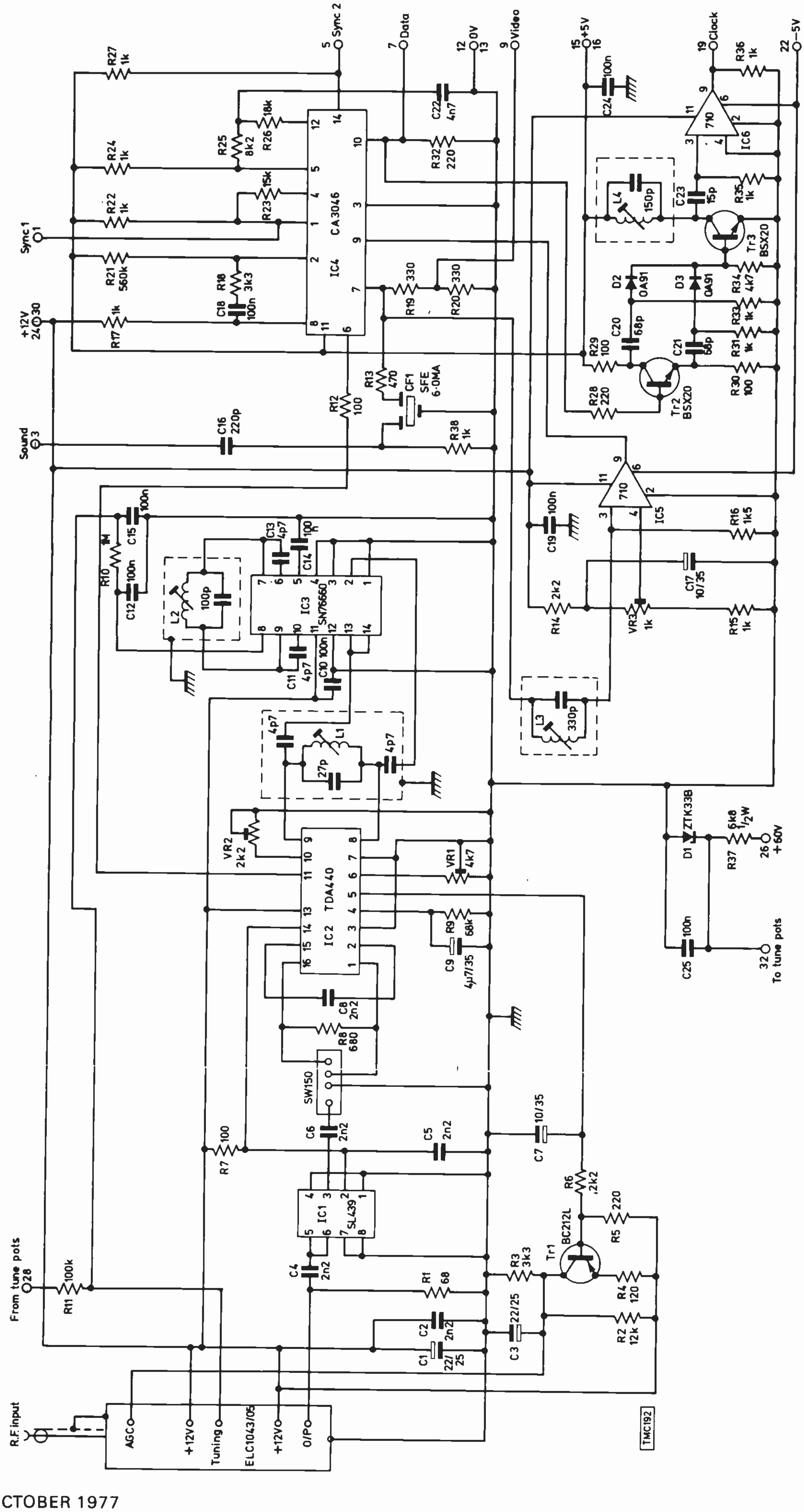


Fig. 4: Complete circuit of the receiver/data recovery board.

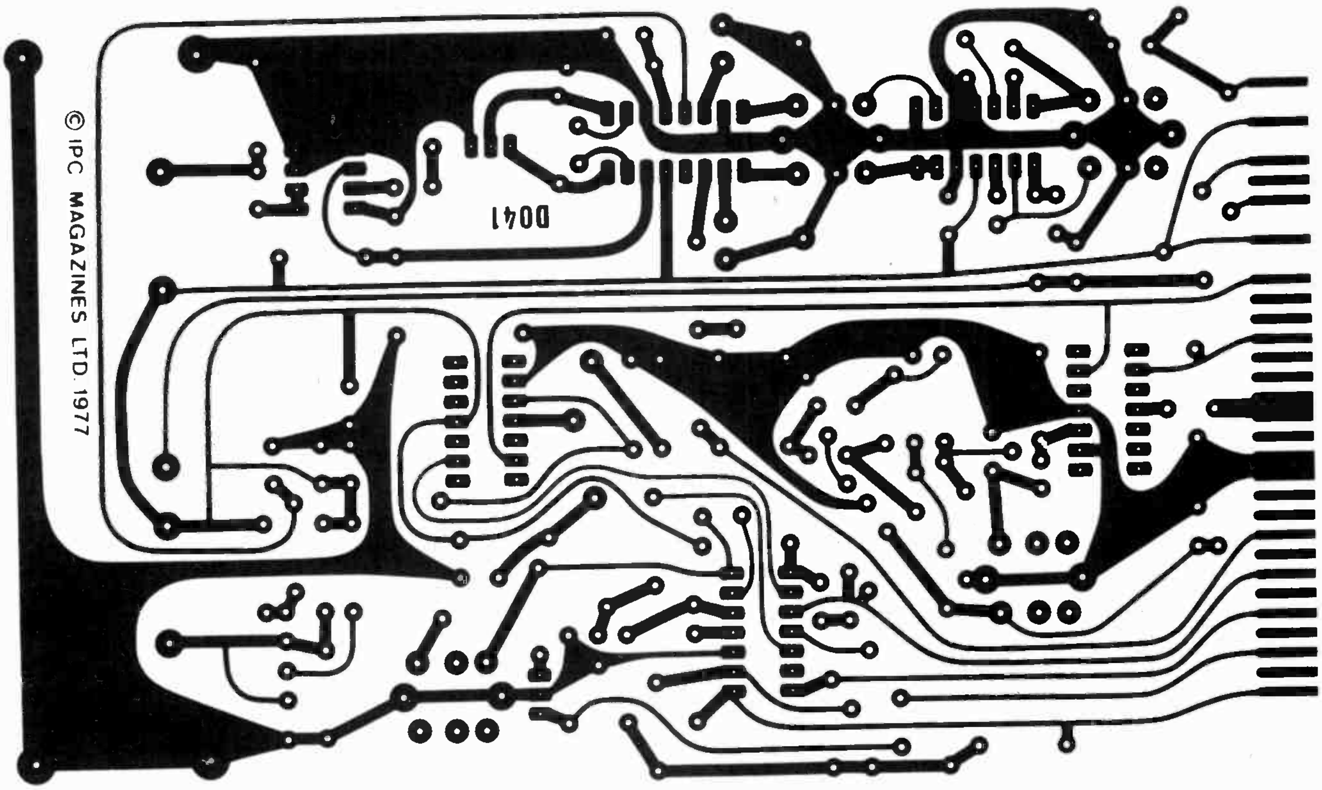


Fig. 5: Print layout.

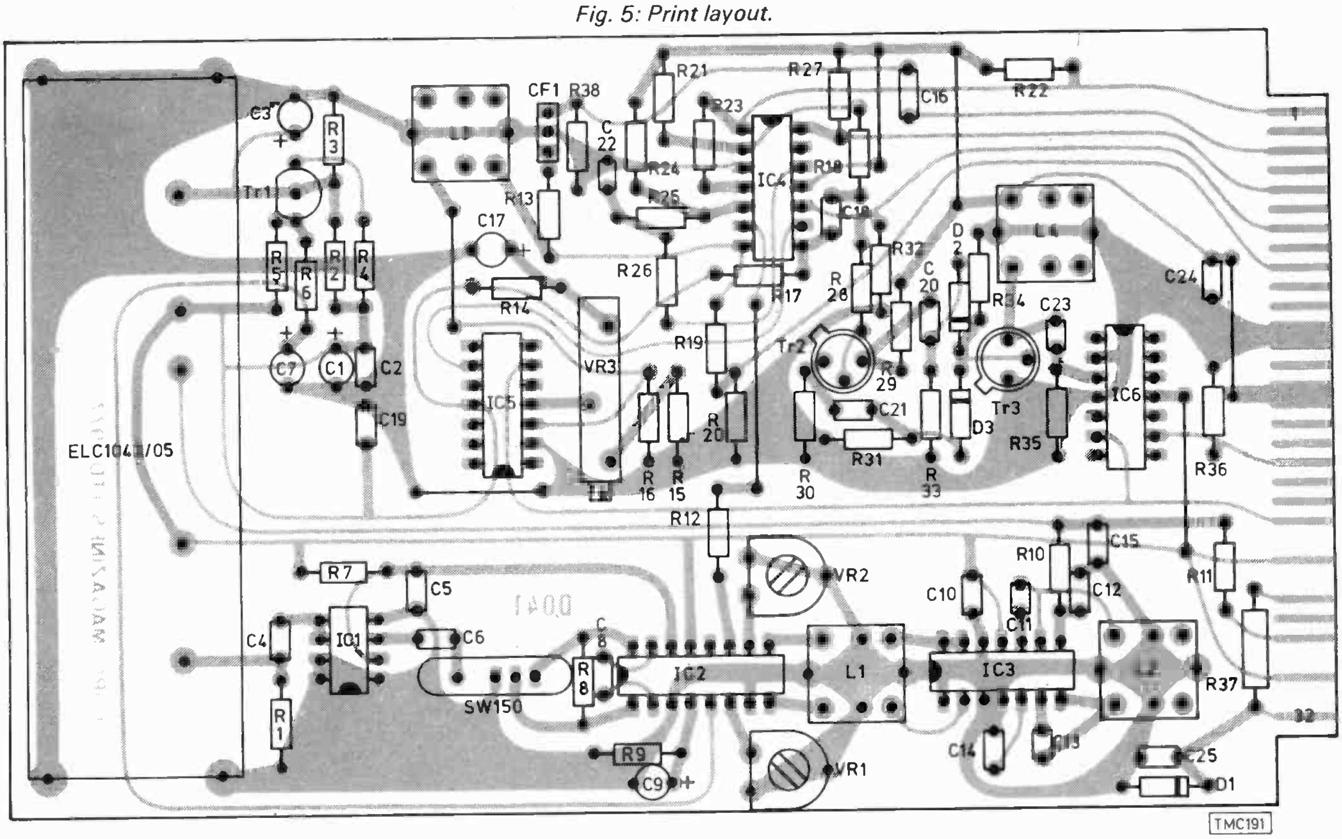


Fig. 6: Component layout.

bits, thus giving 16 data transitions to allow the decoding clock to be locked into correct phase relative to the signal. In order to keep the decoding clock in phase, it has been arranged that at the very worst there will always be at least one bit transition in every 14 bit times.

Ideally the clock should produce a pulse exactly half way through each bit period. If we arrange that the clock is running at 6·9375MHz, it will produce one cycle during each bit period. So if we choose the proper edge of the clock wave, it should always occur halfway through a bit period as long as the clock is locked to the received bit pattern.

The simplest form of clock generator consists of a pulsed tuned circuit resonating at 6·9375MHz. Each time a bit transition occurs the tuned circuit is pulsed so that it produces a damped oscillation at the required clock rate. If the Q is high enough, the oscillation will be maintained at a useful level for some 16 or more bit periods even if no further pulses are applied. The damped oscillation may then be amplified to produce a square clock pulse for the decoding logic.

In this decoder the squared up data signal is fed to a BSX20 transistor which acts as a phase splitter. This is a very high speed switching transistor which will maintain the sharp edges to the pulses in order to reduce timing jitter. The two outputs are differentiated to produce short spikes which are then combined using diodes to produce a train of positive-going pulses which occur at every transition of the input data signal. These pulses drive another BSX20 transistor which switches energy into the tuned circuit so that it produces damped oscillations at 6·9MHz. The signal from the tuned circuit is then coupled to another 710 comparator and turned into a squarewave clock signal at normal logic levels. The clock frequency and phasing relative to the input signal are controlled by the tuning of the resonant circuit. This is adjusted to give minimum errors in the displayed text.

CONSTRUCTION

Fig. 5 shows the copper print for the receiver section printed circuit board, whilst Fig. 6 shows the component location. The u.h.f. tuner is mounted directly on to the board at one end. Apart from keeping component leads short to avoid stray pick up, the construction of this board is quite straightforward. It is important that the screen of the coaxial cable from the aerial input should be fixed down to the tuner case close to the input pin to avoid any stray signal pickup.

Next month we shall complete the assembly of the whole unit and deal with the alignment of the i.f. amplifier and the setting up of the decoder circuits.

Please note . . .

Due to circumstances beyond our immediate control, an error has appeared in the circuit diagram and printed circuit board for the display card which appeared in the July and August issues. In fact, pin 11 of IC6 should be shown connected to bit 4 and *not* bit 5. The pcb can readily be modified by cutting the track from pin 11 of IC6 where it joins pin 4 of IC3. By using a short piece of wire, the end of the track can then be joined to pin 11 of IC3. This modification *must* be performed on all boards which are designated D013. Subsequent batches of display boards from Readers' PCB Services Ltd will have this modification incorporated and these will carry reference no. D013a. We sincerely apologise to all our readers for this error.

Service Notebook

G.R. WILDING

Awful Colour Picture

A four-year-old Pye hybrid colour set produced a poor definition, low brilliance picture with grossly incorrect colours. The saturation control had been over-advanced in order to brighten the picture, and on returning it to a normal setting it was evident that while the reds were quite strong blue was much weaker and green virtually non-existent. After removing the back we discovered that the blue output could be brought up to almost the level of the red output by advancing the appropriate c.r.t. first anode preset control, but that even with the green control fully advanced there was still only the faintest suggestion of green. The first anode voltages were measured and found to be roughly the same at about 800V, so a new PCL84 G – Y output valve was tried. This brought no improvement, so voltage checks were made around the PCL84s. Everything was roughly correct, so with nothing apparently wrong in the circuits feeding the tube's grids and first anodes we turned to the PL802 luminance output pentode which drives the cathodes.

Both the anode and screen grid voltages were found to be well above the correct figures, and as the h.t. line was normal it was apparent that the valve wasn't passing the normal current, due to the valve itself, incorrect biasing or something wrong in the cathode circuit where flyback blanking is carried out. A new valve produced an over-bright picture and, after readjustment, normal brightness and colours were obtained. So what at first appeared to be a fault in the green output circuitry turned out to be a luminance fault! It also brings out how widely the operating levels of the individual guns in the one assembly can vary.

Insufficient Height

The trouble with a Hitachi Model CSP680 colour set was insufficient height, though the linearity wasn't too bad. The fault could be due to a defect in any of the three stages concerned – field blocking oscillator, driver and output stage – but in view of the fair linearity it was more likely to be in the oscillator or driver stages, since output stage defects usually result in bad linearity with reduced height. This is equally true of valve circuits of course. The voltages all seemed to be about normal, so going on probabilities we decided to change any electrolytics present. There are two in the blocking oscillator circuit, the charging capacitor C604 (10μF) and the timing capacitor C603 (2·2μF). Changing the former produced no real improvement, but replacing the latter completely restored the height to normal.

Focus Fault

We were called to see an ITT colour set (CVC8 chassis) with the complaint "poor picture". This turned out to be poor focusing, and though moving the focus control lever to one extreme produced a considerable improvement the focus was still not up to the normal standard. In these receivers the problem is commonly due to the 4·7MΩ resistors connected in series with the control at each end: being mounted inside the e.h.t. cage, they tend to run warm. Accordingly both resistors were changed, but on switching on again there was only a slight improvement and the focus lever still had to be set at one extreme.

The slider of the control is decoupled by a 210pF capacitor, so this was next checked. There was no leak however so we followed the wiring through to the c.r.t. base panel where a 2·2MΩ resistor (R276) feeds the focus electrodes. There was a considerable voltage drop across this resistor, which turned out to be virtually open-circuit. On replacing it, normal focus with the lever at almost exactly centre point was obtained.

Excessive Blue

A solid-state GEC colour set displayed an excessively blue picture. This was found to be due to low c.r.t. blue cathode voltage, so the blue output stage was checked. None of the resistors were discoloured to suggest value change, and as the emitter and the collector load resistor were both "spot on" we decided to change the BF336 blue output transistor. The result was a much better picture, though on reducing the saturation control setting to minimum it was far from black and white. Adjusting the c.r.t. first anode presets cured this, but it was noticed that they were all at near their maximum setting. As the vertical linearity was out, we decided to leave the set working until a test transmission came on.

After a while however the brilliance reduced, as if the brightness control had been turned down. There could have been many causes of this, since the main and preset brightness controls both operate on the TBA560 luminance/chrominance processing i.c., with d.c. coupling thereafter to the tube's cathodes to preserve the black level. A check on the decoder section revealed nothing amiss so, bearing in mind that the c.r.t. first anode presets were at near maximum setting and that the high-value resistors providing this supply tend to increase in value in all colour receivers, we decided to check this part of the circuit. The higher-voltage ends of these presets are fed via a 560kΩ resistor (R506) which turned out to be greatly discoloured, having increased in value to well over 1·2MΩ. Replacing this and readjusting the presets restored a full brilliance, natural picture which remained at the correct brightness level.

No Signals

The owner of a dual-standard monochrome set fitted with the ITT/STC VC51 chassis complained that on switching on there was neither picture nor sound, just an unmodulated raster. On switching off and on again however he had been able to get good sound and a normal picture. This had gone on for a week, but no amount of switching off and on would now restore results. The set was used on u.h.f. only, so as a first step we switched over to v.h.f. The result was ample sound, but the raster remained unmodulated. This ruled out the tuner and the common vision and sound i.f. stage so, as the intercarrier sound is tapped from the anode of the PCL84 video output valve, the trouble was in either the PCL84, the vision detector or the EF184 second i.f. amplifier – the PCL84 is capacitively coupled to the c.r.t. cathode, so its failure to pass anode current would not result in the c.r.t. being biased off as occurs when the video output valve is d.c. coupled to the c.r.t. cathode. Since EF184s have a fairly high failure rate after some years' service this was tried first: a replacement made no difference, but normal reception was restored on replacing the PCL84.

Out of curiosity we replaced the old PCL84 and checked its cathode voltage. This turned out to be zero. The heater wasn't short-circuit, so it must have had an open-circuit cathode connection – an open-circuit anode would have resulted in excessive screen grid current and a high cathode voltage, while there would still have been some anode current if either the screen grid or control grid had been open-circuit. The odd thing is how the cathode connection had at first been restored by switching the set off and on again.

Colour Drop-out

A Hitachi receiver fitted with the PAL-3 chassis gave a perfect picture when switched on, but after twenty minutes or so the colour dropped out. As in all colour sets there could be several reasons for this, but we noticed that just before the picture turned to monochrome the colour sync was lost. This clearly indicated that the reference oscillator was drifting off frequency. Again, there could be a variety of causes, but in this particular chassis the first move should be to check the setting of the reference oscillator's collector coil L505. On resetting this, normal colour was restored and there were no signs of frequency drift even after several hours' use.

Blown HT Fuse

No sound or picture was the complaint with a hybrid Decca monochrome set (Model MS2401) and on inspection the 500mA h.t. fuse was found to be open-circuit, the blackened inside of the glass indicating that it had been blown by a fairly severe short. There was neither a short nor an unduly low resistance between the h.t. rail and chassis however, nor from the cathode top cap of the PY88 boost diode to chassis – this check is always advisable since it can show up a defective boost or harmonic tuning capacitor. The only thing we could do therefore was to replace the fuse, switch on and await developments.

Normal sound and quite a good picture appeared, but with constant rolling. There is no field hold control in these sets, so it seemed at first that a field fault of some sort had caused the fuse to blow. The picture then collapsed to a thin white line, though even with the brilliance control fully advanced this was of low brightness. We then noticed that the wire-ended focus slide potentiometer had virtually burnt away, and on removing it and making a voltage check we found that there was no voltage on the supply lead to the control.

As Fig. 1 shows, the feed is taken from the boost rail via a 220kΩ resistor (R116). The field charging circuit is fed from the same point, hence the field collapse, while a further feed from the boost rail supplies the c.r.t.'s first anode,

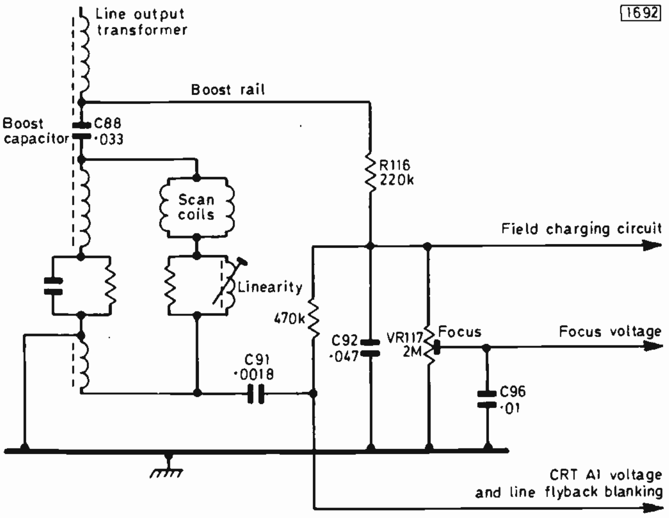


Fig. 1: Boost supply circuitry, Decca Models MS1700/MS2001/MS2401. A defective R116/VR117 network had resulted in a blown h.t. fuse. Note that C91 performs two functions: in addition to smoothing the c.r.t.'s first anode supply, it also couples the line flyback blanking pulses to this electrode.

accounting for the lack of brightness. Clearly either R116 was open-circuit or C92 short-circuit, and on touching R116 with a test prod it disintegrated. C92 – and C96 – turned out to be in order, and on replacing R116 and the focus control a lasting cure was obtained. It seems that the track of the focus control must have fallen in value, causing an increased current flow which eventually led to both resistors failing.

Intermittent Field Collapse

The raster on a Thorn colour set fitted with the 3000 chassis collapsed intermittently to a fraction of the normal height. In view of the intermittent nature of the fault we decided to change the field timebase/sound panel. The fault continued exactly as before however. The sides of the raster remained vertical, pretty well eliminating the field scan coils, so attention was turned to the convergence panel. The field convergence circuit is connected in series with the field scan coils, the coupling being via a 400μF electrolytic (C705). This was the prime suspect, and on replacing it no further field collapse was experienced.

Small, Dull Picture

The picture on a Pye monochrome set fitted with the 769 chassis was only about one third normal height, while the brightness level was poor. Even with the brilliance control fully advanced it was possible to see only the picture highlights. Channel changes and disconnecting and replacing the aerial plug brought momentary high brightness streaks, so clearly the lack of brightness was due to the c.r.t.'s working voltages. The common link between the two faults is the boost supply, which feeds the c.r.t. first anode and the height control. The boost capacitor was found to be providing ample voltage at tag 5 of the line output transformer however. The boost supply is then filtered by an *RC* network consisting of R87 (470kΩ) and C72 (0·047μF, 1kV) which is connected to chassis. There was a big voltage reduction at the junction of these components, and a resistance check across the capacitor gave a reading of only about 50kΩ instead of well in excess of 1MΩ. Clearly C72 was leaky, and on replacing it normal brightness and more than adequate height were obtained.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

APART from a few lulls, the conditions during July generally followed the excellence of those during June, with a varied selection of Sporadic E signals from both near and afar. We've had a record mail – by a long way – this month, which seems to indicate a growing interest in long-distance TV reception. This is especially rewarding when we hear from enthusiasts who are attempting, and succeeding, under unfavourable conditions. J. Cook (Newcastle) for example is using a channel B2 dipole in his fourth floor flat, while D. Bassnett (Glasgow) is operating with a four-element wideband Band I array in his loft. The excellent Sp.E openings this season have given new enthusiasts encouragement, and I'll be delighted to help those who write in for advice as far as possible.

Local Conditions

Due to the amount of news, I'm again reducing to the minimum my report on reception during the month here at Romsey. There's been a tendency for long-hop signals to predominate. For a period TSS (Russia) ch. R1 was logged daily, on test card from 0630 onwards and then on programmes from 0700. Several Sp.E openings continued for several hours and embraced most countries in Europe, with the strange exception of TVR (Rumania). Indeed I've logged TVR only once this season. Conditions have favoured reception from the north (Scandinavia) rather than the south (Spain and Portugal).

Station confirmation has been greatly eased since NRK (Norway) started to use transmitter identifications on their PM5544 pattern. Note however that some transmitters retain the standard "Televerket" marking. YLE (Finland) has provided several excellent signals here on ch. E2. There's also been Tropospheric reception, with u.h.f. signals from Northern France on July 2nd. David Martin (Shaftesbury) logged DR (Denmark) in Bands I and III, and NOS (Holland) and DFF (East Germany) at u.h.f., on the 11th. It seems that the ch. E36 DFF signal travelled via ducting, since there were no other signals at this distance present. SR (Sweden) was also present on this day, in Band III.

Aerial System Changes

I've been busy making changes to the aerial system. Two short-backfire wideband u.h.f. arrays have been stacked, and the bandwidth retained despite using a matching/phasing harness that might have reduced it. The solution was to use a Jaybeam group C/D harness with the output (i.e. the feeder end of the 50Ω matching section) terminated into the input of a Wolsey Supa Nova wideband u.h.f. preamplifier. This has a 22dB gain with a noise figure of 3·5dB. The purpose of this arrangement was to swamp any inherent mismatch in Band IV, and the system seems to be working well.

I've also mounted a three-element Trumatch type wideband Band I array at about 35ft. Some hours after doing this a hum was noticed at the bottom of the lattice mast, and on feeling it a distinct vibration was present. The cause was found to be resonance in the Band I reflector element (see Fig. 1), a form of standing wave building up in a slight breeze. This was damped out by inserting lengths of sash cord: if left over a period of time damage due to metal fatigue could well have occurred.

Foreign News

Gibraltar: PAL colour transmissions are planned for "The Rock". A new transmitter is to be installed to double e.r.p. to 200W. Due to the political situation, no Eurovision link is available and any news material is flown out and shown later. Both RTVE (Spain) and RTM (Morocco) can be received in Gibraltar.

Russia. Some months ago we reported that TSS was contemplating a change to PAL transmission from the present SECAM. Bill Holt, Leeds recently received PAL signals from TSS. TSS hopes that within the next five years satellite television will cover 85% of the population (i.e. direct to viewer).

Switzerland: Additional TV programming is to be via cable rather than radiated off air.

West Germany: Work on the Frankfurt TV tower is at an advanced stage. When completed, it will be the world's fourth largest TV tower with a total height, including aerial steelwork, of some 1,084ft, the concrete reaching to 969ft. Opening is scheduled for Spring 1978.

Sweden: A major reorganisation will take place next Summer when the existing agreement with the government expires. The existing TV1 v.h.f. network will carry both national and regional programmes. Stockholm will remain headquarters for TV-S and for news on the regional TV-R network. The existing Sveriges Radio monopoly will disappear and the government is to issue transmitting licences to other parties. The Scandinavian countries are to participate in a satellite programme that will allow viewers

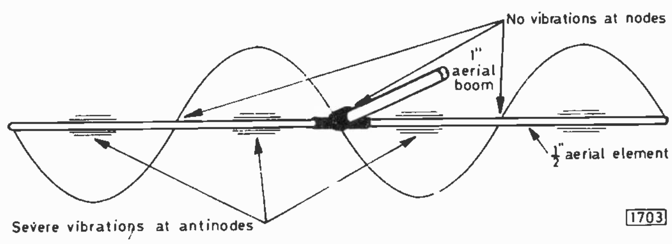
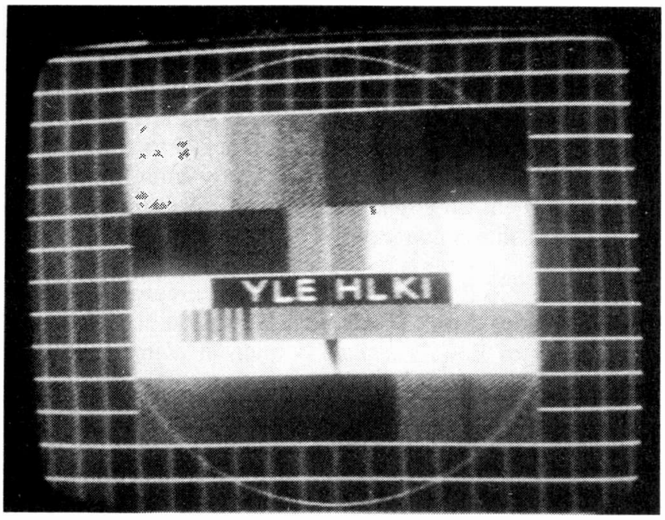


Fig. 1: Standing-wave vibration pattern noticed on a 120in. Band I aerial reflector element.



FUBK test pattern received from YLE (Finland) on ch. E2 by Clive Athowe (Norwich).

to see neighbouring country's programmes.
Japan: Work on 12GHz satellite test TV transmissions by NHK is at an advanced stage. Two channels (in colour) will be transmitted from the 100W transmitters aboard the satellite, for domestic reception using dishes of up to 2m diamater.
USA: The FCC (Federal Communications Commission) has now authorised the use of CP (circular polarisation) for television transmission. The main advantage is a reduction in ghosting when receiving signals in built-up areas with indoor aerials.

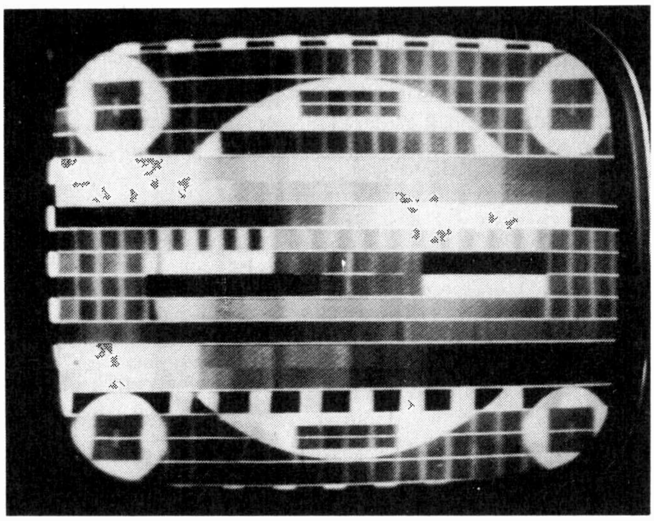
New EBU Listings

West Germany: Saarbruecken ch. E45 500kW e.r.p. horizontal.
Egypt: Mahalla ch. E8 1600kW e.r.p. horizontal (impossible in the UK, but an interesting e.r.p!).
Spain: Parapanda TVE-2 ch. E23 158kW horizontal (03W55 37N18); Alpicat TVE-2 ch. E49 158kW horizontal (00W32 41N40).
France: Rouen TF1 ch. E23 500kW; Chambery FR3 ch. E23 100kW; Lille TF1 ch. E24 1000kW; Bergerac FR3 ch. E31 250kW; Le Havre TF1 ch. E46 100kW; Chaumont A2 ch. E49 80kW; Hirson FR3 ch. E51 500kW; Vannes FR3 ch. E53 500kW; Alencon FR3 ch. E54 100kW; Neufchatel FR3 ch. E54 80kW; Laval FR3 ch. E60 100kW; Sens FR3 ch. E60 100kW; Verdun FR3 ch. E62 500kW. All with horizontal polarisation.
Hungary: (For the optimists!) Csavoly MTV-1 ch. R28 10kW horizontal (19E09 46N12); Budapest 1 MTV-1 ch. R1 reduced to 120kW e.r.p. from 150kW e.r.p.
Poland: Bydgoszcz TVP-2 ch. R36 100kW horizontal.

Matters Arising

The Philips transmitter at Waalre (near Eindhoven) is radiating test signals during weekday working hours. Its e.r.p. is 2·5kW (horizontal), and the signals include colour slides, the PM5544 pattern and the monochrome RETMA 1946 chart. The PM5544 pattern has been seen with the identification "ELCOMA" which stands for Electronic Components and Materials and is apparently an experiment with solar cells. The RETMA card carries the identification "Kan 60 Waalre" in the upper grey scale and the Philips symbol in the centre. The Belgian Aalter ch. E2 transmitter is to close at the end of the year.

The following information on RUV (Iceland) comes from Kevin Jackson (Leeds). There are no programmes on



TSS-1 (USSR) test pattern received by Dr. Duncan at St. Andrews, Fife, on ch. R1.

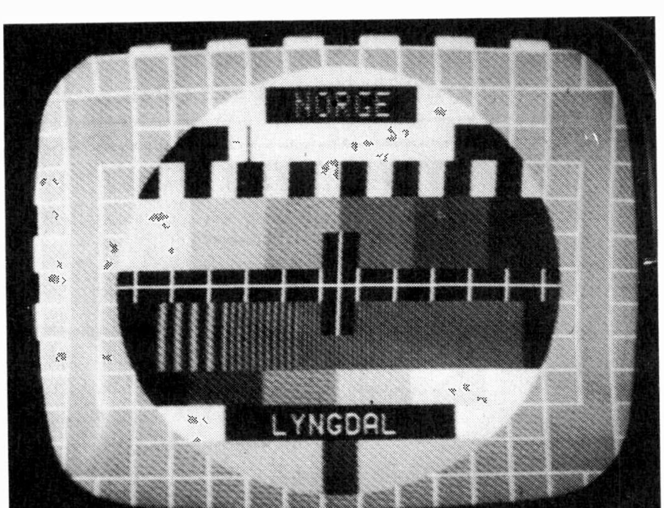
Thursdays. During Summer weekdays programmes are from 2000-2230, on Sundays from 1800-1900 and 2000-2230, and on Saturdays from 2000-2330. Approximately 25% of programmes are in colour, with 40% local programmes, the rest being imported. The population coverage is 98%. The test pattern is the PM5544 with identification.

From Our Correspondents . . .

Leslie Hetesi (Hungary) has logged several Norwegian transmitter identifications including Gulen, Melhus and Greipstad on ch. E2, Bagn and Gamlen on ch. E3 and Konsberg on ch. E4. Mr. Hendriks (Amsterdam) received an EBU bar pattern carrying the identification "F11 IEC" on June 8th at 1220-1230: has anyone any ideas as to its origin? He reports that the Schoksberg (Saarland) TV transmitter is now operating on channels E42 and E45, with a 930ft. tower.

Dr. E. Duncan (St. Andrews, Fife) has had considerable success this year on both Band I and Band III. He's sent us several photographs, a couple of which are included this month, and comments that June 9th and 14th were especially good, with very high m.u.f.s, and that June 25th was "a day to remember". He's now using a Philips G8 selectivity unit which is giving much improved results.

Reg Roper (Torpoint, Devon) comments that the Polish PM5544 pattern has no identification but a darker



Tropospheric reception of the NRK (Norway) PM5544 test pattern at St. Andrews, on ch. E9.

background, and tells us that a station at Ajaccio, Corsica is now in operation on ch. F4.

Kevin Jackson (Leeds) has had the magnificent reception of TSS Riga ch. R10 via Tropospheric ducting(?), a distance of some 1,015 miles. The EZO pattern was logged at 0545 on July 4th, followed by a clock then the news at 0600 (GMT). Fade out occurred shortly after. With JRT (Yugoslavia) ch. E6 already received in Leeds via Sp.E this season, Yorkshire might seem a better place to settle in than East Anglia!

Band III Sp.E was also noted by George Ridgwell (Harold Wood) during June, with RTVE on ch. E6. There were plenty of Band I signals coming in at the time and, using a twelve-element wideband Band III array plus Wolsey Supa Nova masthead amplifier, he logged similar signals on this Teleton receiver.

Tony Harris (Fareham) has received good signals from most European countries, using a Skantic receiver. John White (Scunthorpe) has received signals from Sweden, Norway, East Germany, Belgium and Denmark. First prize for an unusual reception must go to Mike Allmark (Leeds) who logged RAI (Italy) on ch. E2: this is apparently a small relay located in Switzerland, with an e.r.p. of only 42W!

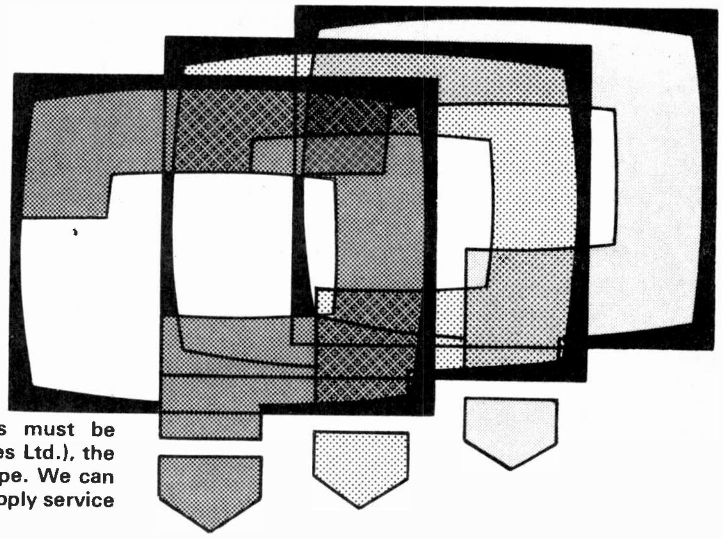
Kazunori Ushigome (Tokyo) has written to say that the 0249 test card captioned from China in my book "Long-Distance Television" (page 14) is incorrect. The TV transmitters linked to Peking use the Philips PM5544 pattern, the checkerboard pattern and at times a chessboard pattern. The 0249 card is used by Russia and could have originated in Vladivostock or Magadan – both are received in Tokyo. The picture on page 14 was taken many years ago however, at a time when China did use the 0249 pattern! It was taken during a period of high sunspot activity, and is included to show the characteristic appearance of a trans-Equatorial skip signal. We are grateful for the comments however and hope to hear more from Kazunori on DXing in Japan.

An Unusual TV/FM Radio Relay Station

NRK (Norsk Rikskringkasting, Oslo) have provided us with details of an interesting relay station on Vega Island, off the central western Norwegian coast. The station is some 773 metres above sea level and in addition to the usual equipment has emergency generating plant – there are inclined to be failures in the power feed from the mainland, such a failure automatically starting the emergency generator. The reinforced concrete aerial tower is 77 metres high, with a 31 metre steel aerial mast on top, the latter covered with a plastic and fibreglass sheath to prevent the formation of ice on the transmitting elements. Due to the adverse weather conditions, the tower and mast are designed to withstand a wind speed of 60 metres per second with an ice coating of 60cm. (about 2ft.). There's a funicular cable hoist for access, terminating 60 metres from the transmitter building. To protect visiting engineers against the dangerous winds, a tunnel connects the cable hoist terminal and the transmitter.

The f.m. radio transmitter has an e.r.p. of 33kW, the ch. E9 TV transmitter an e.r.p. of 30kW, giving coverage extending approximately 100km north and south of Vega. Since the mainland is very rugged the coverage varies and several transponders are used to re-radiate the transmissions. It is intended eventually to have some 55 transponders in the area. NRK add that Norwegian TV coverage now extends to some 95% of the population, and that a further 1,500 transponders will be required to cover the remaining 5%. Due to the high cost of this there are no plans at present for a second TV service at u.h.f.

Your PROBLEMS solved



Requests for advice in dealing with servicing problems must be accompanied by a 50p postal order (made out to IPC Magazines Ltd.), the query coupon from page 666 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

GEC 2023

When the set is switched on there is excessive contrast: as the set warms up the contrast becomes glaring, with the blacks becoming jet black. Adjusting the contrast control makes no difference at all. The sound level is also very low. At full volume, you can just hear it. These faults are present on both systems.

The probable reason for the contrast control being ineffective is that there is a cancelling positive voltage on the a.g.c. line. The most likely place this could come from is the gain-controlled EF183 i.f. amplifier valve. It could have an internal fault: check it by substitution. Otherwise the contrast control may have a broken chassis connection, which is via PL2–3 and PL2–4. The sound fault could well be due to R92 (18kΩ) and R93 (5·6kΩ) which are associated with the EH90 valve. These resistors frequently change value.

BEOVISION 3400

The picture is often very dim in spite of the brightness control being set to maximum. The picture comes up normally however if the set is left switched on for say a couple of hours, and usually stays that way, though it's still not as bright as when the set was new. The set is then normally, though not always, o.k. when switched on the following day, but if the set is not used for some time the picture reverts to its dim condition pending an extended warm up period.

Use the meter to ascertain which c.r.t. voltage is varying. It will probably be the cathode voltage, in which case the following are suspect: the 1μF tantalum capacitor in the luminance detector can (can 8010046), the 12V zener diode 1D1 at the rear of the front chassis, the luminance delay line driver transistor 1TR17 (type MPS6517) and the 12HG7 luminance output valve.

GEC 2110 SERIES

The problem is intermittent loss of colour, sometimes for an hour or two but occasionally for several days. The colour sometimes goes after changing channel or adjusting the colour control. Both the tuner and the colour control have been proved to be o.k. by substitution.

The TBA540 reference oscillator i.c. (IC251) is often responsible for this. If possible check it with a hairdryer and freezer before trying a substitute.

DECCA 30 SERIES CHASSIS

There is a linearity fault on this set: the left-hand side of the picture bends upwards, particularly at the top, giving the impression that the picture is being "sucked" up to the top left-hand corner.

Try the effect of adjusting the NS pincushion phase control L404 on the bottom panel. If this fails to cure the non-linearity, the trouble is likely to be due to the pincushion distortion correction transductor L407, or out of tolerance scan coils. The picture might improve with some adjustment of the line linearity control L408.

PYE 99 PORTABLE

There is no raster on this set. The line oscillator and output transistors have been replaced without making any difference. The board has been examined, and the line output transformer appears to be perfect. The only thing that was slightly discoloured was the line oscillator transistor.

First ensure that the +1 and +2 lines are present and 11V or so. To trace the line drive an oscilloscope is almost essential. If you don't have access to one, feel R768 (1Ω) which feeds the emitter of the line driver transistor. If it's warm, the line oscillator and driver stages are working. If it's not warm, check the voltage at the collector of the line oscillator transistor (TS414). If it's about 6V the oscillator is running and the driver transistor TS415 should be checked: if it's markedly different the oscillator has stopped. In that case check TS414, the reactance transistor TS413 and associated components. (Philips T4 chassis.)

GEC S/S HYBRID COLOUR CHASSIS

The trouble was that the set suddenly became badly misconverged after a couple of hours. This happened a couple of times, then the misconvergence became permanent. I've been through the complete convergence procedure several times but have not been able to achieve much improvement.

Your problems will probably be largely over when you replace the 250μF electrolytic capacitor C600 on the convergence panel. This couples the waveform at the cathode of the field output pentode to the vertical convergence circuit. Then if necessary check the continuity of all the convergence controls. You will have to go through the whole convergence procedure again of course.

PYE 169 CHASSIS

The sound is good on this set, but there is no vision, just a good linear raster. Is there a quick way to solve this problem?

The presence of the sound suggests that the i.f. strip is in order, while the raster suggests that the video output stage is o.k. The trouble is most likely to be in the TAA700 video/sync processing i.c. therefore. If you have a scope, check the gating pulse input to pin 3 first, then the video output pin 12. If the voltages around the i.c. and the i.c. itself are o.k., check the voltages around the transistors in the i.f. strip.

BEOVISION 3400

This three year old set still gives a magnificent picture, but the convergence is unstable. When the convergence has been set, it stays stable for minutes, hours or even days, but then starts wandering into colour fringeing and sometimes alteration of the colour balance – the convergence control box is not ventilated, and definitely warms up. A high-key picture can trigger off defocusing accompanied by a horrible creamy-green colour, the picture restoring itself when the high-key content has ended or the brightness control is turned down. Resistor 9R6 runs much hotter to the touch than any other resistor of comparable size.

First set up the beam limiter and the 30V line controls – numbers 31 and 56. If the 30V line varies when the convergence drifts, this will be the answer – check the two 4·7V reference zener diodes 2D19 and 2D23, and if necessary the associated transistors. Make sure that the set-white switch (near the 12HG7 luminance output valve) is not noisy – this commonly happens. 9R6 is rated at 7W and is the screen feed resistor for the PL509 in the e.h.t. generator circuit: it works hard, normally running very warm. Its thermal link would break if it was passing excessive current.

PHILIPS 170 CHASSIS

There is sound but no raster. The line timebase valves have been replaced, also the boost capacitor, but there is no line whistle. There is plenty of spark at the top caps of the PL504 and PY800, and removing the DY87's top cap makes no difference. The PL504 is overheating.

The sparks you obtain indicate that there is line drive but that the line output transformer has shorted turns, thus loading the PL504. The shorted turns appear to be in the e.h.t. overwinding, which feeds the DY87's anode. Run the receiver for a short while, then switch off and feel the overwinding. If it has shorting turns, it will feel warm.

PYE 691 CHASSIS

There are a couple of problems with this set. First, as the set warms up there is a slight reduction in height. Secondly, the picture is inclined to be too green when switched on, though this fault corrects itself during the course of the evening.

You will find the height control on the field timebase panel, which houses the two BD124 output transistors. If there is insufficient range of adjustment, try interchanging the two output transistors. This action sometimes restores normal height. The trouble could well be due to the AC128 driver transistor being overheated. If it's on the top of the panel – where you'd expect to find it – remove it and mount it underneath where it keeps cool. The changing colour is most likely to be due to a worn PCL84 on the CDA panel. Check the centre (green) one. If this isn't the cause of the trouble, check whether the green first anode voltage remains constant. If not, check resistors as necessary.

ITT/STC VC11 CHASSIS

There is a good, bright picture on u.h.f., but the picture disappears when the brightness is turned up. This does not happen on v.h.f. The values of the focus and both width controls seem to have altered considerably, and the picture is too wide and cannot be adjusted. These small controls are riveted on: how does one deal with this?

First check the DY86/DY87 e.h.t. rectifier valve, which could be low emission. Also check the 0·9Ω resistor mounted under the e.h.t. rectifier's valveholder (1Ω will do) and the condition of the valveholder itself. A change in the value of the controls you mention is unusual on this chassis: when checking the resistance values with a meter each control must be disconnected from the circuit otherwise false readings will be obtained. The excessive width could be due to a defective PL81 line output valve, or to the v.d.r. (E298/ZZ/06) or the 220pF 4kV pulse feedback capacitor in the width circuit. If replacement width controls are required, the procedure is to drill out the rivets and fit the new controls using short 6BA nuts and bolts.

PLESSEY DUAL-STANDARD MONOCHROME CHASSIS

The 405-line picture is all right, the contrast control varying the a.g.c. bias. On 625-lines however there is a very heavy negative a.g.c. bias which cannot be overcome by adjusting the contrast control.

The triode section of the PCL84 video valve is used in this chassis as a gated a.g.c. stage. We suggest you try a new valve, and check the value of the triode's grid leak resistor R146 (100kΩ) as this is inclined to increase in value to cause the sort of trouble you have. We've also known the trouble to be due to the gating pulse coupling capacitor C145 (0·001μF) going open-circuit, and the valve not making good contact with the holder sockets. Check also R117 (560Ω) and C116 (6·4μF) which are added in the pentode cathode circuit on 625 lines to adjust the bias, and also provide the 625-line input to the a.g.c. stage.

THORN 1400 CHASSIS

There seem to be several different things wrong with this set. First, the brightness is dark to start off with, building up to excessive brightness. Then there are two continuous white lines across the top of the screen, and about six 2in. lines running down both sides of the screen. There is also a hazy white stripe running down the full length of the left-hand side of the screen. The picture is otherwise perfect, and does not roll.

For the brightness trouble, check the 220kΩ resistor R119 which is in series with the brightness control, on the h.t. side. If this increases in value, the brightness control, which acts on the c.r.t. cathode, will have insufficient voltage to bias the tube back. For the white lines at the top, if the top is compressed adjust the top linearity control. Also try a new PCL805 if necessary. If there is no top compression, couple this fault with the vertical rulings and check the pulse components feeding the line and field flyback blanking pulses to the c.r.t. grid – C102, C103 and R134. Also ensure that the pulse winding E-D on the line output transformer is making proper contact, particularly tag D to chassis.

ITT VC200 CHASSIS

There's a slight hum from the speaker, but neither raster nor sound. The valves and c.r.t. light up normally, but R106 in the power supply section glows red hot soon after switching on. The voltage at the cathode of the h.t. rectifier is normal at around 300V, but at the anode of the PY88 there is only 80V.

There are five h.t. lines in this chassis. R106 is in series with the HT3, HT4 and HT5 lines. HT3 goes direct to the anode of the PY88 efficiency diode, with smoothing by C86 and decoupling by C133 (0·0015μF, beside the PY88). These could be shorting. Rather more likely is that one or other of the third harmonic tuning capacitors C135 and C141 (both 270pF 8kV) has gone short-circuit, thus returning the PY88's cathode to chassis. This would have put years on the life of the PY88, which should be replaced if C135/C141 is to blame.

PHILIPS G8 CHASSIS

The set sometimes takes ten minutes or more to produce a picture, though the sound always comes on correctly. While waiting, a very dark picture can be obtained by turning the brightness and contrast controls to maximum. Once the normal picture has come on there is never any need to make adjustments. The e.h.t. tripler has been changed, and the supply voltages appear to be correct.

This problem on the G8 chassis usually stems from the beam limiter circuit, of which there have been two varieties. In either case the semiconductor devices are usually responsible. In most sets there is a 12V zener diode (D5582) in the beam limiter department on the line timebase module. This is particularly prone to cause this sort of trouble. If not, d.c. voltage readings in the area while the fault is present should pinpoint the cause of the trouble.

BUSH CTV25 (Mk. III TIMEBASE)

The line drive control has been set to give adequate width and enough voltage on the focus control for good focusing. It has to be nearly fully clockwise to provide these conditions. After the set's been on for about an hour however there is continuous sparking on the focus spark gap, resulting in black lines on the picture. This can be stopped by backing off the line drive control, but the picture is then badly out of focus and cannot be improved by adjusting the focus control. All line timebase valves have been replaced, and a new e.h.t. multiplier tried.

Adjust the line drive control for 24kV at the c.r.t. final anode, then adjust the focus control for optimum focusing. Measure the resultant focus voltage with the e.h.t. meter. If this does not exceed 5·2kV and the sparking persists, clean up the spark gap and apply a smear of silicone grease. If necessary, slightly enlarge the gap using a small file.

PYE 691 CHASSIS

The picture becomes very non-linear at the top after about twenty minutes, with foldover. Any subtitles running from the bottom to the top of the screen contract to about half size at the start of the foldover area, then begin to lengthen before disappearing at the top.

The trouble could be in the field timebase or in the power supply. If the supply at plug B7 is low (should be 20V), check the 20V zener diode D52 in the power supply circuit. If the supplies are correct, the most likely trouble in the field timebase is the lower output transistor VT27.

DECCA 30 SERIES CHASSIS

The sound suddenly started to fade away, taking only about two-three seconds to fall to zero. There is now a good picture but no sound.

This trouble is usually due to the audio circuit h.t. feed resistor R82 (1·8kΩ, 5W) failing. It's beside the sound output transformer, which is on the bottom panel. Check the output pentode's cathode components (R78 390Ω, C81 22μF) and change the PCL82 if these are damaged.

ITT CVC9 CHASSIS

This set has a fault very similar to the well known striations on the left-hand side of the raster, only it's not so severe. It consists of about five half inch wide bands present on the first two and a half inches on the left-hand side of the screen. The fault appears as soon as the screen illumination comes on, and is also present on a blank, noise-free raster. I've tried all the usual components for this sort of thing – the linearity coil damping network, the line output valve's screen grid decouplers, and the line output transformer damping components – but the fault persists.

Some early production CVC9 chassis did suffer from this problem, due to a fault in the line output transformer. The modified transformers fitted to later production are coded with a blue spot.

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.

An HMV Model 2647 (Thorn 1400 chassis) arrived in the workshop with the complaints of buzz on sound and dark shaded horizontal lines on the picture. The service card indicated that the symptoms were not always present, but that when they were both were affected by the picture content – decreasing or increasing respectively with decreasing or increasing screen illumination.

The symptoms seemed to be a "cross" between front-end overload (and hence cross-modulation) and mains hum. We decided first to check the possibility of overloading, simply by severely attenuating the aerial signal fed to the receiver. But even with some 20dB attenuation – resulting in a singularly noisy display – the symptoms remained.

Attention was then directed to the main reservoir, smoothing and filter electrolytics; but these all proved to be in order, as also did the mains rectifier and the larger decoupling capacitors.

At this stage the symptoms suddenly vanished, and the picture seemed to become marginally brighter and clearer. No amount of adjustment and readjustment would cause them to reappear. It was then found that by applying mechanical pressure round by the control panel section the symptoms could be brought on again, and this time it was noted that the buzz would fall to almost zero when the brightness was fully retarded, and that the degree of buzz depended on the setting of this control and hence on the tube's beam current.

What was the most likely cause of the trouble? See next month's Television for the solution and for a further item in the Test Case *series.*

SOLUTION TO TEST CASE 177
– Page 610 last month –

When the symptom is obviously caused by lack of one primary colour from the display tube, as in last month's problem, one of the first checks should be on the emission of the appropriate gun. For grey-scale tracking the first anode of each gun is separately supplied from a high voltage source (a 900V h.t. rail in the Thorn 2000 chassis) via a preset control and a decoupling resistor and capacitor.

The junior technician found that the symptom was hardly affected when the green first anode preset was adjusted. If he had worked from there rather than going through the process of checking the standing bias on the guns he would have solved the problem sooner. The green gun itself was perfectly o.k., the trouble being caused by value increase of the 100kΩ resistor feeding the green first anode and by deterioration in the insulation of the associated 0·001μF decoupling capacitor.

In spite of the age of the receiver, the emission of all three guns was remarkably good. A brighter picture was obtained by slightly advancing three first anode presets, consistently with correct grey-scale tracking of course.

QUERY COUPON

Available until 17 October 1977. One coupon, plus a 50p (inc. VAT) postal order, must accompany EACH PROBLEM sent in accordance with the notice on page 663.

TELEVISION OCT 1977

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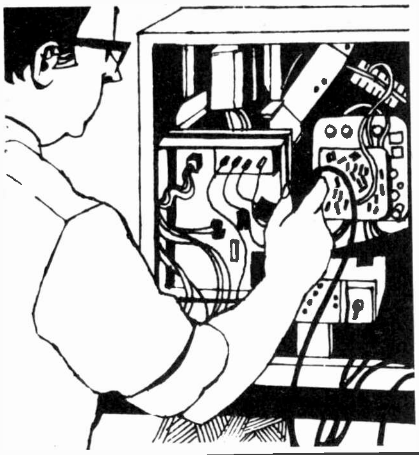

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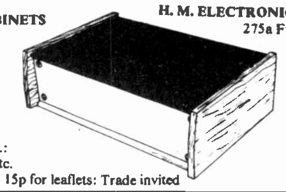

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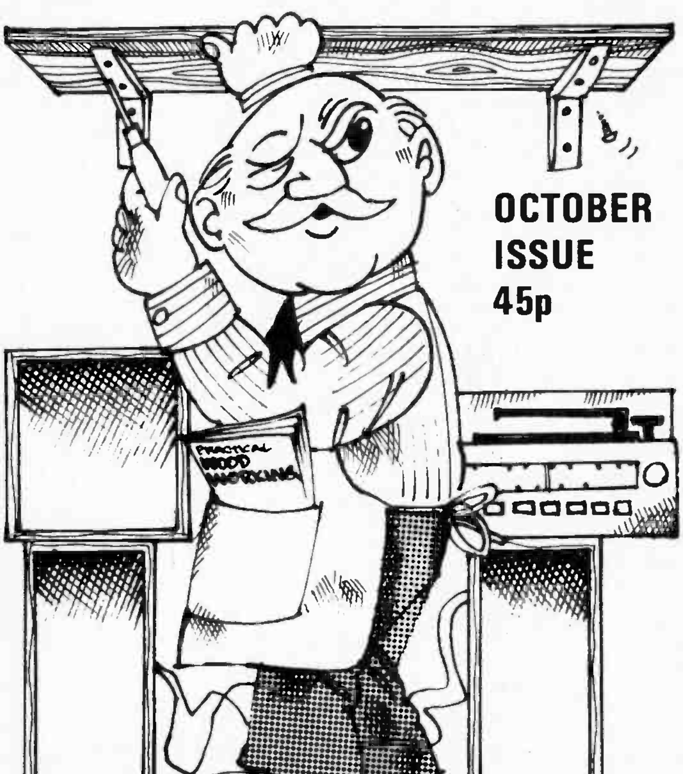

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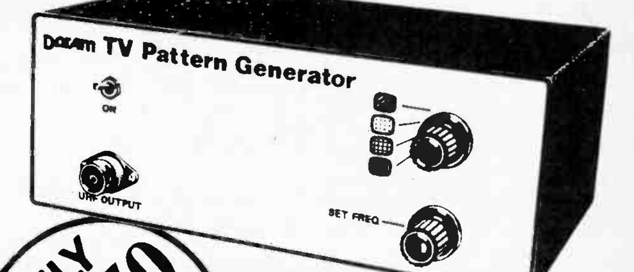

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5Z3	1.00	6GK5	0.75	85A2	0.75	ECL86	0.64	PC97	0.75	UABC80	0.45
5Z4G	0.48	6GU7	0.90	150B2	1.00	EF22	1.00	PC900	0.40	UAF42	0.70
6/30L2	0.79	6H6GT	0.30	807	1.10	EF40	0.78	PCC84	0.39	UBC41	0.50
6AC7	0.55	6J5GT	0.65	5763	1.65	EF41	0.75	PCC85	0.47	UBC81	0.55
6AG7	0.60	6J6	0.35	AZ31	0.60	EF80	0.29	PCC89	0.49	UBF80	0.50
6AH6	0.70	6JU8A	0.90	AZ41	0.50	EF83	1.25	PCC189	0.52	UBF89	0.39
6AK5	0.45	6K7G	0.35	DY51	2.00	EF85	0.36	PCF80	0.80	UC92	0.50
6AM8A	0.70	6K8G	0.50	DY86/7	0.45	EF86	0.50	PCF82	0.45	UCC85	0.45
6AN8	0.70	6L6GC	0.85	DY802	0.50	EF89	0.42	PCF86	0.57	UCF80	0.80
6AQ5	0.68	6L7(M)	1.50	E80CF	5.00	EF91	0.70	PCF200	1.35	UCH42	0.71
6AR5	0.80	6Q7G	0.50	E88CC	1.20	EF92	0.50	PCF201	1.00	UCH81	0.50
6AT6	0.50	6SA7	0.55	E180F	1.15	EF183	0.42	PCF801	0.49	UCL82	0.55
6AU6	0.40	6SG7	0.55	E188CC	2.50	EF184	0.42	PCF802	0.75	UCL83	0.57
6AV6	0.50	6V6G	0.50	EA50	0.40	EH90	0.45	PCF805	2.25	UF41	0.70
6AW8A	0.84	6X4	0.65	EABC80	0.40	EL34	1.25	PCF806	0.53	UF42	0.80
6AX4	0.75	6X5GT	0.45	EAF42	0.70	EL41	0.57	PCH200	1.00	UF80	0.40
6BA6	0.40	9D7	0.70	EAF801	0.75	EL81	0.70	PCL82	0.54	UF85	0.50
6BC8	0.90	10C2	0.70	EB91	0.20	EL84	0.35	PCL83	0.49	UF89	0.52
6BE6	0.40	10DE7	0.80	EBC41	0.75	EL86	0.60	PCL84	0.46	UL41	0.70
6BH6	0.70	10F1	0.67	EBC81	0.45	EL95	0.67	PCL86	0.65	UL84	0.54
6BJ6	0.65	10F18	0.65	EBF80	0.40	EL360	1.80	PCL805	0.60	UM80	0.60
6BK7A	0.85	10P13	0.80	EBF89	0.40	EL506	1.20	PFL200	0.70	UY41	0.50
6BN8	1.00	10P14	2.50	EC86	0.84	EL509	2.50	PL33	1.00	UY85	0.35
6BQ7A	0.60	12AT6	0.45	EC88	0.84	EM80	0.55	PL36	0.60	U19	4.00
6BR7	1.00	12AU6	0.50	EC92	0.55	EM81	0.60	PL81	0.49	U25	0.71
6BR8	1.25	12AV6	0.60	ECC33	2.00	EM84	0.45	PL81A	0.53	U26	0.60
6BW6	1.70	12BA6	0.50	ECC35	2.00	EM87	1.10	PL82	0.37	U191	0.50
6BW7	0.65	12BE6	0.55	ECC40	0.90	EY51	0.45	PL83	0.45	U301	1.00
6BZ6	0.60	12BH7	0.55	ECC81	0.48	EY81	0.45	PL84	0.50	U404	0.75
6C4	0.50	12BY7	0.85	ECC82	0.48	EY83	0.60	PL504	0.90	U801	1.00
6CB6A	0.50	13D8	2.00	ECC83	0.48	EY87/6	0.37	PL508	1.30	VR105	0.50
6CD6G	1.60	19AQ5	0.65	ECC84	0 35	EY88	0.55	PL509	2.20	VR150	0.75
6CG8A	0.90	19G6	6.50	ECC85	0.50	EY500	1.45	PL519	2.80	X41	1.00
6CL6	0.75	19H1	4.00	ECC86	1.25	EZ40	0.52	PY33/2	0.50	Z759	5.85
6CL8A	0.95	20P1	1.00	ECC88	0.72	EZ41	0.52	PY80	0.50		
6CM7	1.00	20P4	0.84	ECC807	2.80	EZ80	0.35	PY81	0.50		
6CU5	0.90	30C15	0.77			EZ81	0.40	PY82	0.40		

All goods are unused and boxed, and subject to the standard guarantee. Terms of business: Cash or cheque with order only. Despatch charges: Orders below £25, add 50p extra per order. Orders over £25 post free. Same day despatch. Terms of business available on request. Any parcel insured against damage in transit for only 5p extra per parcel. Many other types in stock. Please enclose S.A.E. with any enquiries. Special offer of EF50 VALVES, SOILED, BUT NEW AND TESTED £1 EACH.