JULY 1977

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TELEVISION

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tv games in colour

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Bridge Rectifier 1 amp 100V 20p

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69 161R
147 260R 25w 20p

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ISOLATING SOCKET
VHF
UHF 40p

MJE2021
SJE5451 15p EACH
90V 80W 5A

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18Kv and 20Kv Rectifier Sticks and Base and Anode Lead
40p 18Kv 50p 20Kv

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BA182 12 for £1.00 Each Pack

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Thyristors RZ427 300V 5A 27p

Thyristors RCA 40506 50p

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·044 MFD 1000v }
·1 MFD 1000v }
·047 MFD 1000v } 8p EACH
·0047 MFD 1000v }
·01 MFD 1000v }
·47 MFD 1000v 15p

E.H.T. Rectifiers used in triplers (G770/HU37) 3 off 15p

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X80/150	12p
CSD118XPA	15p
CSD118XMH	15p

Thorn Mains on/off Switch 15p

200+150+50M 300V	50p
1000+2000M 35V	20p
100+200M 325V	30p
200+200+100 325V	40p
200+100+50+100 325V	40p
150+200+200M 300V	70p
200+100+100M 350V	70p
200+200+100+32 350V	70p
400+400 200V	40p
800M 250V	40p
200+100+100+50 300V	40p
200+200+150+50 300V	£1

180PF 8Kv	10M 350v
1000PF 10Kv	100M 50v
1200PF 10Kv	330M 10v
1000PF 12Kv	330M 25v
160M 25v	330M 35v
220M 25v	330M 50v
1000M 16v	330M 63v
220M 35v	470M 25v
220M 40v	470M 35v
220M 50v	470M 40v
470M 25v	10p
22M 315v	EACH

BF127 BF178
BF264 BC350
BF180 BF121 } 15p EACH
BF181 BF257
BF182 BF137
BC300 BC161

BU105 ex panel	50p
BU105 new	£1.00
BU105/04 new	£1.50
BU126 ex panel	50p
BU205 new	£1.90
BU208 new	£2.00
2N3055 new	45p
BD116 new	30p
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R2030 new	75p
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TAA550	30p
TBA510	£1.00
TBA480Q	£1.00
TBA550Q	£1.50
TBA720A	£1.50
TBA790B131	£1.00
TBA800	95p
TBA920	£2.00
TAA700	£2.00
TBA530Q	£1.00
TBA550	£2.00
SN76544N	50p
SN76640N	£1.00
SAA570	50p
TBA120A	50p
TCA270Q	£2.00
TCA270SQ	£2.00
IN4005	5p

100M 100V	4M 350V	1000M 35V	12½p EACH
470M 100V	470M 50V	1000M 40V	
32 + 32M 350V	250M 64V	1000M 50V	
470+470M 250V	75p	4700M 30V	25p

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100 Green Polyester Condensers. Mixed Values. £2.00 per 100.

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TELEVISION

July 1977

Vol. 27, No. 9
Issue 321

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

BINDERS AND INDEXES

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QUERIES

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

this month

OUR NEXT ISSUE DATED AUGUST WILL BE PUBLISHED ON JULY 18

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NOW AVAILABLE EX-RENTAL MONO AND COLOUR TV's FOR SALE

Type	Price (£)
AC107	0.20
AC113	0.17
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AC117	0.24
AC125	0.20
AC126	0.20
AC127	0.22
AC128	0.20
AC131	0.13
AC141	0.22
AC141K	0.27
AC142K	0.27
AC151	0.17
AC165	0.16
AC166	0.16
AC168	0.17
AC176	0.20
AC186	0.16
AC187	0.24
AC187K	0.28
AC188	0.21
AC188K	0.28
AD130	0.50
AD140	0.60
AD142	0.60
AD143	0.60
AD145	0.50
AD149	0.60
AD161	0.50
AD162	0.50
AD161	1.30
AD162	1.30

Type	Price (£)
AF106	0.42
AF114	0.22
AF115	0.22
AF116	0.22
AF117	0.22
AF118	0.43
AF121	0.43
AF124	0.23
AF125	0.25
AF126	0.25
AF127	0.27
AF139	0.35
AF151	0.24
AF170	0.29
AF172	0.20
AF178	0.55
AF180	0.60
AF181	0.44
AF239	0.40
BC107	0.14
BC108	0.14
BC109	0.14
BC113	0.12
BC114	0.12
BC115	0.12
BC116	0.14
BC117	0.14
BC119	0.27
BC125	0.15
BC126	0.15
BC136	0.17
BC137	0.17

Type	Price (£)
BC138	0.17
BC139	0.23
BC140	0.25
BC141	0.24
BC142	0.24
BC143	0.23
BC147	0.10
BC148	0.10
BC149	0.10
BC153	0.15
BC154	0.15
BC157	0.15
BC158	0.14
BC159	0.14
BC160	0.24
BC161	0.24
BC167	0.13
BC168	0.13
BC169C	0.14
BC171	0.13
BC172	0.13
BC173	0.15
BC177	0.16
BC178	0.17
BC179	0.17
BC182L	0.11
BC183L	1.11
BC184L	0.11
BC186	0.25
BC187	0.25
BC209	0.13
BC212	0.13

Type	Price (£)
BC213L	0.13
BC214L	0.13
BC249	0.31
BC281	0.17
BC262	0.20
BC263B	0.20
BC267	0.19
BC301	0.30
BC302	0.30
BC307A	0.12
BC308A	0.12
BC309	0.14
BC547	0.11
BC548	0.11
BC549	0.11
BC557	0.11
BD112	0.50
BD113	0.65
BD124	1.00
BD131	0.39
BD132	0.39
BD133	0.39
BD135	0.35
BD136	0.35
BD137	0.35
BD138	0.40
BD139	0.40
BD140	0.40
BD222	0.40
BDX22	0.73
BDX32	1.90
BDY18	0.75

Type	Price (£)
BDY60	0.80
BF115	0.23
BF121	0.30
BF154	0.14
BF158	0.20
BF159	0.20
BF160	0.19
BF163	0.30
BF164	0.20
BF167	0.21
BF173	0.23
BF177	0.26
BF178	0.33
BF179	0.29
BF180	0.31
BF181	0.29
BF182	0.35
BF183	0.33
BF184	0.23
BF185	0.23
BF186	0.30
BF194	0.11
BF195	0.11
BF196	0.13
BF197	0.13
BF199	0.17
BF200	0.28
BF216	0.12
BF217	0.12
BF218	0.12
BF219	0.12
BF220	0.12

Type	Price (£)
BF222	0.12
BF221	0.21
BF256	0.37
BF258	0.42
BF259	0.47
BF260	0.24
BF262	0.32
BF263	0.25
BF271	0.18
BF273	0.17
BFX84	0.27
BFX85	0.26
BFX88	0.26
BFY37	0.22
BFY51	0.25
BFY52	0.25
BFY53	0.27
BFY55	0.27
BHA0002	1.90
BR100	0.32
BSX20	0.23
BSX20	0.23
BSX76	0.23
BSY84	0.36
BT106	1.10
BU105/04	2.00
BU126	1.65
BU208	2.45
OC22	1.10
OC23	1.30

Type	Price (£)
OC24	1.30
OC25	0.45
OC26	0.40
OC28	0.60
OC35	0.45
OC36	0.58
OC38	0.43
OC42	0.45
OC44	0.18
OC45	0.18
OC46	0.35
OC70	0.22
OC71	0.22
OC72	0.30
OC74	0.35
OC75	0.35
OC76	0.35
OC77	0.50
OC78	0.13
OC81	0.20
OCB10	0.14
OC82	0.20
OC820	0.13
OC83	0.22
OC84	0.28
OC85	0.13
OC123	0.20
OC169	0.20
OC170	0.22
OC171	0.27

Type	Price (£)
IC's	
SN76013N	1.48
SN76013ND	1.20
SN76023N	1.50
SN76023ND	1.20
SN76226DN	1.50
TBA341	0.97
TBA520Q	1.75
TBA530Q	1.55
TBA540Q	1.75
TBA560CQ	1.90
TBA570Q	1.75
TBA800	1.12
TBA810	1.50
TBA920Q	2.00
TBA990Q	1.85
TCA270SQ	1.75

Type	Price (£)
VALVES	
DY87	0.40
DY802	0.48
ECC82	0.42
EF80	0.40
EF183	0.50
EF184	0.50
EH90	0.60
PC86	0.70
PC88	0.70
PCC89	0.55
PCC189	0.60
PCF80	0.50
PCF86	0.58
PCF801	0.60
PCF802	0.70
PCL82	0.60
PCL84	0.55
PCL86	0.60
PCL805	0.60
PFL200	0.70
PL36	0.85
PL84	0.52
PL504	0.90
PL509	1.50
PY88	0.52
PY500A	1.00
PY801	0.50

E.H.T. TRAYS

MONOCHROME

950 MK2 1400	2.26
1500 18" 19" stick	2.37
1500 24" 5 stick	2.48
Single stick Thorn T.V. 11.16K 70V	0.75

E.H.T. TRAYS COLOUR

Pye 691,693	4.41
Decca (Large screen)	5.67
GEC C2110	5.77
GEC Hybrid C.T.V.	5.57
Thorn 3000/2500	5.77
Thorn 8000	2.42
Thorn 8500	4.73
GEC TVM25	2.50
ITT/KB CVC5	5.96
Philips 58 520 Series	5.96
RRI (RBM) A823	6.09

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★ **MONO AND COLOUR T.V.'s ALWAYS AVAILABLE FOR EXPORT TO ANY COUNTRY**

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All Mono valves supplied at 10p each + 20p p.p.
Many colour valves supplied. Please enquire for prices.
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TELETEXT 77, MANOR SUPPLIES NEW ASSEMBLY KIT. AERIAL INPUT COLOUR, MIXED 'OFF AIR' & TELETEXT, NEWSFLASH, ETC. DEMONSTRATION MODEL IN OPERATION.
NEW! COMBINED COLOUR BAR GENERATOR AND CROSS HATCH UNIT KIT, MK. 4 AERIAL INPUT, ALSO GIVES R-Y, B-Y AND OTHER FUNCTIONS **£35.00** p.p. 85p.*
NEW! COLOUR BAR GENERATOR KIT, MK. 3 (FOR ADDITION TO MANOR SUPPLIES CROSS HATCH UNITS) AERIAL INPUT, ALSO GIVES R-Y, B-Y AND OTHER FUNCTIONS **£25.00** p.p. 85p.*
CROSS HATCH UNIT KIT, AERIAL INPUT TYPE, INCL. T.V. SYNC AND UHF MODULATOR. BATTERY OPERATED. ALSO GIVES PEAK WHITE & BLACK LEVELS. CAN BE USED FOR ANY SET **£11.00** + 45p. pp.* COMPLETE TESTED UNITS, READY FOR USE (DE-LUXE CASE) **£18.00** p.p. 75p.*
NEW GREY SCALE KIT, ADDS ON TO ABOVE CROSS HATCH KITS AND UNITS **£2.90** p.p. 25p.*
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"TELEVISION" COLOUR SET PROJECT. MARK II DEMONSTRATION MODEL WITH LATEST IMPROVEMENTS. WORKING AND ON VIEW, LISTS AVAILABLE.
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SPECIAL OFFER I.F. Panel, leading British maker, similar design to "Television" panel. Now in use as alternative inc. circuit and connection data, checked and tested on colour **£12.80** p.p. 80p. Also **DECODER** panel checked and tested on colour, full details, **£16.80** p.p. 85p.
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PHILIPS G6 single standard convergence panel, incl. 16 controls, switches etc., and circuits **£3.75** p.p. 75p, or incl. yoke, **£5.00. PHILIPS** G8 panels for spares, decoder **£2.50** p.p. 75p. Field/line osc. **75p** p.p. 35p.
VARICAP, Mullard ELC1043 UHF tuner **£4.20**, ELC1043/05 **£5.50,** G.I. type (equiv. 1043/05) **£3.50** p.p. 30p. UHF & VHF salvaged varicap tuners **£1.50.** Control units, 3PSN **£1.25**, 4PSN **£1.80**, 5PSN **£2.30. Special** offer 6PSN **£1.00**, 7PSN **£1.80** p.p. 25p. TAA 550 **50p** p.p. 15p.
VARICAP VHF PHILIPS £3.80, ELC1042 **£4.80**, p.p. 30p, ELC1042 on PYE P.C.B. **£5.40,** Plug in 6 posn. control unit **£2.50** p.p. 65p.
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UHF/625 Tuners, many different types in stock. Lists available. UHF tuners transistd. incl. s/m drive, indicator **£3.85**; 6 posn. or 4 posn. push-button **£4.20** p.p. 85p. Integrated tuners **BUSH, DECCA, PYE 40** 6 posn. **£4.50** p.p. 90p. AE ISOL **30p** p.p. 20p.
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TBA "Q" I.C.s. 480, 530, 540, **£2.20,** 550, 560C, 920 **£3.20** p.p. 15p.
HELICAL POTS, 100K. 4 for **£1.20** p.p. 20p.
BRC 1500 Mains Droppers, two for **90p** p.p. 40p.

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- BUSH 105 to 186SS, etc. **£6.40**
- DECCA DR1, 2, 3, 121/123, 20/24, etc. **£6.40**
- DECCA MS2000, 2400 **£5.80**
- FERG., HMV, MARCONI, ULTRA 850, 900, 950I **£7.30**
- 950II, 1400, 1500, 1590 **£5.90**
- GEC 2000, 2047 series, etc. **£6.20**
- ITT/KB VC2 to 53, 100, 200, 300 **£6.20**
- MURPHY 849 to 2417, etc. **£6.40**
- PHILIPS 19TG121 to 19TG156 **£3.80**
- PHILIPS 19TG170, 210, 300 **£6.20**
- PYE 11U, 368, 169, 769 series **£6.20**
- PYE 40, 67 series (36 to 55) **£3.80**
- PAM, INVICTA, EKCO, FERRANTI equivalents as above.
- SOBELL 1000 series **£6.20**
- STELLA 1043/2149 **£6.20**

SPECIAL OFFERS

- BUSH TV53/86/95/99 **£1.00**
- EKCO 380 to 390 **£1.00**
- EKCO 407/417 **£1.00**
- FERR. 1084/1092 **£1.00**
- FERG. 506 to 546 **£1.00**
- GEC 448/452 **£2.50**
- KB VCI, VCII (003) **£2.80**
- P/SCOTT 733 to 738 **£1.00**
- REG 10-6, 10-17 etc. **£1.00**
- SOBELL 195/282/8 **£2.50**

MANY OTHERS STILL AVAILABLE

COLOUR LOPTS p.p. 85p.

- BUSH 182 to 1122 etc. **£7.60**
- MURPHY Equivalents **£7.60**
- DECCA "Bradford" (state Model No. etc) **£7.80**
- GEC 2028, 2040 **£9.20**
- PYE 691, 693, 697 **£15.80**
- THORN 8500 **£8.50**

THORN 850 Time Base Panel, Dual Standard **50p** p.p. 75p.
MULLARD Scan Coils Type **AT1030** for all standard mono 110° models, Philips, Stella, Pye, Ekco, Ferranti, Invicta **£2.00** p.p. 75p.
PHILIPS G8 Tripler (1174) **£6.00** p.p. 75p. Others available.
6·3V CRT Boost Transformers **£2.90** p.p. 75p., Auto type **£1.80** p.p. 45p.

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(Near W. Hampstead tube stn: 28, 59 159 Bus Routes) 01-794 8751

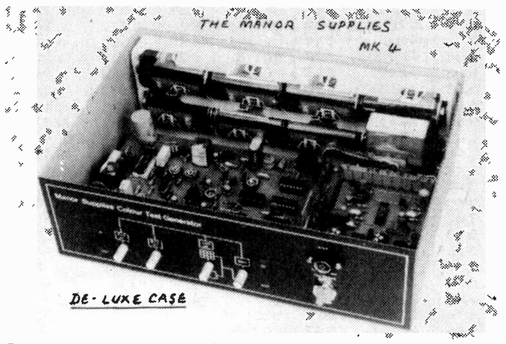
Mail Order: 64 GOLDERS MANOR DRIVE, LONDON N.W.11.

PLEASE ADD 12½% VAT TO PRICES (EXCEPT * 8%)

MANOR SUPPLIES

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 + 85p P/Packing.
CASES, ALUMINIUM £1.80, DE-LUXE £4.80, BATT. HOLDERS 78p + 8% VAT.

ALSO THE MK3 COLOUR BAR GENERATOR KIT FOR ADDITION TO MANOR SUPPLIES CROSS HATCH UNITS.

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TELEVISION

Lionel Howes

We regret that due to his continuing ill health Lionel Howes, editor since October 1974, has had to relinquish the position. We are sure that readers and his many friends will join us in wishing him a speedy recovery to good health. It is hoped that he will be able to continue his involvement with the magazine at a later date.

COVER PHOTOGRAPH

Our thanks to Thorn Consumer Electronics Ltd. for the loan of the Ferguson Model 3738 colour set shown on the cover displaying the TV Games project featured in this issue.

FOLLOW THAT CIRCUIT!

A well known technical publisher used to use the slogan "books are tools". If you think that this is maybe far-fetched, just consider how often you have to refer to data of one sort or another, or a service manual when the fault you're dealing with won't respond to the normal checks and you've gone as far as you can with visual examination and prodding around. Practical works of reference are indeed tools in that they contribute to the process of successfully carrying out a repair.

The most useful tool of this sort is of course the service manual, and here above all else the circuit diagram is the item that contributes most in guiding you to a successful conclusion. There are many times when even the most experienced engineer can't get any farther without a study of the relevant circuit. This is much more likely to be the case if the set he's dealing with is one that he hasn't encountered all that often before – or perhaps not at all. With sets of foreign origin the problem is even greater. Take the back off one of those reliable Japanese sets that has at last succumbed to some sort of ailment and you're likely to be confronted with a mass of printed circuit boards of various shapes and sizes, interlinked by a labyrinth of multi-coloured wires. In this situation it's advisable to consult the circuit diagram first, to ascertain just what sort of circuit you're going to have to poke around in.

So we're back to circuit diagrams being tools. And the point we'd like to make here is that there are always good tools and bad tools and that this is nowhere less so than in the case of circuit diagrams. Considering that they all show how the same basic sorts of components are connected together it's quite extraordinary the degree of variation one finds. Some circuits are so logically and clearly laid out that one can see almost instantly where the power supplies come from and go to and the progress of the signals from the input to the output. Good tools! At the other extreme one comes across circuits that are so obscure that one is never quite sure without a lot of chasing along lines with a fine tipped instrument – the writer uses a small scapel – whether one is following a power supply or a signal path, let alone a feedback path, pulse path or something like a blanking or beam limiting arrangement. Indeed there is one oriental setmaker who issues circuits where even the main power supply paths can take an age to trace, whether you're going from the power supply panel to the fault area or vice versa. The supply wanders from board to board, splitting up to go hither and thither, sometimes going off a board and then going back in again at another point, and so on. A very bad tool, even if the voltages are clearly shown!

Is there anything that can be done about this? Perhaps it's getting too late in the day, since TV circuits are getting simpler all the time and if the concentration on i.c.s goes much further they'll soon consist of a very few items whose purpose is quite clear. But for some reason or another a resurgence of complexity always seems to occur. Your colour TV circuits may suddenly start to look like glorified crystal sets: but what about the VCRs and Teletext decoders you're going to have to deal with next? No, it's not too late to air the matter once more.

The fact is that most circuits are built up from basic "building bricks" which require standard inputs and outputs and the normal power supply connections. Transistor amplifiers may be of the common-emitter, common-base or emitter-follower configuration, may use pnp or npn transistors and may be powered from positive or negative rails. But there still has to be an input, a power supply, biasing and a load. And these can be drawn in standard ways. The same point can be made about most other discrete circuitry, oscillators, switches and so on. And however complex they are, it is possible to draw feedback paths, pulse shaping networks and so on quite clearly. The problem is greater with i.c.s, since you can't see what is lurking behind a particular pin. A block diagram within the i.c. block is the answer, but is not always practicable. But even without it, the links to the following and preceeding i.c.s, the power supply feeds and external controls and time-constant or tuning circuits can be drawn clearly. All too often however they're not.

To get any order – and that's what's required – into all this some general and internationally accepted guidance is necessary. There have been attempts in the past – rather distant past now unfortunately – to lay down basic guide-lines. Simple potential divider, bias networks, load circuits, cross-couplings and so on can and should be drawn in a standard manner. Is it the training of draftsmen, or the engineers who brief them, or what that results in simple circuitry being drawn in unnecessarily confusing ways? Some basic guide-lines could at least be hammered home – though probably no one would agree as to what exactly they should be! What's certain is that we do need this improvement to one of our most essential tools.

In Puffed a Couple of Chaps...

Les Lawry-Johns

WE had a couple of Japanese portables in recently, both with cracked tubes. What a pricey job this is. One is well advised to check the current price of these tubes, plus the VAT, plus the carriage, etc. before giving an estimate. Anyway, we had just about wrapped these up and were wondering why these Far Eastern jobs have such heavy mains leads – one of them could have easily run a washing machine, the other tied up the QE2 – when a van pulled up outside.

In puffed a couple of chaps carrying a large Ultra colour set. We chatted about this and that and it transpired that the trouble with the set was "a poor picture with lines shooting across it." Having arranged a convenient time to collect it, the owner and his son in law departed, leaving us with what appeared to be a straight-forward job. Unfortunately, having got the set on the bench we found that one or two other things appeared to be wrong. To be quite candid about it, and with the benefit of hindsight, practically every nightmare that can afflict a Thorn 3000 chassis was present on this one. So sharpen your pencils and take a few notes. Who knows, the same (not all we hope!) may happen to you!

No Raster

With the set up on the bench there was neither picture nor raster, but there was a funny arcing noise every now and again from the beam limiter board. On trying to take a voltage measurement across R907 (see Fig. 1) we found that it was loose. This is one of the key test points on the chassis as it shows the current taken by the line output stage: the voltage across the 1·5Ω resistor should be 1·3V if all is well. If the reading is higher, either the timebase is taking too much current or the resistor has risen in value. You may say that a low-value wirewound resistor does not change value. But it can, and has on more than one occasion to cause loss of brightness. This time however it was loose and the solder had decomposed.

We soon made this good and confidently switched on. Nothing doing, no voltage here at all. We then checked that the supply was in order, on the power board – about 60V at F603 – and followed the supply along to the collector of the line output transistor. Upon looking at the underside of the transistor however we found some hideous blobs of solder on the base and emitter pins, and touching these with a screwdriver brought the e.h.t. crackling up. Switching off we also noticed some drops of solder on the decoder board, which is underneath. So we dutifully cleaned off the transistor pins, made good the soldering, and cleaned up all (we thought) the little bits of solder on the board.

The Tearing Lines Appear

Now on switching the set on the e.h.t. and raster appeared but on plugging in an aerial there was only a very poor monochrome picture (in a nice shade of yellow) with severe interference in the form of tearing lines. This was what the man had said of course: the rest must have resulted from vibration during handling showing up the dry-joints.

So we next turned our attention to the left side i.f. panel. Now you cannot quarrel with the layout of this panel. The transistors are clearly marked and are easily found, along with all associated components. A pleasure to work on.

We were not certain of the nature of the fault, and decided therefore to short out the input signal and see if there would be any sign left of the disturbance. Connecting an 0·01μF capacitor from the base of the first i.f. transistor VT101 (see Fig. 2) to either its emitter or to chassis would, we thought, knock out the signal. It didn't, but resulted in a lovely clear picture, free of interference. Oh dear. Taking off the capacitor brought back the interference and the poor picture. For the want of something better to do we then used it to short the collector to chassis. Lovely picture!

We then concluded that we were up against an a.g.c. fault or an open-circuit decoupler in the supply line. Checking the latter didn't help much but bridging C179 seemed to help – bridging it with an electrolytic that is, not with the 0·01μF capacitor, twit. Moving down the chassis, we next bridged C134 and this cleared the condition. Now when the base of VT101 was bridged with the 0·01μF capacitor the

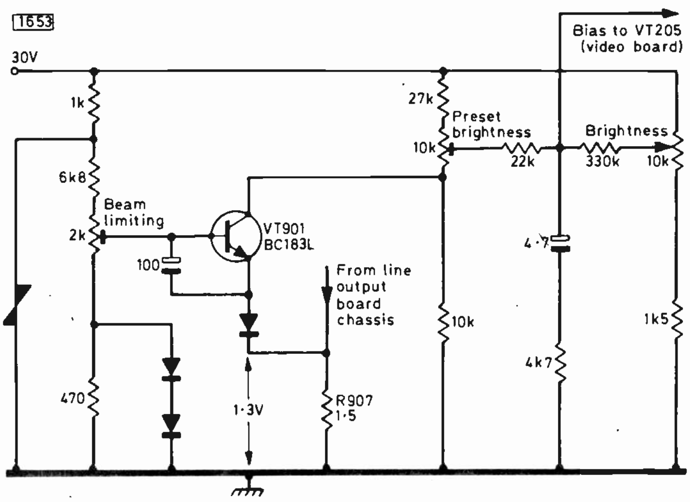

Fig. 1: The beam limiter circuit, Thorn 3000/3500 chasis.

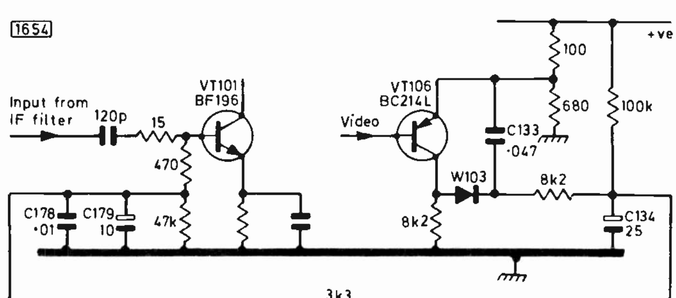

Fig. 2: The first controlled i.f. stage VT101 and the a.g.c. detector/amplifier transistor VT106. C134 was omitted in later production chassis.

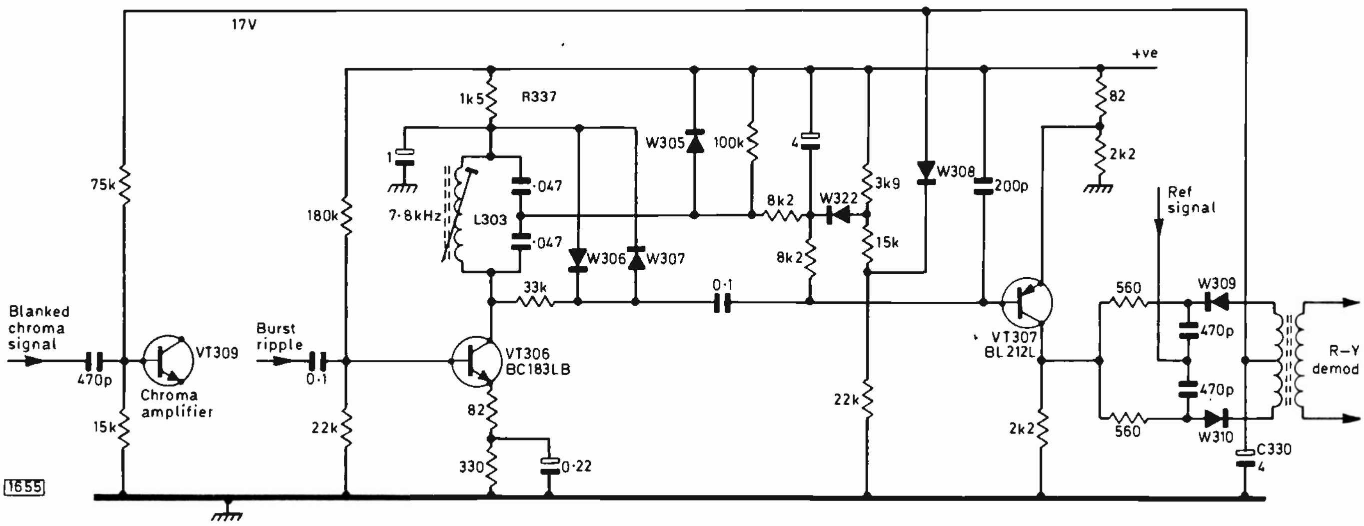

Fig. 3: The chroma turn-on bias is derived from the PAL switch circuit, which is driven by the ident amplifier VT306.

signal disappeared as it should have done in the first place (oh the complexity of it all).

Getting the Colour Back

We now had a clear picture in what should have been black and white with no trace of colour. Taking the opportunity, we set up the gray scale with the first anode potentiometers and the drive controls until the monochrome picture looked respectable, and then turned our attention to the decoder board. Most voltages were, well, not too far out, but there was a complete absence of turn-on voltage at the base of the chroma amplifier VT309 (Fig. 3). Ah ha, we said. Nipping smartly over to the PAL switch driver/chroma bias generator transistor VT307 we found no voltage at its emitter. The network of diodes connected in its base circuit caused us to have a momentary mental blackout, so we broke off for a cup of coffee.

Refreshed, we returned to the fray and found that there was now no voltage at the collector of the ident amplifier VT306, whereas this voltage had been about right earlier. A niggling doubt crept in. If the collector voltage had been there earlier, the chances were that the turn-on voltage for the chroma amplifier had also been there. If so, why had there been no colour? Dismissing these dismal thoughts, we investigated the supply to VT306. R337 had its 30V at one end but there was a dead short to chassis at the other. Looking at the circuit showed this to be unlikely from a component point of view, so we took the plastic cover off L303 and there was a thin sliver of solder which had somehow got under the cover during the manhandling process, having laid dormant and harmless for many moons after having dropped down from the previously mentioned clumsy soldering of the line output transistor. Being under cover, it had escaped our eagle eye. With the short removed however there was still no colour and the voltages, although much nearer, were still not right.

It was obvious that the trouble was now leading us back to the burst detector, and much time was spent checking and rechecking as the colour burst came in all right but petered out at the emitter of the burst detector driver VT302. Just at that moment my good friend Ray came on the scene. We poured out our troubles. "Can't say I've had much trouble with decoder boards on this chassis", said Ray helpfully. He suggested that since the detector coil L301 didn't tune there may be some solder under that one too. We shook our head. Couldn't get in there.

I went to see if the coffee pot was still going, and left Ray playing. A shout of triumph brought me hurrying helter skelter. Ray had taken the cover off L301 and there it was: a spot of green on one of the wires, which parted when touched. Again disturbed by the manhandling? Red faced and ashamed, I muttered that I had been about to investigate the condition of L301 when he came in but that nevertheless he was a fine fellow and a valued friend.

Having reset L301 after repairing it, glorious colour was displayed. "OK now?" Ray asked irritatingly. "I'll just borrow an indoor aerial and be on my way".

The Picture and Sound Vanish

When the smirking idiot had gone, we subjected the set to a simulated manhandling process – just in case. The picture and sound vanished. No chopper output, no 30V line, all fuses intact. Wearily we returned to the fray. We spent some time looking for dry-joints etc. The 30V stabiliser transistor VT601 was OK (Fig. 4), with voltage at its collector. But there was nothing at its base to turn it on. Check C609, but this normally causes ragged verticals when defective, and it wasn't shorted. Check the zener W605. No shorts. Come back Ray, you're not an idiot, I don't mind if you do smirk.

Wait a minute though, have another look at the supply to VT601. Not quite right is it? Check C607. Open-circuit. Replace. All's well. I'm rather glad he didn't come back.

We delivered the set ourselves, and very carefully too.

Effects of Age

As these 3000 and 3500 chassis begin to feel their age,

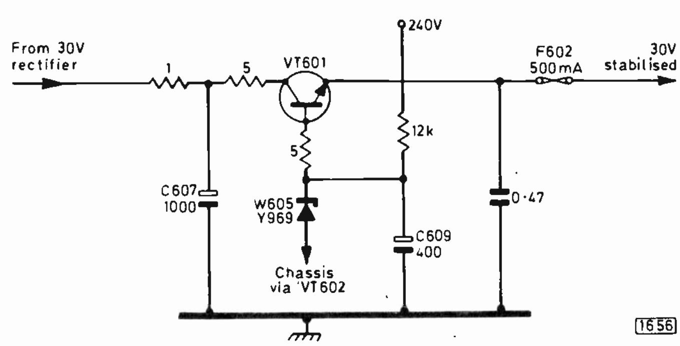

Fig. 4: The 30V stabiliser circuit.

the previous well known list of stock faults apply a little less and one now encounters the effects of heat over an extended period, corroding contacts etc. – as indeed we mentioned in the case of R907 on the beam limiter board. It's also worth while having a look at the timebase board, which is revealed in part when the beam limiter board is lifted. Particularly in older models, there is often quite a bit of corrosion around L502 and R528, whether W507 is fitted or not – these components are in the power supply feed to the line driver and output stages. A clean up job here can save trouble later.

Similar remarks apply to the power supply board, where the wirewound resistors are now tending to part company with the print – and it must be admitted that it's not easy to work on the underside of this panel. Our experience shows that the items likely to require replacement on the power supply panel are the chopper transistor itself (VT604) – remember to check its insulating washer, which can be punctured, and clear away any corrosion – the wirewound resistors (check all for continuity), the electrolytic capacitors (particularly C607), the 30V zener W605, and transistors VT601 (30V stabiliser) and VT605 (chopper driver). Smaller components likely to escape attention but which we've found troublesome include C631 (0·01μF) in the driver's collector circuit and C622 (0·022μF) and W618 in the feedback amplifier circuit.

Whilst line output stage failure due to faulty line output transistor(s) or the tripler is pretty obvious and easily checked (for example by merely pulling off the tripler lead from the transformer) there are other and more obscure line timebase troubles. For example, intermittent loss of line hold is often due to the small electrolytics C506 and C511 playing about. The two can be replaced in moments and there is no point in holding a conference about whether they are faulty or not or which. Oh yes, when soldering the line output transistor(s) make sure that no solder falls on the decoder panel...

The convergence panel has been subjected to considerable alteration as far as the layout is concerned, but the same basic comments apply. A little scorching here and there, shorted diodes or electrolytics, defective potentiometers and of course our old friends the first anode switches which tend to leak, thereby robbing the relevant c.r.t. first anode of its voltage and resulting in the absence of that colour (usually green, remember . . . ?).

We have said that the sudden drop out of a certain colour is often due to low first anode voltage on the c.r.t. gun concerned. The trouble is quite often that one colour comes up far too bright however, so that all that can be seen is an almost blank screen of that colour, making it difficult to see picture information contributed by the other two colours. A quick check at the tube cathodes will often reveal that although there may be about 160V on two of them there is precious little at all on the other. This immediately throws suspicion on the collector load resistor of the output transistor concerned. Earlier models used separate wirewound resistors (R250, R264 and R277). Later versions use a pack with four lead-out wires, enabling the unit to be stood off the panel. It appears that this thick-film unit is not as reliable as was at first hoped, and we fit separate resistors as required.

Intermittent Colour Drop Out

This is not a servicing article on the 3000 chassis however, so we had better not carry on too much about these sets. We have a 9000 series set which suffers from intermittent colour drop out. The slightest vibration restores colour (you've only got to blow on the cabinet and the colour comes back) and you can't make it go off no matter what. All plugs, sockets, leads and soldered connections have been checked, probed and prodded. No result. The colour stays for hours after intensive searching and then drops out. Can you hear me Ray? Rayyyy . . .

A Simple Soldering-Iron Stand

Malcolm Burrell

ACCIDENTS with hot soldering irons can be annoying at the least and both expensive and embarrassing at the most! In the home workshop, on the kitchen table or in the field some form of stand is desirable. The one shown here is just as efficient as many commercial models and was devised and built in half an hour.

It consists of a length of tubing, for example $\frac{7}{8}$in. aerial mast, hammered flat at one end which then has two holes drilled in it so that the tubing can be mounted on a stout block of wood or screwed directly on to the bench. All sorts of variations are possible. A double unit to accommodate both a standard and a small low-wattage iron can be constructed for example, while a length of tubing mounted in the tool box provides a convenient stand which will protect other tools – and customers' carpets!

A hardboard cheek can be mounted on the lid of the tool box so that a long lead can be stored on the outside, giving more space for tools and essential spares inside. If the electrical installations in your area are not too diverse, fit a plug to the lead: a useful arrangement is a two-pin 5A plug with a 13A type razor adaptor.

If your soldering iron's bit is not of the fixed type it's a useful habit to give it a twist every time you plug the iron in: this ensures that the fixing does not seize and facilitates replacement of defective bits without having to scrap the element as well. ■

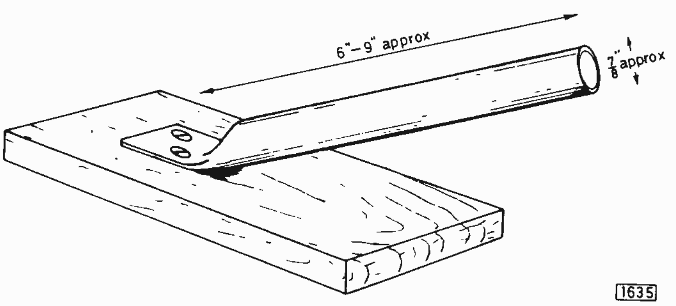

Fig. 1: The soldering-iron stand.

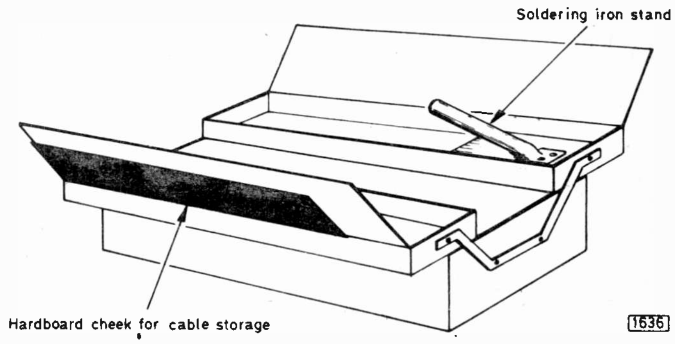

Fig. 2: Metal tool box adaptations.

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TV Games *In Colour*

Steve A. Money T.Eng. (CEI)

Part 1

THIS seems to be the year of the TV game. Take a look in the radio and television department of any large store and you are likely to find various television games units on sale. Most readers, being electronically inclined, would probably prefer to be able to build their own TV games unit however. *Television* has therefore developed a constructional project which provides a TV games centre having a number of advanced features which are not available on most other TV games units.

TV games are not new of course, but until this year the construction of a suitable unit would have involved the use of a large amount of complex logic and even then would provide only a simple game such as television tennis. Most TV games were to be found in amusement arcades. Realising that there was a potential market in TV games, some of the big semiconductor manufacturers developed special integrated circuits which could provide the complex logic required on a single chip. At first these were aimed at the amusement arcade and commercial games market but the devices are now at last becoming available to the home constructor so that the TV game becomes a reasonable proposition for a home construction project.

Most of the TV games units on sale in stores, and the few construction kits that have appeared recently, make use of the General Instrument type AY-3-8500 device. This will produce a selection of up to six different games, although most games units provide only four of these since the two rifle shooting games require extra equipment. The display on the screen is in black and white and includes an automatic display of the score each time a point is scored. The sound effects are usually reproduced on a speaker mounted in the TV game control unit rather than coming from the TV set.

For the *Television* games centre a newer and rather more sophisticated integrated circuit, from National Semiconductor, has been used. This is the MM57105 which, when used with the LM1889 video modulator chip, provides a full colour display on the screen, assuming of course that you have a colour receiver. Sound effects when the ball hits the bat or the boundary fence are reproduced on the sound channel of the television receiver, giving a more realistic result. Three basic games are provided, with practice versions of each. There are thus six games options to choose from. Other features, such as automatic on-screen scoring, ball control and automatic service, are included.

Before going on to deal with construction let us take a closer look at the games and features offered in this TV games unit.

Ice Hockey

Because the National Semiconductor games chip was originally developed for the North American market it is not surprising that the first game provided is ice hockey. This is played on a blue field, representing the ice, and the wall around the playing area is marked out by a yellow line on the screen. At each end of the field the gap in the wall forms the goal. Each team consists of a goalie and three forwards which are displayed as yellow rectangles and squares respectively. Each player can move his goalie up and down the screen in front of his goal line by operating the player control. The forwards in each team are controlled by the internal logic of the game however and move up and down in a more or less random fashion.

The hockey puck appears on the screen as a small blue square and moves around inside the playing area, bouncing off the walls or players whenever it hits them. In fact the players will deflect the puck only when it's travelling in the direction of their goal line – otherwise the puck passes right through the player as if he was not there. The object of the game is to get the puck through your opponent's goal, thus scoring a point. Whenever the puck passes through either goal the current score is displayed for about a second before play automatically resumes. When one team has scored 15 points the game is won and play stops until a new game is initiated.

Tennis

The second of the games is tennis which, as one might expect, is played on a green court with blue borders at the top and bottom of the screen. In this game the rackets for the two players are shown as vertical orange lines whilst the net and scores are yellow.

The ball, which is pale green, bounces off the upper and lower borders of the court in much the same way as the puck does in the ice hockey game. In tennis the object of the game is to try to make your opponent miss the ball so that you score a point. The game is won when either of the players reaches a score of 15, and the score is displayed automatically each time one of the players fails to hit the ball with his bat.

Squash

The third basic game is squash which is played on a three sided magenta coloured court with both players at the same end. Only one of the bats is displayed at a time and will be that for the player whose turn it is to hit the ball. The two bats are displayed in different colours, one blue and the other orange. The scores are displayed in the same two colours. The pink ball can bounce off all three walls of the court, and points are scored whenever a player fails to intercept the ball on his turn. As in the other games the first player to get 15 points is the winner and play ceases at that point.

Practice

Each of the three basic games can be set up for single player practice operation. One of the player controllers then moves both bats or goalies together. This is a useful feature which allows beginners to get the feel of each game before playing in earnest.

Handicapping

One player will often be a lot more experienced than the other. To deal with this a system of handicapping can be used. There are three sizes of bat which can be selected for each player. The normal bat size is a line about 1½ inches high on a 22 inch TV screen. An intermediate ¾ inch high bat or a small ⅜ inch bat can also be selected for either player so that if the better player is given a smaller bat he will compete on more even terms with his less experienced opponent. Bat size is selected by moving the bat to be changed to the top of the court and pressing the player's reset button either once or twice until the desired bat size is produced.

Using this facility it is possible to play against the machine in the ice hockey game. One goalie is set to full size and positioned in front of the goal. The player's goalie is set to the medium size to give the machine a fair chance and the game is played by one player using the small goalie.

Ball Control

When the ball or puck hits one of the side walls it will rebound at an angle which depends upon the angle at which it actually hit the wall. This follows the same rules that apply when a ball hits a wall in real life. When the ball hits a bat however it has been arranged that the new direction of travel depends upon the positioning of the bat relative to the ball. This allows the player to direct the ball to the part of the court that he wants to send it to.

To achieve ball control the bat consists of eight segments, though it does not appear like this on the screen. If the ball hits one of the two central parts of the bat it will travel horizontally across the screen. When the ball hits one of the upper three segments it will travel at an angle towards the top of the screen. Each of the three segments produces a different angle, with the top segment giving the steepest angle and the one near the middle the shallowest angle. A similar action occurs for the lower three segments, except that the ball travels at an angle towards the bottom of the screen. Thus by placing the bat so that the ball hits it at the proper point the ball can be sent off at any one of seven different angles. The segments still operate on the smaller bat sizes but directing the ball becomes rather more difficult.

To simulate the conditions of a real match the ball is arranged so that it travels relatively slowly when play is resumed after a point has been scored. This simulates a service stroke in tennis. After the ball has been hit four times the ball speed automatically increases to make play rather more exciting.

The Circuit

Now let's us get down to the hardware side of the games unit. Fig. 1 shows the complete circuit diagram of the *Television* games centre.

Since the complex logic of the system is contained in three integrated circuits there is not a lot of other circuitry to be added, apart from a power supply and the u.h.f. modulator.

The game itself and the generation of the TV display are controlled by the MM57105 (IC1) which produces at its outputs the composite video/sync signal, with sound and chroma control signals, needed to generate the TV display. Inputs from the two player control units are used to determine the positions of the two bats and control the reset action. The actual game displayed is selected by switch S4 on the front panel of the games control unit.

Bat position is determined by the time-constant of the player control resistor (RV1 or RV2) and the timing capacitor (C1 or C2).

Network R3, C3 operates a power on reset circuit in the MM57105 so that when power is first applied all the internal logic is correctly reset and the ice hockey game is set up ready to start play.

The games circuit requires two non-overlapping clock inputs for proper operation. These are generated by the MM53114 clock generator (IC3). The input to this device is a 4·43MHz colour reference frequency, and from this all the timing and video output generation is derived.

The third special integrated circuit is the LM1889 (IC4). This is a special video modulator circuit designed to operate with video games. It produces full colour PAL signals modulated on to one of the two v.h.f. signal channels or can be used to produce just the required modulation signal.

One part of the LM1889 consists of a 4·43MHz colour reference oscillator controlled by the external crystal X1. Lead and lag networks producing 45° phase shifts are used to drive a chrominance modulator in the LM1889 which when fed with chroma control signals from the games chip will produce the required PAL chrominance subcarrier at its output.

Because we need a u.h.f. signal for use with a British television receiver the v.h.f. modulators in the LM1889 are not used.

A sound oscillator within the LM1889 uses the tank circuit L1, C12 to produce a 6MHz sound subcarrier which is frequency modulated by a control signal from the games chip to give the desired sound effects.

Video, sound and chrominance signals are all mixed together at pins 12 and 13 of the LM1889 and passed on to the u.h.f. modulator section.

The Modulator

A simple transistor oscillator using a BFY90 produces the u.h.f. carrier signal which, with the layout used, will give a signal at around channel 40. Increasing the value of C19 will enable the circuit to be tuned to a lower u.h.f. channel if desired.

Composite video is applied to the base of Tr1, which acts as an inverting, unity-gain amplifier. The signal is then tapped from the 1kΩ preset RV3 and injected at the emitter of the u.h.f. oscillator transistor. In this way the carrier is modulated by the video signal, the depth of modulation being varied by RV3 – adjust for optimum results. Because it is difficult to get full modulation, it may help to advance the setting of the receiver's contrast control.

Power Supply

Two power supply lines, at −9V and −15V, are needed for the MM57105 games chip. A simple full-wave rectifier gives the −15V supply which is stabilised by the 7815 fixed voltage regulator (IC2). For the −9V supply a 5·6 volt zener is used in series with the −15V rail to provide the necessary voltage drop.

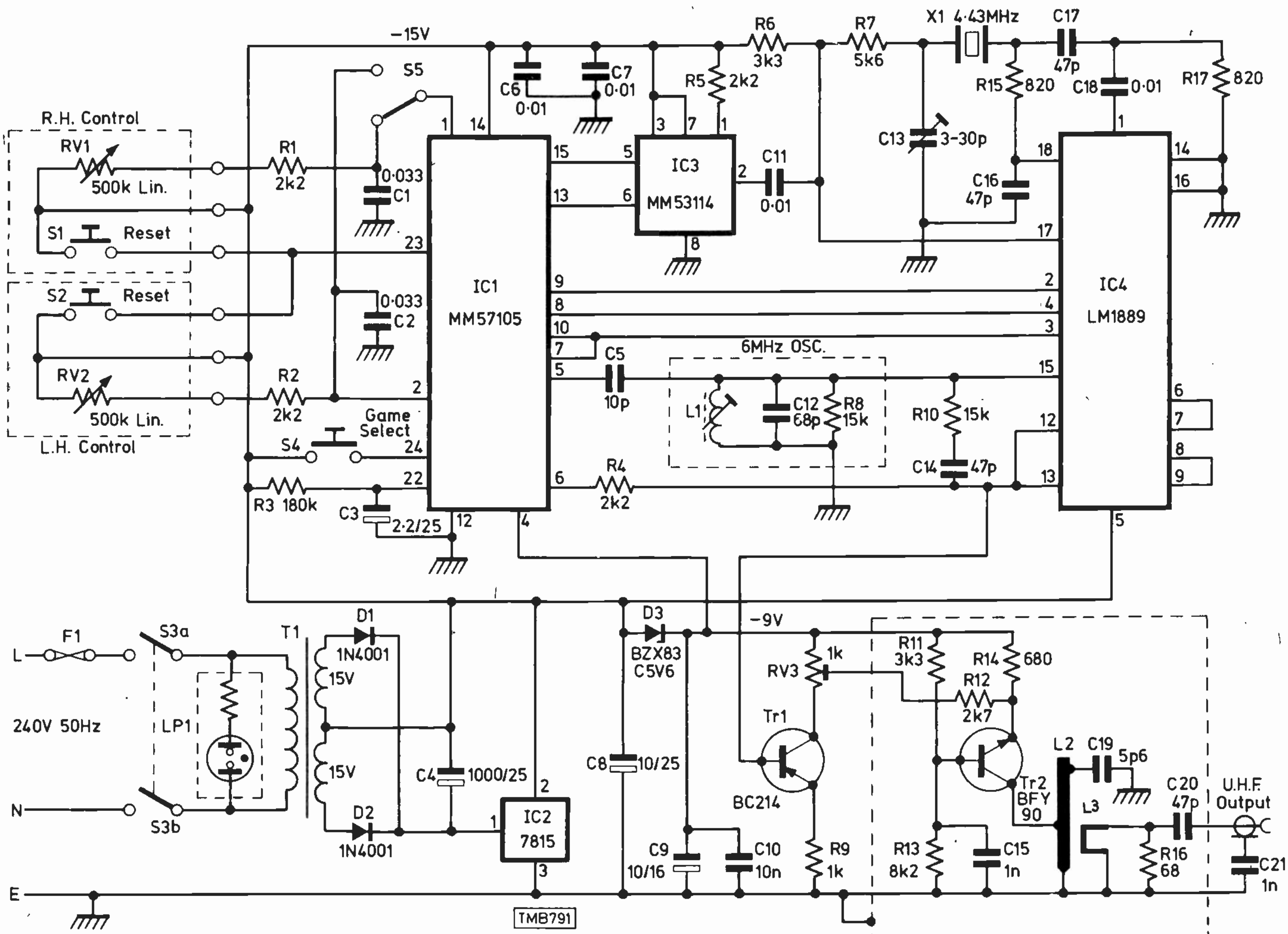


Fig. 1: Complete circuit diagram of the games unit.

★ Components list

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

R1	2·2kΩ	R7	5·6kΩ	R13	8·2kΩ
R2	2·2kΩ	R8	15kΩ	R14	680Ω
R3	180kΩ	R9	1kΩ	R15	820Ω
R4	2·2kΩ	R10	15kΩ	R16	68Ω
R5	2·2kΩ	R11	3·3kΩ	R17	820Ω
R6	3·3kΩ	R12	2·7kΩ		

RV1 500kΩ linear
RV2 500kΩ linear
RV3 1kΩ subminiature horizontal preset

Capacitors:

C1, 2	0·033μF polyester
C3	2·2μF tantalum bead
C4	1000μF 25V electrolytic
C5	10pF ceramic plate
C6, 7, 10, 11, 18	0·01μF ceramic disc
C8	10μF 25V tantalum bead
C9	10μF 16V tantalum bead
C12	68pF ceramic plate
C13	3-30pF ceramic trimmer
C14, 16, 17, 20	47pF ceramic plate
C15	1000pF ceramic plate
C19	5·6pF ceramic plate
C21	1000pF 1000V ceramic

Transistors and diodes:

TR1	BC214	D2	1N4001
TR2	BFY90	D3	BZX83 C5V6
D1	1N4001		

Integrated circuits:

IC1 MM57105
IC2 7815 15V regulator
IC3 MM53114
IC4 LM1889
IC1, IC3 and IC4 available as a set from A. Marshall (London) Ltd., 42 Cricklewood Broadway, London, NW2 3ET, price £17.00 including postage, packing and VAT.

Miscellaneous:

L1 50 turns 38s.w.g. enamelled close wound on standard 4mm TV coil former with can and tuning slug
L2, L3 Part of PCB
T1 Primary 240V
Secondary 15V – 0 – 15V 200mA
X1 Standard 4·43MHz PAL colour reference crystal
Case Vero case type 1411
Hand controller boxes (Vero)
Knobs for hand controllers
S1 Min. Push button push to make
S2 Min. Push button push to make
S3 2 pole PC mount Push switch
S4 2 pole PC mount Push switch (Action link removed)
S5 2 pole PC mount Push switch
IC sockets 24 pin DIL, 18 pin DIL and 8 pin DIL (or Soldercon sockets)
PCB Reference no. D034

Servicing the Tandberg CTV1 Chassis

W. S. J. Brice, B.Sc.(Eng.)

THE subject of this article, the Tandberg CTV1 chassis, is the predecessor to the company's current range of 110° solid-state colour TV receivers. In contrast to the latter it employs a 90° deflection c.r.t. and a hybrid chassis. At first glance it looks similar to many other hybrid designs, but on close scrutiny some unusual and interesting features are to be found. Correctly set up, the chassis is capable of producing excellent pictures. It helped Tandberg to establish a reputation as manufacturers of quality TV receivers.

Line Output Stage

The set is designed around a straightforward PL509/PY500A line output stage (see Fig. 1) with a tripler e.h.t. supply, but the protection of this stage is unusual and interesting. The protection device consists of two springs arranged vertically between the two line output stage valves and joined at the top by a low melting point alloy, thus forming a temperature sensitive switch which opens when either or both valves overheat, isolating the h.t. supply to the line output stage. To make the switch more sensitive to the overheating of the valves the springs have a matt black finish in order to absorb the infra-red radiation from tortured anodes more effectively. A short length of the special alloy in wire form is thoughtfully supplied with each receiver, twisted around a tag close to the bottom of the switch. Very early receivers had a fuse in place of the thermal switch.

Line Oscillator

In this hybrid receiver there is nothing quite so hybrid as the line oscillator, which uses a BC157 and an ECH84 (see Fig. 2). The BC157 is the oscillator stage, with the heptode section of the ECH84 as a reactance stage and the triode section as a voltage amplifier to give sufficient voltage swing to drive the PL509. Some earlier receivers do not have the transistor oscillator stage however, the triode section of the valve being both oscillator and driver. This is a point to watch as only one version is shown in the service information.

Field Timebase

The field timebase circuitry (see Fig. 3) is completely solid-state, using a silicon controlled switch as the field oscillator and a single transistor amplifier with linearity feedback, followed by two transistors connected as a Darlington pair to drive the rather unusual output stage. This uses a single transistor biased in class A and choke-coupled to the scan coils. The choke is in fact an autotransformer with a step up winding providing pulses which after suitable shaping are fed to the c.r.t. cathodes for field flyback blanking.

Power Supplies

Unlike many current designs in which the various l.t. rails required are conveniently derived from the line output stage, all the power supply rails are mains derived (see Fig. 4). The result is that the l.t. supplies are fairly complicated. The mains transformer has two l.t. windings, apart from the 6·3V winding for the c.r.t. heaters, and these feed two bridge rectifiers followed by regulator circuits. One gives a regulated +22V rail and an unregulated +29V rail, the other regulated − 18V and +6V rails (set R422 for −18V).

The h.t. supply is straightforward, consisting of a half-wave rectifier with a choke filter.

Tuners

There are separate u.h.f. and v.h.f. tuners mounted at the back of the chassis. The latter is for continental 625-line transmissions on Bands I and III, but is useful in this country for operation on v.h.f. relay systems. The set is also unusual in having a solenoid operated mechanical band-switch for Band I/Band III in contrast to the usual switching diodes.

The IF Strip

The i.f. strip is built into a plug-in, screened module and among the five active devices three are dual-gate MOSFETS, no doubt used because of the advantages of low cross modulation and the easy design of the a.g.c. circuitry. There are three separate video detectors in the i.f. module. One (D1) is for the luminance and chrominance, another (D51) detects the 6MHz sound intercarrier beat, while the third (D220) detects the video signal for the noise-blanking, a.g.c., and sync. separator stages. This detector is fed from a point before the second 33·5MHz trap in order to produce the wide bandwidth video signal necessary for effective noise blanking.

Access

Access to the main chassis at first sight looks to be a problem – apart from the plug-in modules – but the whole

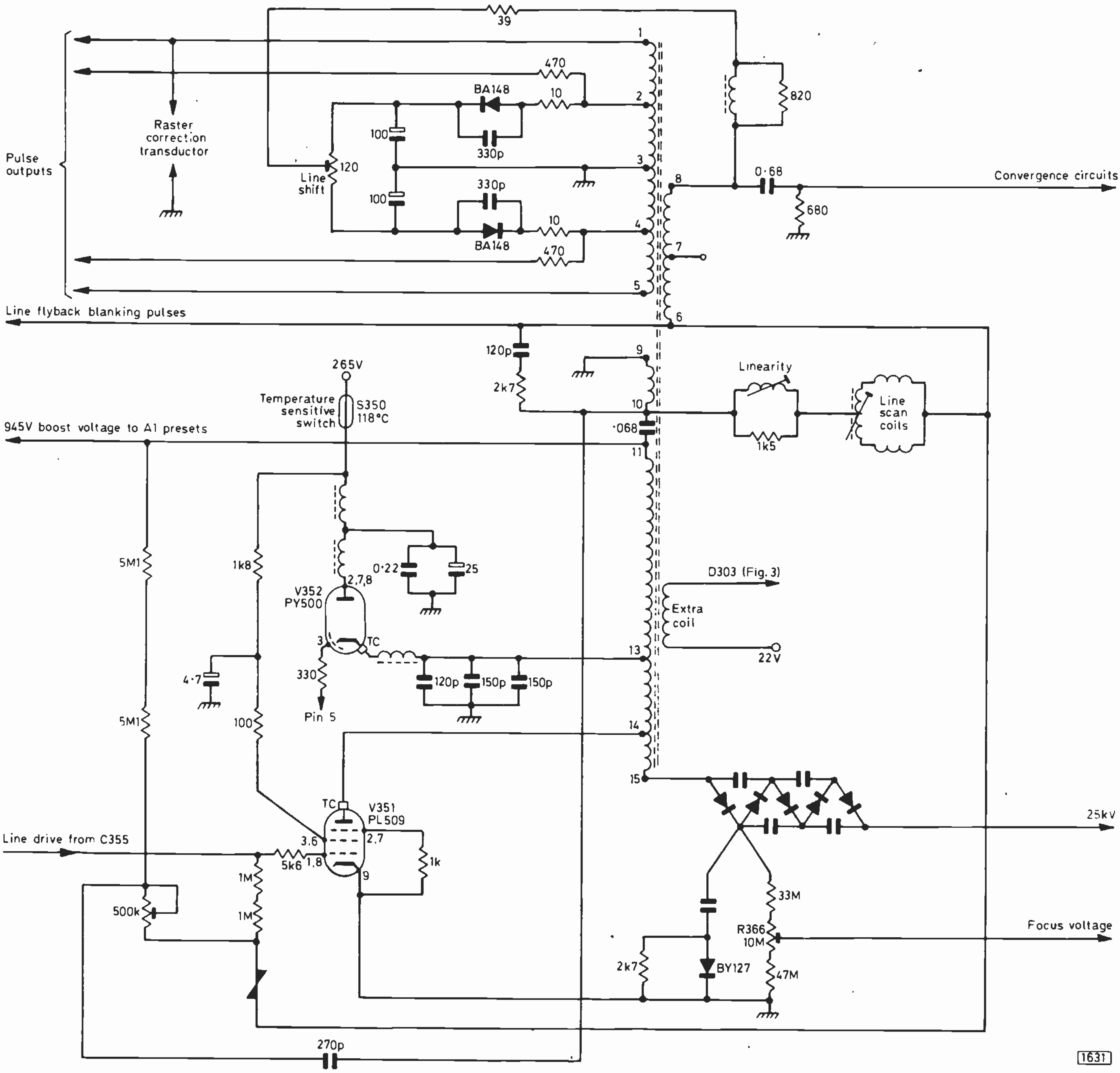


Fig. 1: Circuit of the line output stage. EW raster correction is carried out in the line oscillator circuit.

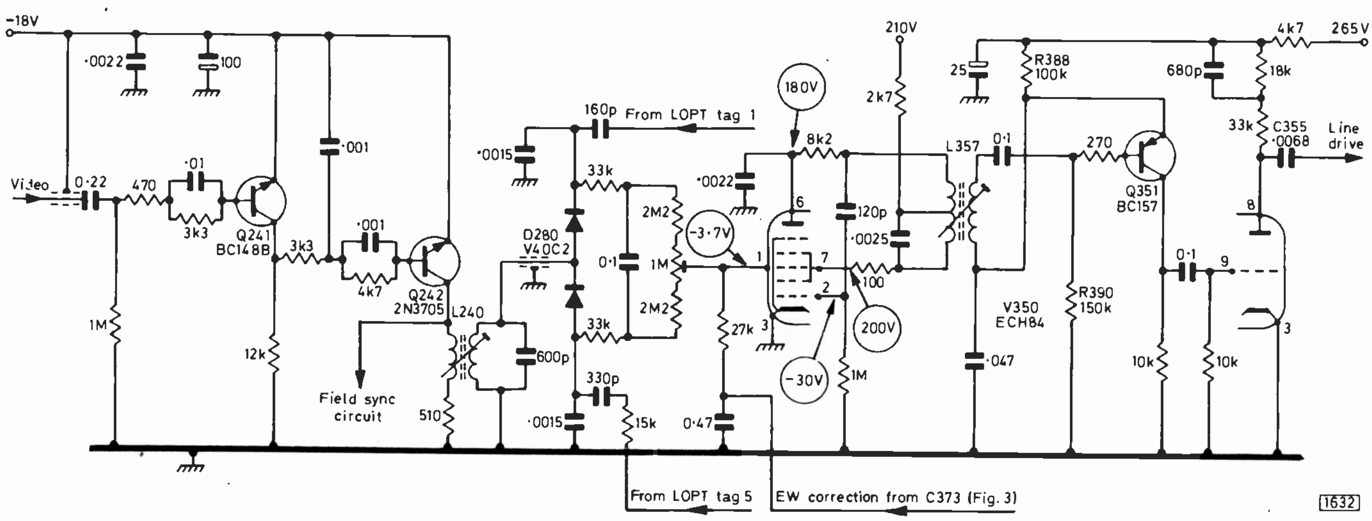


Fig. 2: The sync separator and line generator circuits. In some sets the ECH84 acts as oscillator and reactance valve, with Q351 omitted.

chassis is mounted on rails and can be slid backwards for service after two springs have been released. Access to the underside of the chassis is obtained by releasing the same two springs and pulling the chassis back farther and lifting it – it's hinged at the front – until the top of the line output chassis engages a hook at the top of the cabinet, holding it at a convenient 45°. When new, the sets were fitted with a peg on each side of the chassis secured by screws holding the chassis to the rails. This was a transit precaution. If the chassis is reluctant to slide backwards however these may still be in place.

The control panel, which also carries the audio amplifier and output stages, can be taken out as a unit by moving out of the way the three clips which hold it in place.

Stock Faults

These receivers seem to be inherently reliable but are let down by a number of stock faults which are soon recognised, making for easy servicing but doing nothing for customer satisfaction.

LT Troubles

The l.t. power supplies seem to be one of these "weak links" on the chassis. The usual trouble is that the l.t. supply goes on and off intermittently, sometimes for only a few seconds in an hour. This is usually due to a faulty 2N5296 regulator output transistor, but the BC147s which drive them are not always without blame, so it's a good policy to change both the BC147s and the 2N5296 when a fault like this occurs.

It's easy to identify which of the two l.t. regulators is causing trouble. Failure of either gives the no sound or vision symptoms whilst failure of the 22V regulator gives field collapse as well. So if the symptoms are no sound or picture with a blank raster transistors Q404, Q405 and Q406 are suspect, but if no sound or picture with field collapse go for Q401, Q402 and Q403.

Field Collapse

Field collapse by itself, again at times intermittent, is usually the 2N5496 field output transistor Q305 or occasionally the field oscillator Q301, a BR101. If the correct replacement for the field output transistor is not to hand a 2N3055 can be fitted in an emergency since the heatsink and printed board are drilled to take its TO3 case as well as the 2N5496.

Line Timebase Faults

The usual indication of trouble in the line output stage is the opening of the temperature sensitive switch between the two valves. Replacement of the valves and resetting the switch with the alloy provided is usually a permanent cure. On some occasions the switch seems to open for no good reason, probably due to higher than normal ambient temperature, high mains voltage etc., as the melting point of the alloy is only 118°C. The temptation to reset the switch with ordinary solder (with a melting point of 220°C) should be resisted: this would not melt until the worst possible fault conditions occurred, and could be the cause of severe damage or even a fire.

Other possible causes of no e.h.t. are the tripler – easily diagnosed by disconnection – or a line oscillator which is reluctant to start. If the condition is not cured by a new ECH84 valve and the circuit is of the later type with a transistor oscillator the cause of the trouble may well be R388 or R390 being high in value.

In my own experience at least this chassis seems to suffer more than the average from arcing around the interconnecting leads from the line output stage valves to the line output transformer, and the connections from the line output transformer to the printed circuit board. In the odd case this has even damaged the line output board beyond repair.

The moral of this is that when changing line output stage valves or working on the line output stage one should check that any leads carrying line power run clear of each other and of nearby components, and also watch out for dry-joints and loose connections. By doing this you may save the customer the cost of a new line output panel.

Focus trouble is nearly always the 10MΩ control, but in some cases the spark gap goes leaky in spite of the fact that a high quality glass encapsulated unit is used. When replacing the gap install it with some clearance between it and the c.r.t. base panel in order to prevent leakage due to dirt trapped between the two.

Intermittent Sound

A common and annoying fault which seems to occur sooner or later on most TV sets using this chassis is intermittent sound. In a few cases this is because the sound output transistor Q74, a 2N3055, is faulty, but in the majority of cases the source of this trouble is dry-joints on the emitter and base pins of this transistor and on its securing screws which also serve as the collector connections. The cure is to resolder the joints with a generous dose of solder, taking care that there is no strain on the soldered joints.

Tuning Troubles

Troubles with the tuner seem to be similar to those experienced in other TV receivers with varicap tuners – noisy switch contacts, tuning potentiometers and the like. Remedies are cleaning plus a dash of contact lubricant or replacement, depending on the severity of the case. After several years the most commonly used buttons refuse to work or become intermittent, operating only if the button is held in as far as possible. The cause is wear on the part of the push button which operates the bandswitch – this is located on the top of the push button assembly – and a quick cure is to slacken the screw holding the switch and to move the switch to take up the wear, finally retightening the screw. A more permanent cure where the receiver is used on u.h.f. only is to rewire the switch so that the u.h.f. tuner is permanently in operation.

IF Unit

The i.f. strip is a reliable unit. Since it's a plug-in module it can easily be returned to the manufacturer for service should the thought of working with MOSFETS prove daunting.

Colour Circuits

The decoder and the RGB drive circuits have proved trouble free, with nothing of the nature of a stock fault. It's

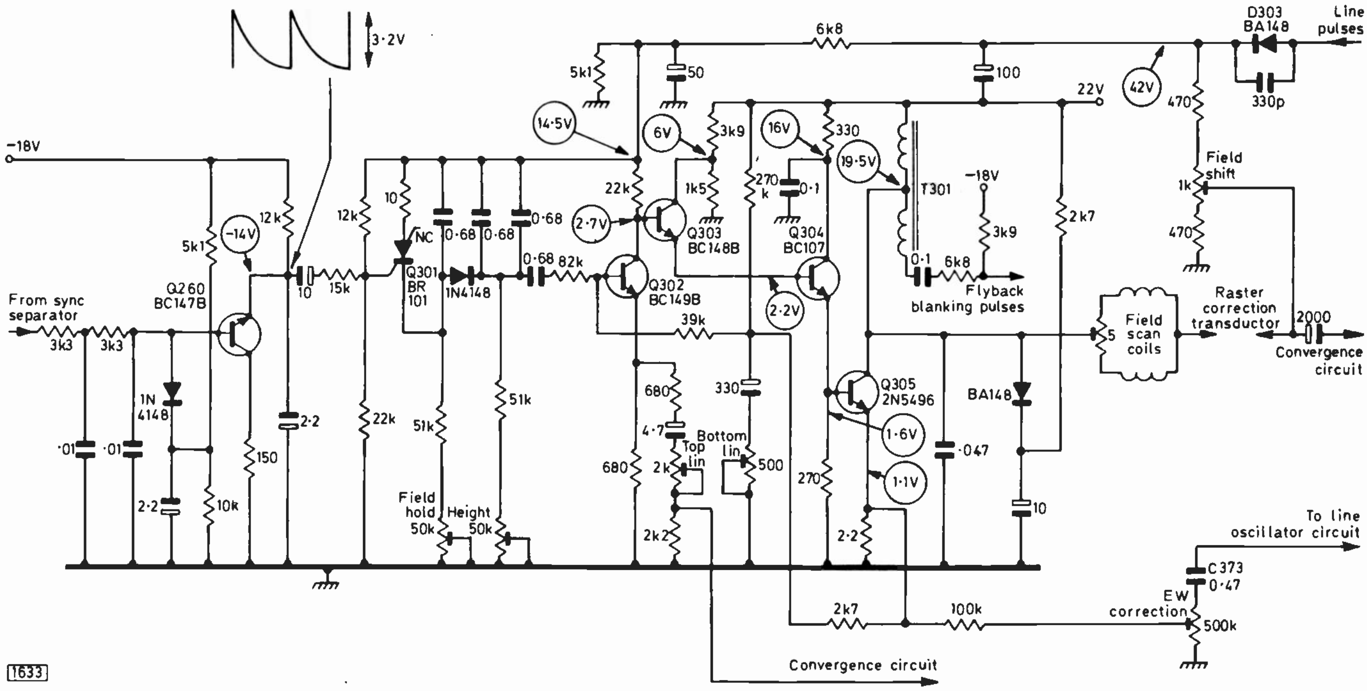


Fig. 3: Field timebase circuit.

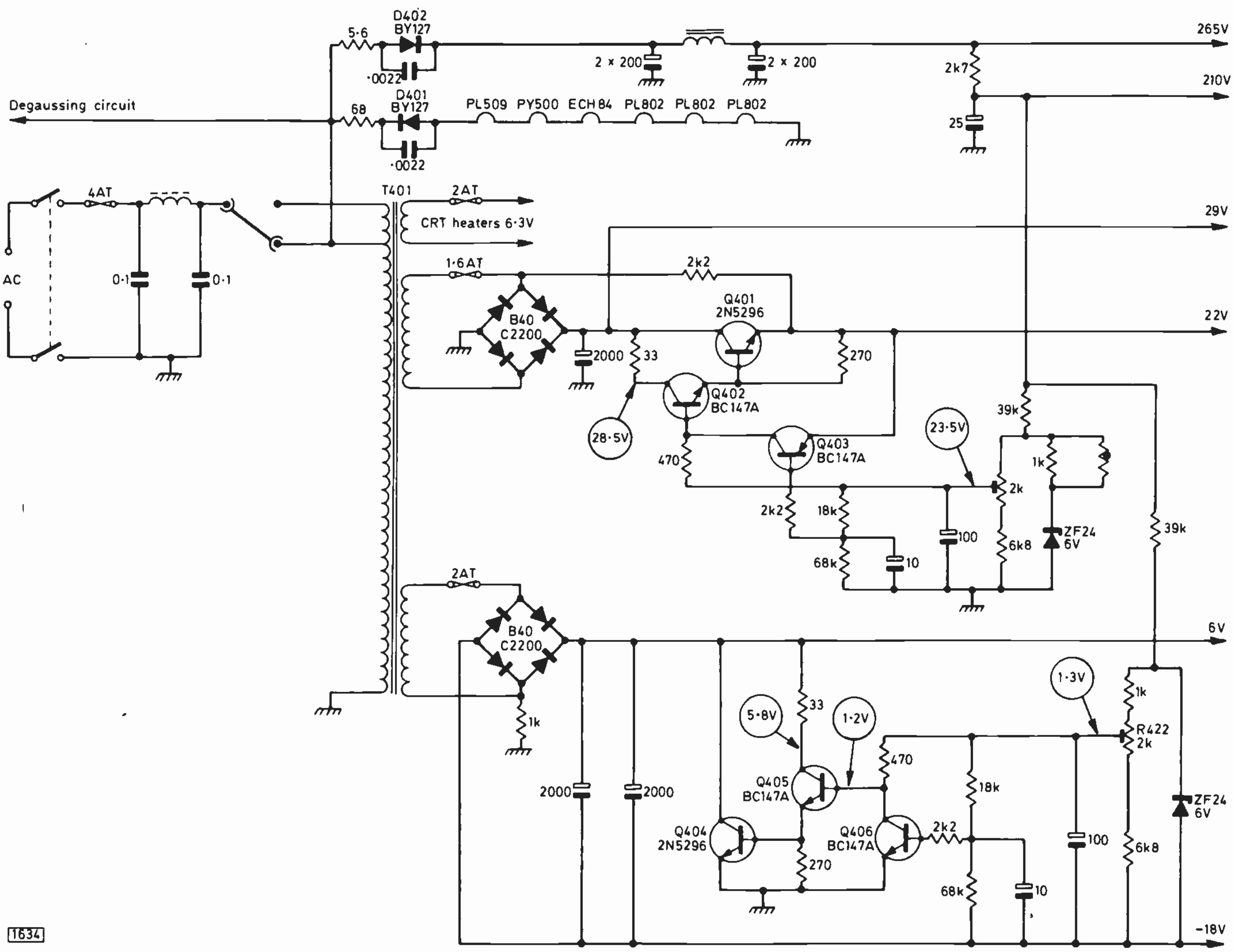


Fig. 4: Power supply circuits.

worth noting however that the three PL802 RGB output valves drive the c.r.t. grids, not the cathodes. A.C. coupling is used, with single diode clamps – the clamp voltage is set by the brightness control. The c.r.t. cathodes are used for beam limiting and field flyback blanking – line flyback blanking is carried out in the c.r.t. first anode circuit. ■

Picture Sharpener for the Philips VCR

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

THE writer discovered that the circuit to be described had been added to a second-hand VCR he purchased. Its function is to increase the horizontal resolution of replayed material. It has no function in the record mode. The circuit is shown in Fig. 1, with waveforms in Fig. 2 to assist with the theoretical description – they are not sketches of actual oscillograms.

Circuit Description

The new circuit board is driven by the luminance emitter-follower TS429 on board B (panel 45). This has a 1kΩ emitter load resistor. Tr1 is also an emitter-follower, and drives the d.c. restorer D1 to set the d.c. level of the video to the correct point to bias Tr2.

The signal from Tr2's emitter is directly coupled to Tr3's base. Tr3, together with the choke in its collector lead, form the picture sharpener. The choke, together with stray capacitance, comprise a highly damped tuned circuit which is shock-excited by a step input waveform. D2 and D3 clip the top and bottom of the output. This has the effect of removing the subsequent oscillations of the damped tuned circuit and also any amplified noise that may appear there. The effect is to leave just the peaks and in practice the remaining ripple does not show on the resulting picture. The pulse produced in this way is further amplified by Tr4 and is mixed with the original signal in the resistors common to Tr2 and Tr4. Tr5 inverts the processed signal and corrects its level to that required by the overall VCR system, and Tr6 presents the correct output impedance to drive the luminance delay line on board C.

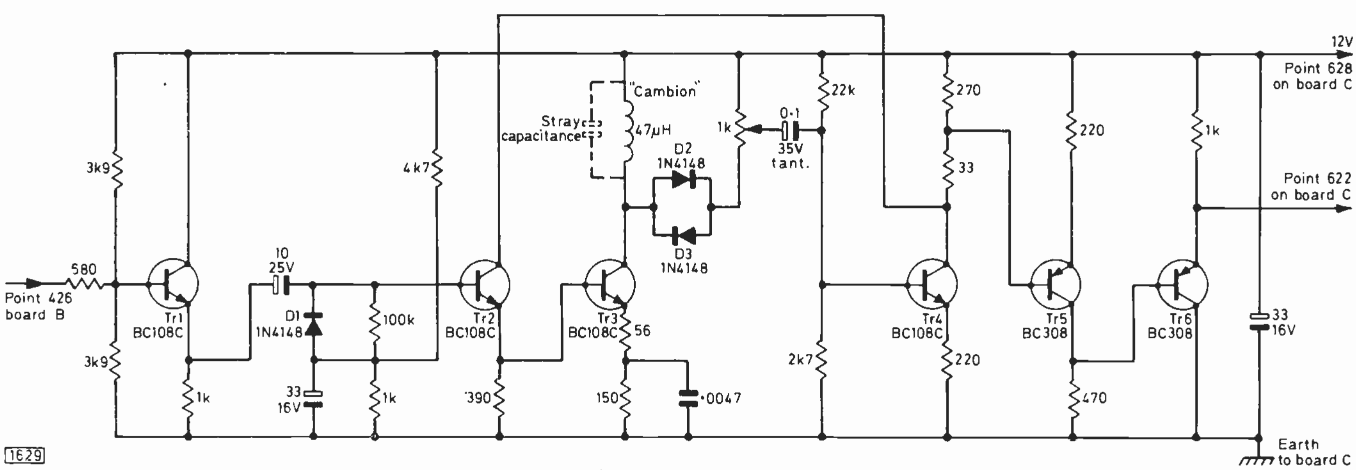


Fig. 1: Circuit diagram of the picture sharpener.

Construction

The circuit had been constructed on a piece of veroboard and fitted to the VCR at the front, perpendicular to board C. It was fixed to the hinged frame by two soldering tags. Connections were made to board C as shown in Fig. 1. The coaxial cable coming from board B was unsoldered at point 622 on board C. This is coded "B281" on the circuit diagram for the machine. A further length of screened cable was soldered to the lead from board B and connected to the input of the new board, and a length of screened cable was connected from the new board to board C. A separate earth had been provided from the earthing point on the new board to the earthing point on board C, and the 12V required was taken from point 628 on board C (coded "B241" on the circuit).

Installation

After installation the 1kΩ potentiometer is adjusted so that the picture is sharper without any extra interference becoming apparent.

Scope for Experiments

The choke used is marked with the word "Cambion". There is room for experiment with the natural frequency

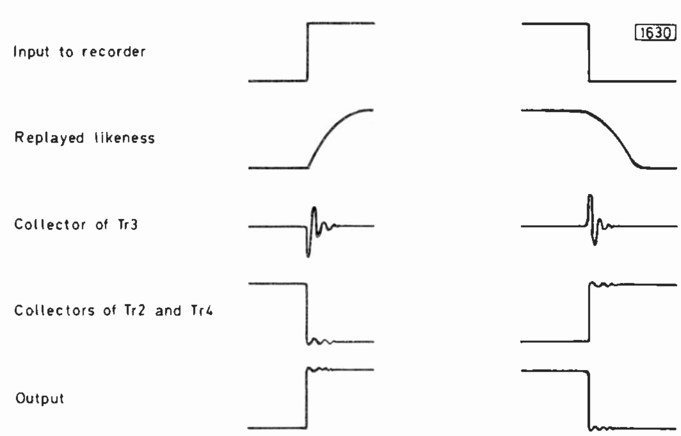


Fig. 2: Theoretical waveforms showing the sharpening action.

and damping factor of the choke to get optimum results. Also there is the possibility of building much more complex circuits to enhance the picture sharpness, using integrated circuit logic. Even some way of "flagging" sharp edges in the recording process could selectively activate a pulse generator on replay to give a much larger effective bandwidth. It's felt however that the modification shown gives a visible improvement in replay quality and is worth adopting. Some later models incorporate circuitry to improve picture quality. A device called the "Video Quality Recoverer" is marketed by Scientronics (40, High Street, Somersham, Huntingdon, Cambridge) at £10. This is probably similar, although I have not seen one.

Modulator Fault

Finally, a VCR fault that I encountered recently. There was no output from the VCR to the receiver, although a picture was available at the monitor and sound was available at the receiver. Naturally the machine was tried with both a tape and an off-air signal, and the fault was the same in each case. This suggested a fault in the U505 modulator module, and probing with an oscilloscope soon revealed that the video was entering the module with the correct d.c. level at point P. By this time thought was being given to the possible cost and the delivery time required to get a replacement U505 module, but I decided to open it up in case IC401 was the cause of the trouble and was a type that could be readily replaced. The signal is fed to pin 2 of the i.c. through a 3pF feedthrough capacitor, a 100Ω resistor and a small choke. This consists of a few turns of self-supported "solderable" enamel covered wire. It was clear that one end of the choke was dry-jointed, and application of the soldering iron completely cleared the fault. Incidentally it would not have been possible to replace IC401 – it's an obscure flat-pack type, and had the fault been within it the whole module would have had to go. ■

More on the CVC20 Chassis

Dewi James visits ITT's Kersley plant

THE development of the new ITT CVC20 chassis, with its PIL tube, was described in *Television* last December. It's currently in production in at least a couple of ITT plants in the UK, and I recently visited the one at Kersley, Lancashire – originally built by Telefusion for the production of their Telpro colour sets. ITT aim to make the CVC20 the UK's most reliable colour TV chassis, and I was impressed by the care taken in its design and construction and the quality control exercised at all stages in its manufacture. Nevertheless there were a few initial problems, as with any new chassis: these are listed later.

Another aim of ITT is to strengthen the links between the manufacturing and servicing sides. One aspect of this will be regular training courses for dealers' engineers. During my visit I was able to discuss the circuitry and servicing with ITT's engineers, but the most useful result – to a practising TV engineer – was the information obtained on faults encountered with early production sets. For the benefit of others, these are as follows.

Early Troubles

The switch-mode power supply transistor T12 (BU126) sometimes goes short-circuit at switch on for no apparent reason, although this fault can also be caused by R80 (150kΩ) in the base circuit of the driver transistor T11 going open-circuit.

A peculiar symptom best described as a "pulsating field collapse" is usually caused by either the field linearity stage transistor T6 (BC183LC) or diode D5 (1N4148) between the field charging network and the field oscillator. Complete field collapse has been caused by failure of diode D5A (1N4148) in the coupling network between the TBA920 i.c. and the field oscillator, while reduced field scan can be due to a dry-joint at the junction of L7A (NS phase coil) and L3 (one of the NS raster correction transductor windings).

In the line timebase there were some early tripler failures but the more usual faults have been due to the diodes in the EW modulator circuit. When D24 (BYX71/350) – the one with its anode connected to chassis – goes short-circuit the effect is excessive width; when the other diode D23 (MR854) goes short-circuit the effect is lack of width. Another cause of excessive width is when the EW modulator driver transistor T903 (BC213L) goes short-circuit – when it goes open-circuit the effect is lack of width.

Very weak contrast has been due to defective transistors in the beam limiter circuit. These are T1 (BC172B) and T2 (BC252B). Similar symptoms can be caused by the associated diode D3 (1N4148).

Should the chroma disappear during channel change, leaving vague green/white bars, fit a 150pF capacitor between pins 14 and 16 of the TCA800 chroma demodulator/PAL switch/RGB matrix i.c. IC503 to prevent instability.

If the electrolytic C39 (22μF, 400V) associated with rectifier D14 goes short-circuit it blows the plug fuse (if there is one) but not the set's fuses. This supply feeds the base of the driver transistor in the switched-mode power supply.

Finally, for the sake of completeness, we add the point made recently in *Your Problems Solved* (April) – intermittent colour drop-out due to dry-joints on the print side of the decoder panel, particularly at the transverse screening strut which runs across the print adjacent to the service switch S501/2.

New Reliability

ITT comment that the initial bugs on the chassis have now been ironed out, and we wish them every success in their quest for reliability.

20AX Screen Burn

Incidentally, it has been found during production of the newer CVC30 chassis, which uses the 20AX c.r.t., that this tube is susceptible to screen burn if the set is left in the field collapse condition for even a very short time. So beware. ■

Test Report
Eagle Transistor Testers

Vivian Capel

SOME sort of transistor tester is nowadays a must for the service department. A variety of such instruments is available and the types on offer fall into three classes: those that analyse the various characteristics of the transistor in detail, enabling curves to be plotted; testers which provide basic leakage and gain measurements; and the in-circuit go/no go tester. The first of these is really an instrument for the design laboratory and is not necessary for service work. There are examples of both the other types in the Eagle range, the TT145 and the TT144 respectively.

Model TT145

The TT145 is a basic characteristic meter. It has a 2½in. meter scale which is calibrated for gain and leakage current. Both the alpha and beta modes are indicated on the gain scale. Alpha, the common-base configuration where the gain is less than unity, is calibrated from 0·7 to 0·9967. Beta, or to use the more common term h_{FE}, is calibrated from 0-300 but is easily extended to give readings up to 600 for high-gain transistors.

There are two leakage current ranges, one up to 50μA for small transistors and the other up to 1mA for power types. There is also a resistance range for checking diodes – this reads up to 1MΩ. In spite of these five different calibrations the scale is uncluttered and very easy to read.

The main control is a three-position switch selecting either npn or pnp tests with a centre-off position. It's also inscribed "forward" and "reverse" for diode testing. Selection of the gain or leakage tests is by means of a press key which is biased to a centre-off position. There's a selector knob for switching to general or high-power transistors or meter adjustment. Alongside is the potentiometer for adjusting the meter.

A pair of terminals is provided for diode connection. They're inscribed with the diode symbol. There are two methods of transistor connection, by three short colour-coded leads terminated by crocodile clips, or by means of a four-in-line transistor socket. I had some doubts as to whether the latter would stand up to continual workshop use in view of the small contact area. It has done so over many months without any sign of trouble however. The crocodile clips are rather less successful, being somewhat large and not inclined to make a firm grip on the transistor lead-out wires. It seems that these are really intended for the larger power transistors and that wire-ended transistors should be fitted to the socket.

Test Procedure

The test procedure is as follows. After connecting the transistor and switching to the correct polarity, the selector is set to the adjust position and the potentiometer adjusted to give a full-scale reading. The selector is then switched to "general" and the test key pulled back. The gain can be read off directly on the scale. If the needle goes beyond the limit the gain is above 300 and the meter must be readjusted, this time to give a half-scale reading instead of a full one. This doubles the gain range to 600. Pushing the test key forward gives the leakage reading, of up to 50μA. If the scale is exceeded when testing power types switch the selector to "high-power". This extends the range to 1mA.

For diode testing, the diode is connected as indicated to the terminals. The control is then switched from forward to reverse. Resistance is indicated on the scale in ohms and the forward reading should be much lower than the reverse one. If you are unsure of the diode polarity connect it at random: the forward and reverse readings will indicate whether it is connected correctly or is reversed.

Conclusions

This instrument has been used in the workshop for a considerable time and has always given positive, unambiguous readings. It has showed up many a suspected faulty transistor when a replacement has not been available to try in circuit. One is always happier ordering an expensive transistor of an uncommon type if one is *sure* that the original is faulty!

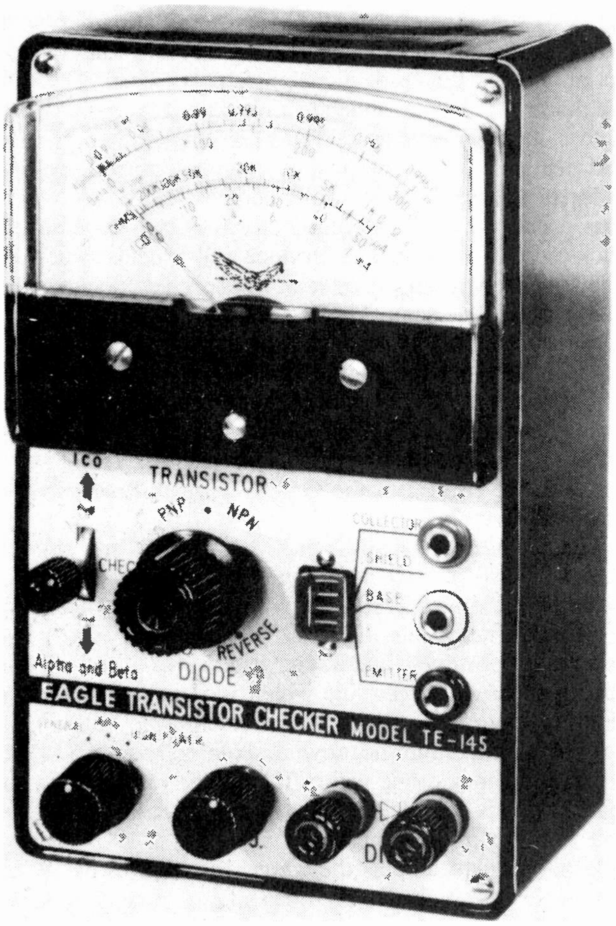
Model TT144

Now to the TT144. This is quite an ingenious device which tests transistors dynamically, that is under signal conditions and not just with d.c. currents flowing. Furthermore it does this without the need to remove the transistor from its circuit. Obviously if this is 100% reliable and successful it will be a boon to the busy service engineer.

The tester incorporates an oscillatory circuit which operates independently of the circuit into which the transistor under test is wired and its power supply. This circuit consists of a transformer which couples the base and collector of the transistor. An additional high-ratio winding supplies a neon lamp, thus giving an indication as to whether the circuit is oscillating.

The main control on this instrument is a potentiometer which varies both the feedback and the base bias. When the feedback and bias are at maximum a good transistor should oscillate strongly and light the neon. This it does when the control, which is arbitrarily calibrated from 0-100, is fully anti-clockwise, i.e. at the 0 marking. As the control is turned clockwise the feedback and bias are reduced and the neon fades until it goes out. The control's position at this point gives an indication of the dynamic gain and enables transistors to be dynamically matched. Any transistor fault, such as a short or open-circuit or high leakage, will prevent oscillation. "Goodness" is determined by just one test therefore.

If more accurate matching is required the neon can be



The Eagle Model TT145 transistor tester.

disconnected by means of a switch on the control panel. This eliminates its loading on the circuit, and a measurement of the oscillation amplitude can then be made by means of a scope or valve voltmeter – output sockets are provided for the connection of such an instrument. The only other control is the on/off and polarity selector switch. As the internal battery is only 1·5V and current is limited by the transformer primary no damage will be done if the wrong polarity is selected. A transistor of unknown polarity can be identified by switching from one polarity to the other to see which gives an indication.

Two sockets are provided for transistor connection, one a small triangular configuration for taking lockfit as well as wire-ended transistors, and the other a much larger one with a tapered moulding to guide the wires easily into their holders. This however prevents transistors with short wires being used with it. Three leads with crocodile clips are provided for in-circuit tests. These medium-sized clips are much too big for the cramped layouts of most printed boards encountered these days. They can be replaced by miniature instrument-type clips however and these are certainly more suitable.

Performance

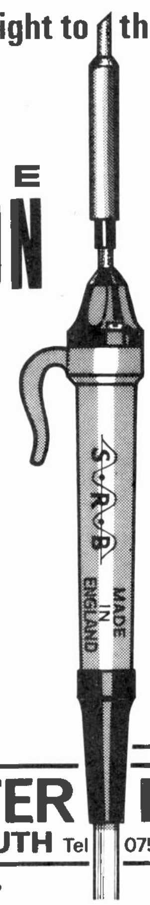
How does the instrument perform? In most cases quite well. An indication is not always obtainable from the neon when testing sound output transistors in situ, but the oscillation produces a buzz from the loudspeaker. Most audio stages gave results, but it is in the i.f. circuits, both sound and vision, as well as radio i.f. and mixer stages that results were more uncertain. This is probably due to the low-impedance paths presented by the i.f. coils – these shunt the l.f. oscillation and prevent it from getting going.

If no indication is forthcoming the handbook recommends disconnecting the emitter lead of the transistor from the circuit and connecting it directly to the tester. In the case of low-current transistors additional battery cells can be tried in series with the collector.

It was found that the neon would sometimes not light in the maximum position of the feedback/base bias control but at some other point. So if the neon doesn't light at first the control should be rotated slowly over its range. Why there should be no oscillations at the maximum bias and feedback settings while oscillations start at a lower level is obscure but may well be due to some peculiarity in the transistor characteristic.

Verdict

It can be seen that there is an element of uncertainty about in-circuit testing. If the neon lights, fair enough, we know we have an operational transistor. But if the neon doesn't light it could be because the transistor is faulty, or there are low-impedance circuit shunts, or the emitter needs isolating, or extra battery cells are required, or the control needs adjusting to find a favourable point! All this rather nullifies the advantage of in-circuit testing. Unless a piece of test equipment gives positive results it's of little value in a professional workshop. So ingenious though the TT144 is, I find myself going to the TT145 every time I have doubts about a transistor even though this means removing it from the circuit. The cost of the TT145 is £22·50 and of the TT144 £11·90, plus VAT. ■



Circuit Notes

H. K. HILLS

Magic Green Line Tuning

We have received several letters from readers asking about the "magic green tuning line" featured in National Panasonic (Matsushita) colour receivers. On pressing a button a vertical green line appears down the centre of the screen. The set is then tuned for minimum width of the green line, this condition corresponding to correct tuning. The way in which the circuitry is arranged differs in different models, but the basic principle remains the same. We will take as our example the portable Model TC42G.

The idea is shown in block diagram form in Fig. 1, while Fig. 2 shows the circuit in simplified form. Basically, a sample of the signal appearing at the final i.f. stage is applied to an amplifier tuned to the vision carrier frequency (39·5MHz). This stage will obviously provide maximum output when the vision carrier is at maximum, i.e. the tuning is correct. This output is detected and fed to an i.c. to which a line frequency sawtooth signal is also fed. When the supplies to these stages are connected by pressing the green line tuning button, this i.c. produces an output pulse which is timed to coincide with the centre of the line scan. Its width depends on the input from the detector. The pulse is used to saturate the R–Y output stage and to cut off the G–Y output stage.

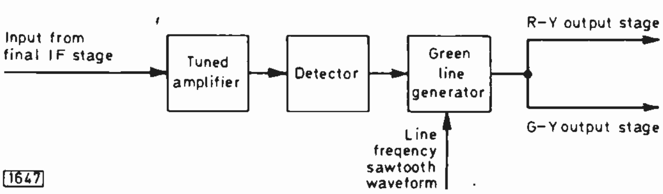


Fig. 1: Block diagram showing the principle of the National Panasonic "magic green line" tuning system.

Turning now to Fig. 2, the signal at the collector of the final i.f. transistor is coupled by the small (1pF) capacitor C154 to the base of the 39·5MHz tuned amplifier Tr151. Power is applied to this stage and sections of the following i.c. only when the "magic line switch" is closed. The detector diode D151 is arranged to give a negative-going output across its load resistor R158. This is smoothed by C157 and reduces the small positive voltage tapped from the slider of the magic line width control R155. The voltage thus produced is fed to pins 5 and 6 of the i.c. A line flyback pulse is integrated to produce a 30V peak-to-peak line frequency sawtooth waveform whose peak occurs at the centre of the line scan. This is fed in at pin 13 of the i.c., its exact position being determined by the setting of R170. The i.c. produces a rectangular pulse of 4V peak-to-peak amplitude at pin 3, the width of the pulse depending on the voltage at pin 5. This pulse is fed via D901 to the base of the R – Y colour-difference output transistor Tr901 and via D902 to the emitter of the G – Y colour-difference output transistor Tr902.

The set uses colour-difference c.r.t. drive, and since the output transistors are npn types the positive-going pulse from the i.c. drives Tr901 fully on while cutting Tr902 off. In consequence while the pulse is present the tube's green grid moves positively and its red grid moves negatively, producing a vertical green line which is superimposed on the picture. Optimum tuning gives maximum output from Tr151 and maximum negative d.c. output from D151, with a minimum magic line width. If the received signal is such that the line is completely killed, it can be restored to a suitable width by adjusting R155.

In subsequent models the whole operation is carried out in a single i.c. which also provides a.f.c.

Switched Subcarrier Trap

An unusual circuit in the TC42G is the method used to render the 4·43MHz trap in the luminance channel inoperative on monochrome, so that the full video bandwidth is used. Associated with the trap (see Fig. 3) are a diode (D303) and a pair of transistors which are connected in the basic differential-amplifier configuration though actually operating as a switch. The control voltage is derived from the colour-killer circuit in the chroma i.c. Pin 4 of this i.c. is at 12V on monochrome. In consequence Tr305 is turned hard on and the voltage developed across R375 cuts Tr304 off. With Tr304 cut off, no current can flow through D303 which consequently acts as an open-circuit switch. The

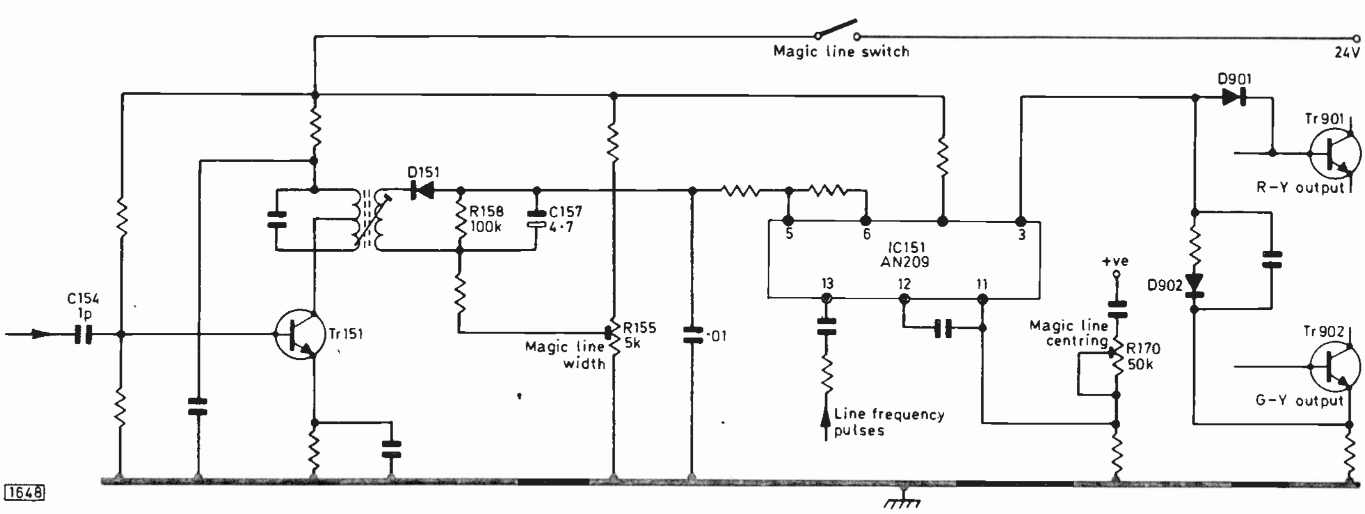


Fig. 2: Simplified circuit of the "magic green line" tuning system used in Model TC42G.

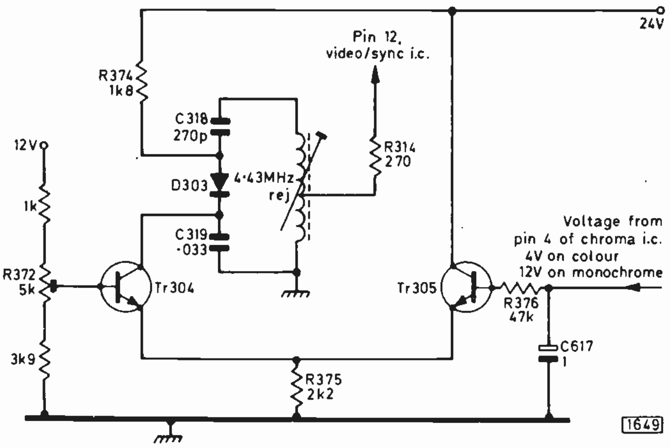


Fig. 3: The unusual switched 4·43MHz subcarrier trap used in the National Panasonic Model TC42G.

result is that C318 can no longer tune the associated 4·43MHz rejector coil. On colour the voltage at pin 4 of the chroma i.c. falls to 4V. In this condition Tr305 no longer conducts. The bias applied to the base of Tr304 from R372 switches it on, and the voltage across R375 this time holds Tr305 cut off. D303 is now conducting, and the 4·43MHz rejector circuit comes into operation.

Electronic Smoothing Filter

The smoothing arrangement following the h.t. rectifier is conventionally an *LC* or *RC* filter. Chokes are bulky and expensive however and their magnetic fields impose mounting restrictions; resistors on the other hand dissipate considerable wattage. An alternative approach used in several W. German chassis is to use an electronic filter. That used in the Nordmende FIV chassis is shown in Fig. 4. At switch on C557 charges rapidly via the zener diode D559 and R558, the voltage across the zener bringing the two transistors T505 and T506 into conduction. Once C557 has fully charged there is insufficient voltage across D559 for it to maintain conduction. It switches off therefore. T505 is now biased by the voltage at the junction of R556/R557, smoothed by C557. As a result the emitter current of T505 is highly smoothed and by further emitter-follower action T506 provides a highly smoothed output. The input from the thyristor regulated power supply has a 15V peak-to-peak ripple content. The output of the electronic filter has a hum voltage of approximately 300mV peak-to-peak. R539 provides current limiting in the event of an h.t. short-circuit, while D560 protects T506 by conducting and operating the protection circuit in the event of T506's reverse collector-emitter voltage being exceeded.

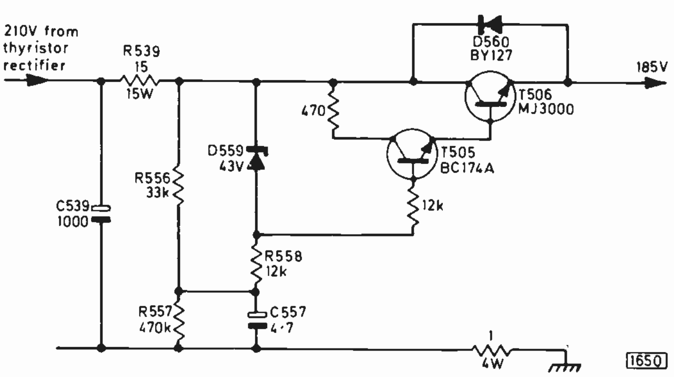


Fig. 4: The electronic smoothing filter used in the Nordmende FIV chassis.

Noise-free Field Sync Pulse Feed

Noise pulses occurring towards the end of the vertical scan can often trip the field timebase. A simple method of removing the effect of such noise is used in Decca hybrid colour receivers and also in the earlier Baird 620/640/660 series of monochrome receivers. The circuit as used in the Decca 10/30 series chassis is shown in Fig. 5. D400 is held conductive during the forward scan, thus clamping to

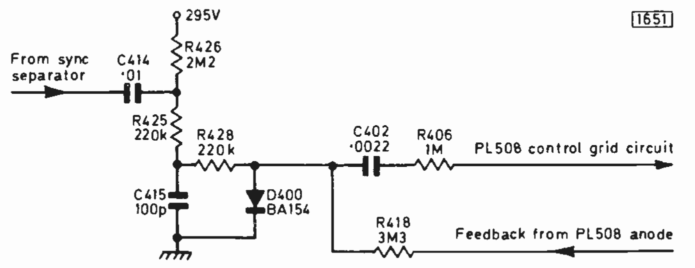


Fig. 5: Field sync pulse integrating/feed circuit used in the Decca series 10 and 30 colour chassis.

chassis the sync pulse feed to the field timebase. The field sync pulses are integrated by R425 and C415, reverse biasing D400 and passing via C402 and R406 to the control grid of the PL508 field output pentode to cut it off and thus initiate the field flyback. In the absence of the field sync pulse D400 is held forward biased by the voltage from R426/R425/R428 and in addition by the field scan waveform applied to its anode via R418. This waveform is taken from the PL508's anode circuit.

Transductor EHT Stabiliser

An unusual feature of many Hitachi colour receivers is the use of a transductor to stabilise the operation of the line output stage and thus the e.h.t. The circuit, simplified, as used in Model CNP192 is shown in Fig. 6. The transductor has three windings, two of which are connected in series

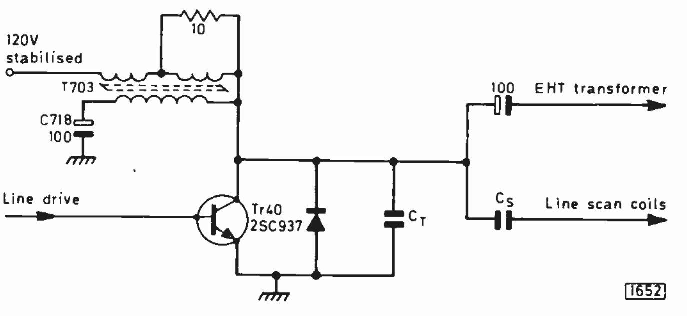


Fig. 6: Simplified circuit showing the use of a transductor in many Hitachi colour receivers to stabilise the e.h.t. voltage.

with the supply to collector of the line output transistor while the third, the control winding, is connected between the collector of the line output transistor and chassis via the d.c. blocking capacitor C718. Now the reactance presented by the series windings on the transductor depends on the a.c. flowing through the control winding. As this current increases, so the core increasingly saturates and the impedance presented by the series windings decreases. With increased demand on the line output stage, due to increased beam current, so the loading effect of the transductor decreases. The net loading on the line output stage thus remains substantially constant, and the e.h.t. voltage is stabilised. Since the transductor's dissipation is low the circuit is reliable.

Servicing the Rank A774 Monochrome Chassis

John Coombes

THE Rank A774 single-standard monochrome chassis was introduced in 1970 and remained in production for many years. Models using it include the Bush TV181S, TV183SS, TV185S, TV186SS, TV313 and TV315, and the Murphy V2015SS, V2016, V2415SS and V2417S. It's a hybrid chassis, using valves in the audio section and the field and line timebases, and transistors elsewhere. One distinguishing feature is the use of an EF184 as sinewave line oscillator. Many of the troubles relate to dry-joints and to capacitors in the line timebase. The latter part of the chassis is a good point at which to start off therefore. See Fig. 2 for the complete circuit of the main chassis.

Lack of Width

A common fault is lack of width. If a new PL504 line output valve doesn't restore full width check the line stabilisation control 3RV8 (2MΩ), which can also be responsible for intermittent lack of width or loss of raster altogether. If a new c.r.t. has been fitted, lack of width can be due to a faulty line linearity sleeve – it's under the deflection coils. If the sleeve is incorrectly positioned there will be cramping at one side of the screen. The adjustment simply consists of sliding the sleeve along the tube neck beneath the scan coils. Other causes of lack of width are a short-circuit scan-correction capacitor (3C49, 0·1μF) and the line output transformer 3T2. If necessary, check the high-value resistors in the line stabilisation/width circuit – 3R58 etc. If the line output transformer is responsible for the lack of width the line stabilisation control will have no effect, the picture will take a long time to appear and unless the brightness is turned well down the picture will balloon and disappear.

No EHT

No e.h.t. means no raster – and usually no sound signals either since the 20V supply for the transistor stages is obtained from the line output stage. The rectifier which provides the 20V supply is 3D8, with filtering by 3C45/3R69/3C48. If this rectifier is defective it can kill the line output stage. This however is not one of the more common causes of no e.h.t.

If a new PL504 doesn't restore the e.h.t. and the valve is running cool check its screen grid feed resistor 3R56 which sometimes goes open-circuit. Alternatively, the associated decoupler 3C37 may be short-circuit. This in fact may be the reason for 3R56 being open-circuit, so if 3R56 has to be replaced check 3C37 as well.

No e.h.t. and an overheated PY88 boost diode probably means that the boost capacitor 3C44 is short-circuit. All too often however loss of e.h.t. is due to the line output transformer. Very often there is a visual sign – a burn up through the e.h.t. overwinding lead, with insulation breakdown to the transformer's core.

On a few occasions I've come across loss of e.h.t. due to 3L6 being open-circuit. This coil is on the line output transformer and feeds the top cap of the PY88. On another occasion the cause of no e.h.t. was traced to shorting turns on the scan coils. This was the only time I've had trouble with the deflection coils.

No e.h.t. and the PL504 line output valve glowing a very bright red probably means no drive from the EF184 line oscillator. A quick check is to see whether there is a negative voltage of about 25-35V at the control grid (pin 1) of the line output valve. If this voltage is absent the most obvious move is to replace the EF184. If this fails to cure the PL504's overheating check the tuning capacitor (3C32, 4700pF) in the line oscillator circuit: it tends to go leaky. If the PL504 is overheating but not too badly the line oscillator may be operating at the wrong frequency. The main suspects here are 3C32 and 3C34: check by substitution. Other causes of no drive to the PL504 are a faulty coupling capacitor (3C39, 0·01μF), the line oscillator's anode load resistor (3R55, 56kΩ) being open-circuit, and the line oscillator's supply decoupling electrolytic 3C31 (10μF) being short-circuit. As already mentioned, make sure that 3RV8 is operating correctly.

Sound but no e.h.t. is the symptom when the DY802 e.h.t. rectifier's heater winding shorts to the frame of the line output transformer.

Line Sync Problems

Loss of line sync is a frequent problem on this chassis and the most common cause is one or both of the flywheel sync discriminator diodes 3D6/3D7 going open-circuit – it is rare to find one short-circuit. Note that 3C60 across the c.r.t. heater was not present on early production sets. It was added to protect the flywheel sync discriminator diodes in the event of c.r.t. flashover. Another cause of loss of line sync is 3C29.

There is a fault which occurs quite often and is very misleading to anyone not familiar with this chassis. The customer might say that when the set is switched on the

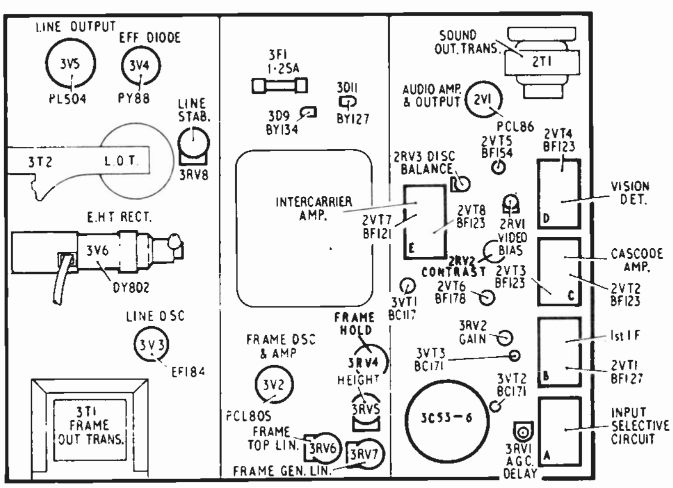


Fig. 1: Chassis layout, viewed from the front.

picture breaks up. If you haven't seen this you may make the mistake of thinking that there is a component failure. The fault may in a poor signal area be described as bad ghosting which occurs periodically. The trouble is due to the bonding around the chassis on the side of the line timebase circuitry. Quite a number of connections here are made to a metal runner around the outside of the line timebase. It has lugs which pass through the printed board and are soldered to the print. It is important to use a large soldering iron to ensure that proper connections are made to the printed board.

Line tearing and intermittent loss of line sync should lead to a check on the flywheel line sync discriminator diodes, the EF184 and 3C31 which can also cause intermittent troubles. Frequency drift is 3C31 again, and line jitter 3C32, 3C34, and 3C36 is also worth trying.

Poor Sync

Quite a common cause of loss of sync, poor sync or even intermittent loss of sync is the sync separator transistor 3VT1 (BC117). 3R3 also causes trouble, giving loss of line and field sync: when it goes open-circuit lock can be achieved for short periods but becomes uncontrollable when the scene changes. The input coupling capacitor to the sync separator transistor, 3C1, was changed from 0·22μF to 0·47μF in later production to give improved sync separator operation.

Field Timebase Faults

In the field timebase the most common offender is the PCL805 valve. Common complaints due to the PCL805 are: field roll, possibly for the first two-three minutes after the set has been switched on; lack of height; bottom cramping; and field collapse – a horizontal white line across the screen. When dealing with field collapse turn the brightness down in order to prevent a burn mark across the centre of the screen.

A common cause of field collapse is simply the wirewound resistor 3R74 going open-circuit – this resistor supplies the field output stage. An occasional cause of field collapse is 3C11 in the cross-coupling network between the pentode and triode sections of the valve going short-circuit.

If bottom cramping is not due to the valve, check its pentode cathode decoupling electrolytic 3C18 (220μF). Also check the bias resistor 3R37 (360Ω). If it has a charred appearance it may have changed value as a result of overheating.

Lack of height, sometimes intermittent, can be due to the height control 3RV5 which very often has a dirty carbon track. Replacement of this skeleton preset is the best course: cleaning will still necessitate its replacement at a later date for sure.

The same fault, a dirty track, also applies to the top linearity control 3RV6 and the overall linearity control 3RV7. The usual result is intermittent faults such as bottom cramping or the top of the picture flicking in and out of linearity.

A rare fault I've come across on a few occasions is intermittent field bounce. Since it doesn't occur at regular intervals the cause is difficult to trace. In each case changing the thermistor 3TH1 in series with the field coils cured the trouble.

Power Supplies

In the power supply, the mains filter capacitor 3C59 (0·1μF) commonly goes short-circuit, blowing the mains fuse (3F1). If the fuse is found blown but no obvious cause can be traced suspect 3C59 of being intermittently faulty.

The most common cause of no supply to the valve and tube heaters is that the dropper resistor 3R72 is open-circuit. This resistor is at the top of the chassis. When the heater protection diode 3D12 goes short-circuit it blows the mains fuse 3F1. A BY127 is a suitable replacement. The heater dropper-diode 3D9 going short-circuit also blows the mains fuse.

The h.t. rectifier is 3D11 and again if this goes short-circuit 3F1 blows. The filter capacitors 3C57 and 3C58 across the heater dropper and h.t. rectifier diodes respectively can also go short-circuit to blow 3F1.

Another cause of 3F1 blowing is the on/off switch which is part of the volume control. It seems to short internally. This can usually be spotted due to a burn spot on the paxolin of the switch.

No results but the heaters alight generally means that 3R77 is open-circuit.

On several occasions I've come across the fault no results due to a break on the printed board – on the board side of the mains input plug P/S3.

Hum on sound can be due to an open-circuit h.t. electrolytic but very often it's just that the main electrolytic can (3C53/4/5/6) is not making proper contact to the solder on the printed board. This dry-joint situation can also cause intermittent rolling or poor line sync, with the picture being upset as the hum bar travels down the screen. Another result is line pulling. These troubles can be quickly detected by pushing the printed board near the electrolytic, thus briefly removing the faults.

Sound Faults

As in the field timebase, the valve is responsible for most troubles in the audio section. The PCL86 can be responsible for distorted sound, sound crackling, intermittent loss of sound and complete loss of sound. It can also be microphonic. Check its bias resistor 2R53 which may have been subjected to overheating.

No sound can also be due to the primary winding of the audio output transformer 2T1 being open-circuit. On a few occasions I have come across an open-circuit loudspeaker. This can usually be repaired because the pig-tail has broken, generally at the external lead connector on the speaker. If the speaker's internal coil has broken however a new speaker will be required. This will also be necessary if the trouble is sound distortion due to the cone rubbing.

Another cause of no sound is simply 3R76 going open-circuit, removing the HT2 supply.

2R47 which supplies the triode section of the valve and the screen grid of the pentode section can also go open-circuit to give the no sound symptom.

The intercarrier sound amplifier consists of the two transistors 2VT7 and 2VT8 in can E. One or other of these can also be faulty, removing the sound, but this is much less likely than the previously listed causes. Another rare cause of no sound is the sound detector diodes 2D2 and 2D3 in can E. Weak distorted sound can be due to 2C42 becoming ineffective.

A common complaint is hum on sound. The usual cause is the HT2 smoothing electrolytic 3C54 which is in the multi-section can. The whole can should be replaced. Check the connections first however in case the trouble is due to a dry-joint.

A modification in the sound output stage was the deletion of the output pentode's cathode decoupling

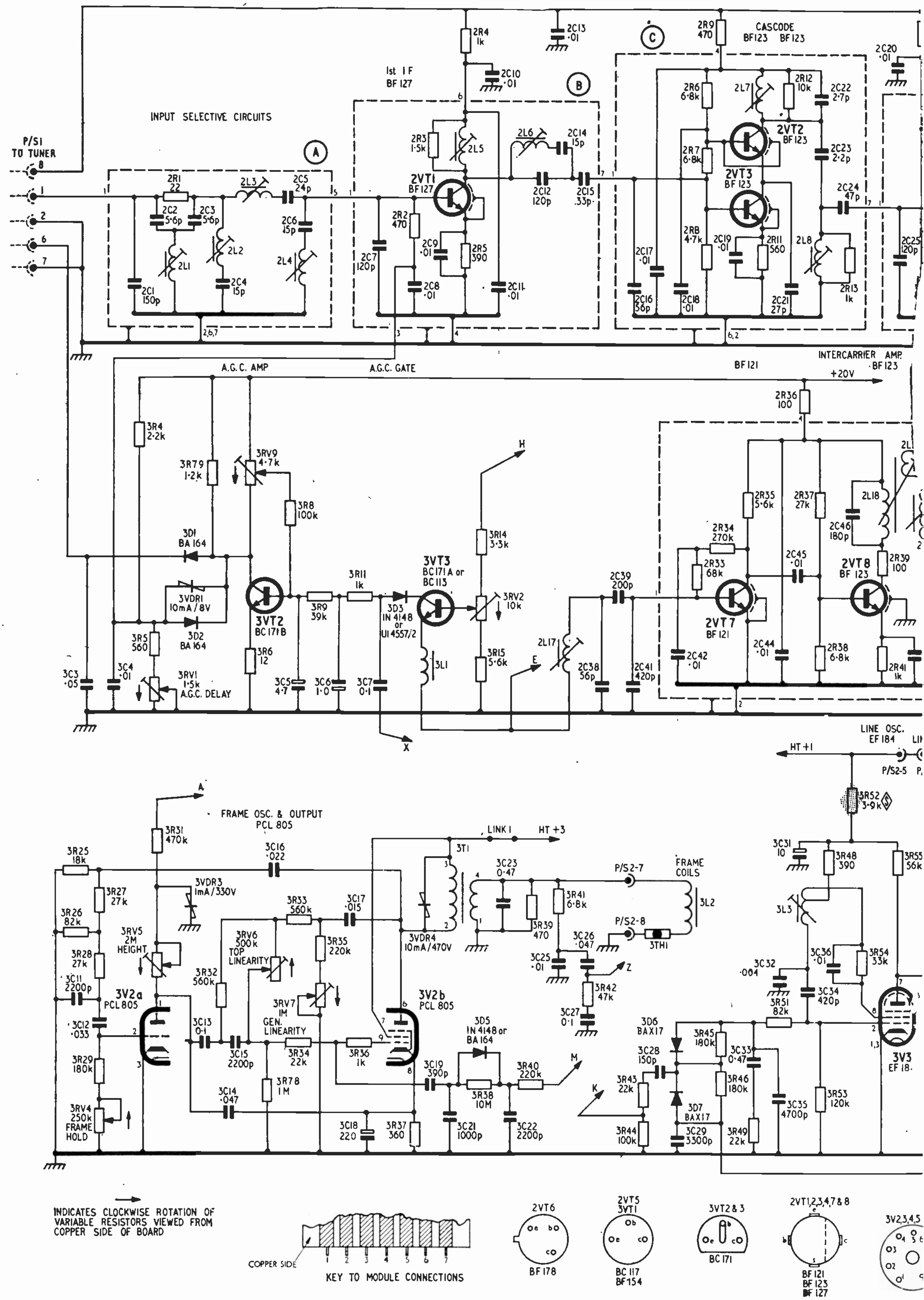
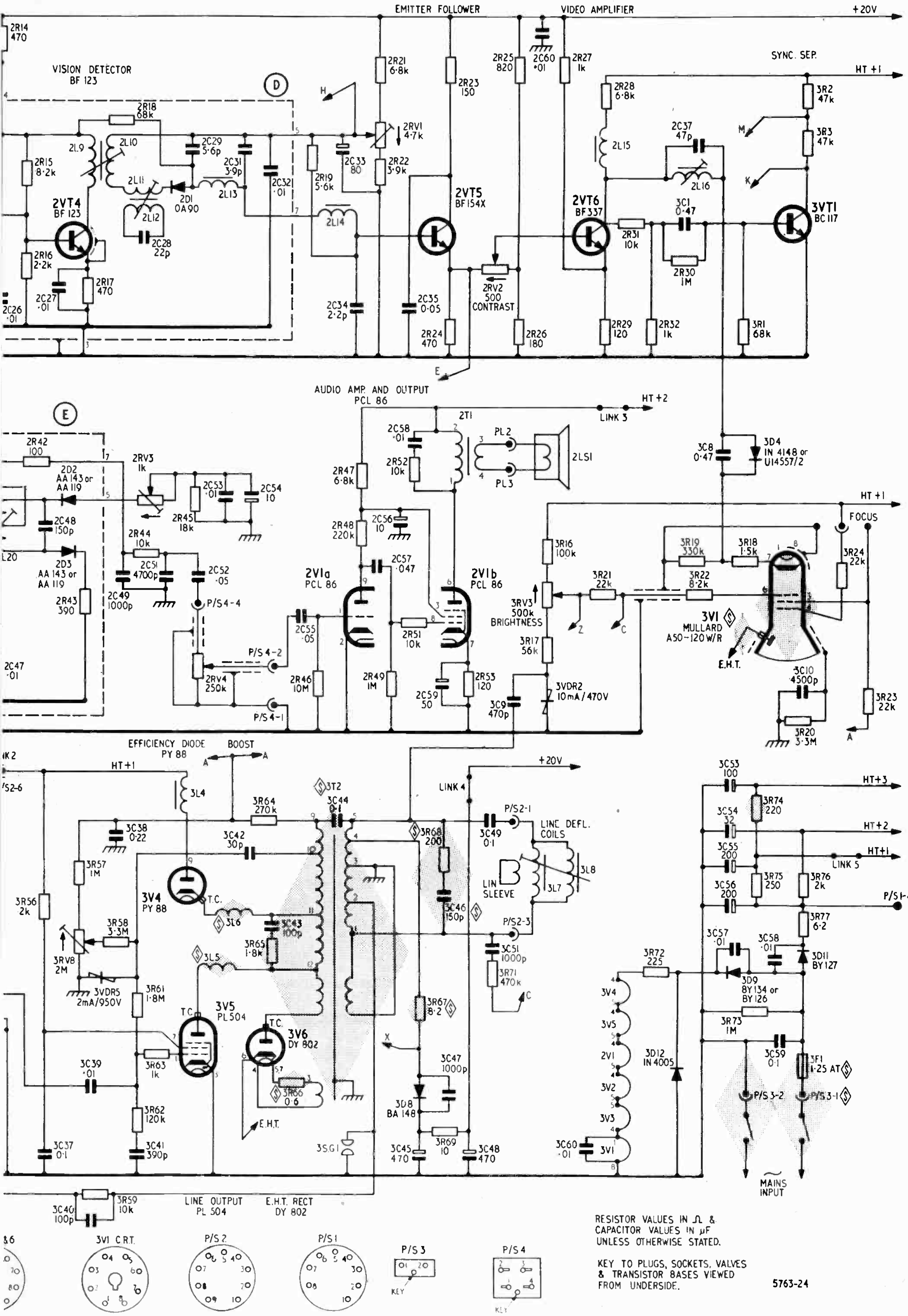


Fig. 2: Circuit diagram, RRI A774 chassis. Modifications include the deletion of 2C59 and the addition of an 0·1µF capacitor and a with 3R58 changed to 4·7MΩ to maintain the width adjustment.



27kΩ resistor in series between the collector and base of the a.g.c. amplifier 3VT2. Later models use more sensitive deflection coils, electrolytic (50μF). This was done to eliminate hum at low volume settings.

Another cause of hum on sound is incorrect earthing around the volume control. One end of the volume control is earthed to the case via the screened lead.

Signal Faults

Sound only with a blank raster seems to occur quite often. The usual cause is a defective video output transistor (2VT6, BF178, later BF337). This goes open-circuit or, less often, short-circuit. Caution is required here: the transistor sometimes doesn't read open- or short-circuit but a replacement restores the picture.

The video emitter-follower 2VT5 (BF154) and the video detector diode 2D1 (OA90) can be responsible for loss of signals. The diode, which is housed in can D, goes open-circuit. Removing the can from the mother board with the aid of a solder sucker is much easier than trying to replace the diode with the can in situ. Before undertaking this time consuming job make sure that the diode is at fault: the aid of an oscilloscope or even a signal generator will tell whether the video signal is being lost within can D.

Prominent flyback lines on the screen I traced to the 6MHz filter coil 2L16 in the video output transistor's output circuit.

An important check if there is line pulling on peak whites or a general bending of the picture is the setting of the video bias control 2RV1. First set the main contrast control fully clockwise, then set the video bias control, using a suitably small trimming tool, fully anti-clockwise. Select a signal-free channel, then adjust 2RV1 until noise becomes just visible on the screen.

As in most modern sets the i.f. stages give very little trouble. If one of the four transistors goes open-circuit the usual result is either a grainy picture or complete loss of picture with grain on the screen.

Intermittent loss of vision along with weak, distorted sound I traced to the final i.f. transistor 2VT4 being intermittently faulty. A case of no sound or vision was found to be due to 2VT2 being open-circuit.

On the mechanical tuner the most common fault is the nylon lugs which travel along a screwed thread to tune in the channels. These break or split so that the channel cannot be selected. Spares are available from RRI and it's worth keeping them in stock since so many Rank tuners use them. Replacement is quite easy. The push-button knobs can also be the cause of inability to select channels or carry out fine tuning. They are made of nylon or plastic and turning or pressing them wears the linking cross.

The r.f. amplifier transistor in the tuner (4VT1, BF180) is sometimes responsible for a grainy picture which can be mistaken for an aerial fault. It can be replaced but care is necessary to avoid damaging or disturbing the surrounding components.

The aerial panel can also be responsible for a grainy picture due to poor soldered joints in the aerial connector. ■

Book Notices

Radio, TV and Audio Technical Reference Book, edited by S. W. Amos, published by Newnes-Butterworths, Borough Green, Sevenoaks, Kent, at £24.

It is not every day that a major work such as this one is published. It's a hefty price, but then it's a hefty book, well over 1,200 pages covering most aspects of radio, TV and audio from the studios to the equipment used at home.

How does one go about commenting on a book such as this? Obviously one can't go through it in detail. So the best thing is to plunge into those sections one is particularly interested in or knows something about. We had a good look at the audio and television sections, and found them up-to-date, well written, clearly illustrated and full of basic information. The sections on monochrome and colour receivers are written by A. G. Priestley, senior development engineer in the Philips' Television Design Laboratory, while E. Trundle, who will be well known to readers of this magazine, covers television receiver servicing.

Even a book of this size can't unfortunately give information on all the varied circuit techniques in use. Thus you won't find anything on the thyristor line timebase, the less usual transistor field timebase configurations, and little on switch-mode power supplies. The section on u.h.f. TV aerials was excellent so far as it went, but it only covered the basic Yagi and log-periodic aerials. There was little on closed-circuit TV and no mention of videocassette recorders, though the subject of amateur television techniques finds a place in the section on television transmitters. We carp however. The book must be regarded as a reference source to the basic components and techniques in use today rather than as a comprehensive guide to the vast multitude of circuits and techniques to be found in practical designs. The presentation makes the information easy to follow and absorb, and there is minimum reliance on mathematics. Mr Amos, his contributors and the publishers are to be congratulated on producing a first class book.

Amateur Television, published by the British Amateur Television Club, 64 Showell Lane, Penn, Wolverhampton, Staffs. at £1.25 post paid to BATC members, £1.75 post paid to non-members. Edited by A. Hughes, T.Eng.(CEI), MITE.

The 112 pages of this book contain a great deal of information and should enable anyone interested in amateur television picture generation and transmission to get started. There are chapters on aerials and reception; transmitting; operating techniques; picture sources; monitors; video recording; slow-scan TV; and colour. The book is particularly helpful in giving practical designs as well as basic information. The presentation is a bit scruffy, but this doesn't detract once you get used to it. We strongly recommend it to anyone thinking of branching out into the world of cameras, transmitters and so on.

Solid State Colour Television Circuits, by G. R. Wilding, published by Newnes-Butterworths, Borough Green, Sevenoaks, Kent, at £5.75.

The change to solid-state colour receiver designs brought with it a vast increase in the circuit techniques the service engineer is likely to encounter. There is a need then for a book which charts a clear course through this wide and complex field. G. R. Wilding should be well known to readers as a regular contributor who concentrates on up-to-date circuit techniques and the servicing problems they bring with them. In this book he surveys and describes a large number of representative circuits used in UK, Japanese and continental colour receivers. It's thoroughly up-to-date, dealing amongst other things with diode modulators, switch-mode power supplies and the Syclops circuit. A useful reference book to have on your bookshelf to consult when next you find yourself short of an explanation of how some particular feature of a modern solid-state set works.

E. Trundle

Developments in Switch-Mode Power Supplies

IN the October 1975 issue we described several switch-mode power supply circuits and their principles of operation. The prolific activity of setmakers since then has seen the introduction of a whole crop of switch-mode arrangements, and some of the more interesting circuits will be described in this sequel. If the author's grapevine is to be believed, activity in manufacturer's development laboratories is continuing at great pace on the power supplies front: perhaps in a year's time some of the up-to-the-minute stuff described below will have become obsolescent . . . oh, Syclops, where is thy sting!

Design Trends

The most significant trend is towards greater sophistication, especially in the overload trip circuits where more comprehensive protection tends to be provided without the off-or-bust system of crowbar thyristors or thermal cut-outs. Increasingly the receiver's pulse is being monitored at several different vulnerable points, each of which can initiate shut down of the power supply should things go amiss. The foremost examples of this are the ITT CVC20 circuit to be described next month and Thorn's Syclops (9000 chassis) system which was admirably covered by Barry Pamplin in the August 1975 and August 1976 issues.

Thyristor circuits require very large values of smoothing and reservoir capacitance with a high ripple-current rating, especially in circuits where overload protection on the sample-and-pulse system is incorporated. Electricity supply authorities do not look kindly on thyristors, and even where a bridge rectifier upstream of the control element prevents d.c. being drawn from the mains the system takes very large short duration bites from the supply line.

Line-frequency Switching

The solution to both these problems is to switch the control element at a rate much higher than 50Hz. The line frequency (15·625kHz) is convenient from three points of view. It is already available in the receiver and allows a degree of integration of the line scan and power supply functions; it is sufficiently high to enable small ferrite-cored power transformers and low-value ripple filter capacitors to be used; while any r.f. radiation due to switching transients is phase locked to the picture and can be more easily suppressed or hidden in the line blanking period, so that interference on the display is less troublesome than would be the case with a free-running oscillator driving the power switch.

Secondary Supplies

Hand in hand with this technique goes the idea of deriving most of the secondary supplies from the line output transformer, either by the conventional method of scan or flyback rectification or, in 110° receivers, by making use of the diode modulator pincushion distortion-correction arrangement, in which the diodes are kept loaded so that they conduct throughout the line scan period, providing a useful source of l.t. power.

Starter Circuits

In many modern designs then, the power supply circuit supplies only the line output stage and the RGB output stages, with (typically) the field and sound departments, the line oscillator and signal stages being powered from the line output stage. This implies the need for some form of kick-start circuit to get the whole shooting-match off the ground: it usually takes the form of a bleed resistor to the line generator from the rectified mains supply, or a configuration whereby a capacitor charges towards h.t. potential, the charging current developing a potential to enable the oscillator (and in the case of the Rank Z718 chassis the line driver) to start up.

Design Requirements

The c.r.t. dictates the design of the line output stage because of its scan and e.h.t. requirements – these are closely defined by the tube manufacturer. The line output stage in turn governs the design parameters of the power supply unit. Most of the design philosophy of the new types of colour tube relates to wider deflection angles and simplification or elimination of the convergence adjustments required. So strong is the influence of the display tube on power supply design that the Sony Corporation currently use three different switch-mode power supply designs for three sizes of c.r.t. – more on this later.

Monochrome Portables

Colour sets do not have a monopoly on switch-mode power supply circuits; the technique has great advantages for portable small-screen monochrome sets in which power consumption is at a premium, even at mains voltage, and where generators or invertors may be used to power the set in certain situations. The other very relevant factor is the use of small-volume cabinets in which the components are fairly tightly packed; the more efficient the electrical circuits, the less the power dissipated in the form of heat – the greatest enemy of reliability, and the thin plastic cabinet shell in which these little sets are usually housed! The elimination of the mains transformer has the further advantage of reductions in cost and weight and the absence of leakage flux. On then to the Indesit 12in. portable receiver: this uses an ingenious pump circuit in which the

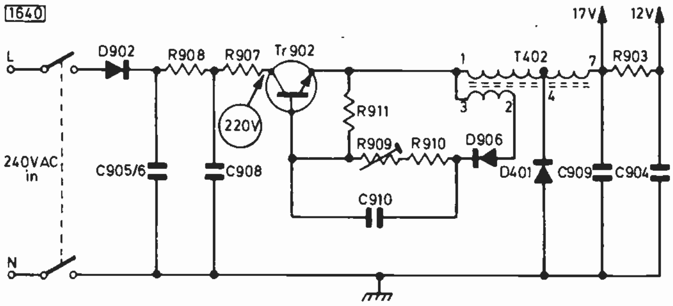


Fig. 1: Basic circuit of the mains power supply used in the Indesit Model T12S portable receiver.

power reservoir is the line output transformer itself – a similar circuit is used in the GEC 3133/3135 series.

INDESIT PUMP CIRCUIT

This power supply combines the concepts of a chopper and a shunt stabiliser. The basic circuit is shown in Fig. 1. The incoming mains is rectified by D902 in the traditional way, with C905/C906 as the reservoir and R908/C908 forming the ripple filter or smoothing action (component reference numbers relate to the later Model T12S). This provides a steady on-load 220V d.c. at the collector of Tr902. The base of this transistor is fed from winding 2-3 on the line output transformer, and D906 in conjunction with C910 and R909/R910/R911 ensure that the drive pulse to the base turns Tr902 on for 5μs during each 64μs line period, adjustable within narrow limits by the set width/h.t. control R909. This means that the duty-cycle (ratio of on- to off-time) of Tr902 is $\frac{5}{64}$ or 7·8%. Thus, given an efficient energy reservoir, 7·8% of 220V will be developed across the load. This comes out at about 17V, and this is the l.t. voltage developed at pin 7 of the line output transformer T402. During each on period of Tr902 energy is stored in the form of magnetic flux in the core of T402, which thus acts as the "chopper choke" of more conventional designs such as the Thorn 3000 series. After its 5μs stint Tr902 switches off. The energy-recovery diode D401 then clamps pin 4 of the line output transformer to earth so that the stored flux in the transformer core provides the 17V l.t. supply at pin 7 by virtue of the collapsing magnetic field. The rest of the set is designed to operate from 12V: this is derived from the 17V supply via R903 and is developed across C904.

Stabilisation

So far so good, but although we have provided the 17V and 12V lines they are not stabilised against mains voltage and load variations. There is no visible means of altering the mark-space ratio of the squarewave at Tr902 base, so that conventional regulation techniques are clearly not used. In fact the fixed duty-cycle of Tr902 and the 650Ω or so made up of R907 and R908 mean that the l.t. voltage source has a fairly high effective impedance, much higher in fact than the load (the effective load impedance for the 12V line is about 6Ω). This approximates to a constant-current source (see last month), so that load variations have far less effect on the supply voltage than with a conventional power supply.

Complete Circuit

If however we can arrange for the set to draw a constant current regardless of load we shall have stabilised the voltage as well, and this is where the shunt-stabiliser Tr901 comes in. Referring to the more complete circuit shown in Fig. 2, the 12V zener D901 is connected across the 12V line via the base-emitter junction of Tr901. As the current demand of the set fluctuates due to variations in sound level, beam current and mains voltage, the zener current fluctuates in inverse proportion. This variation is amplified in Tr901, which conducts more or less heavily, thus compensating for the load impedance changes and stabilizing

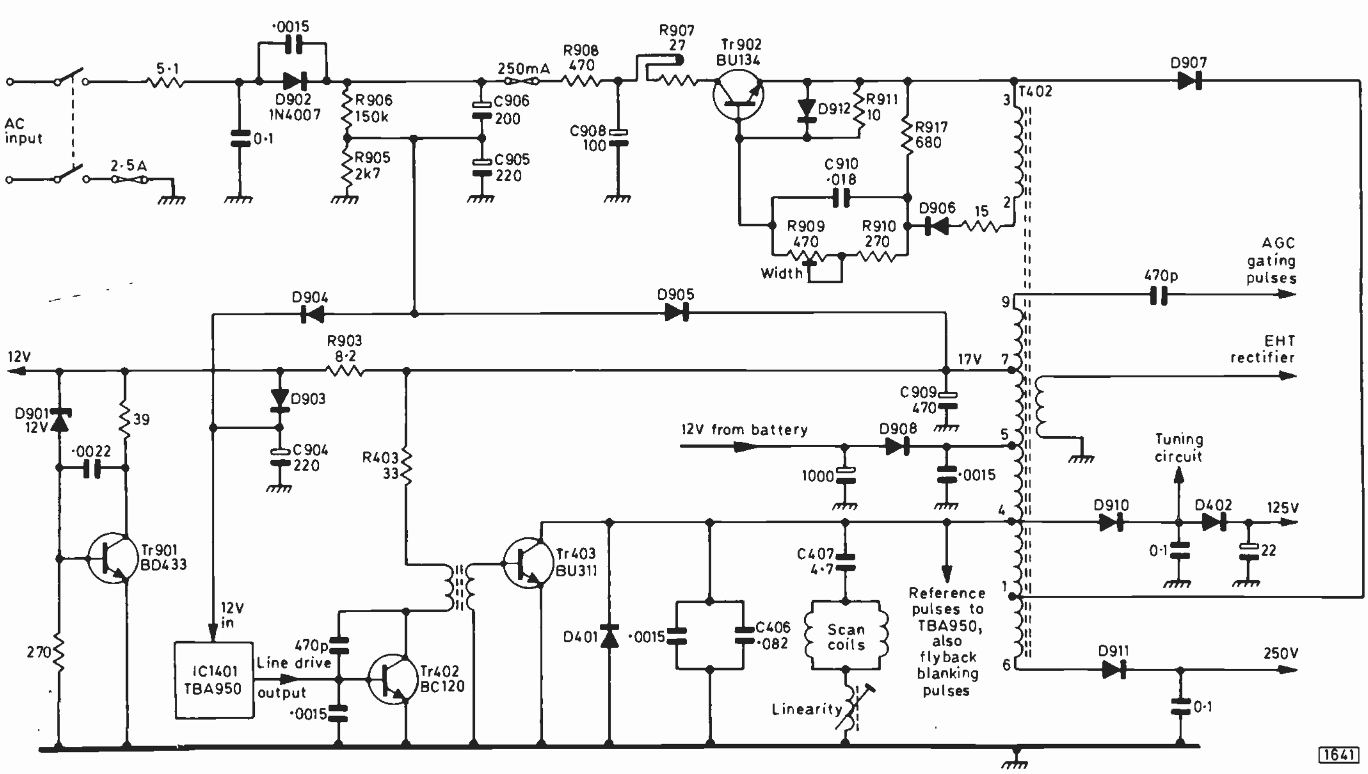


Fig. 2: Full power supply and line output stage circuit, Indesit Model T12S.

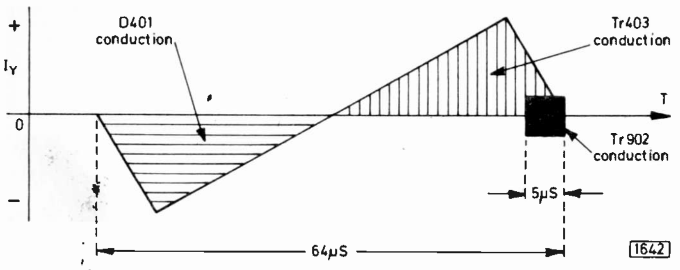


Fig. 3: Conduction duty-cycles of the line output transistor, the chopper transistor and the efficiency diode.

the l.t. voltage. If this is at all unclear, think back to the action of the PD500 in early colour set e.h.t. systems!

Kick-Start and Auxiliary Supplies

There remain one or two other points to clear up. The line oscillator, a TBA950 chip, is normally powered from the 12V line. Thus a start-up supply is necessary to power this – and the driver and output stages – at switch-on. Referring again to Fig. 2, the start voltage comes from the centre of the split reservoir capacitor C905/C906 and potential divider R905/6. At switch on, the mains-derived 6V or so at this point goes to the 12V line via D904 and to the 17V line via D905 so that the line output transformer is energised and the normal chopping action begins. As the 17V and 12V lines become established, D904 and D905 become reverse biased, isolating the start circuit. D903 is there to prevent the start up voltage being mopped up by the rest of the receiver, isolating the signal and sound stages during the kick-start process. This diode comes out of reverse bias and conducts when normal operation takes over.

The line timebase proper is conventional in this receiver, and is shown in Fig. 2. The square-wave oscillator output passes to the base of the line driver transistor Tr402 whose collector voltage source is the 17V line. There is a notable absence of frills around the line driver transformer T401 which feeds the line output transistor Tr403. The line output stage is tuned by C406, with D401 playing the dual roles of conventional efficiency diode and power-pump clamp, while C407 provides s-correction. Fig. 3 shows the conduction periods of D401 and Tr403. The flyback pulse at Tr403 collector is rectified by D910 to provide the supply for the video output stage and a control voltage source for the varicap tuner, while the c.r.t. first anode and e.h.t. voltages are provided by rectifiers operating from overwinds on the transformer.

When battery operation is selected, the chopper Tr902 takes no part, D907 now being reverse-biased. The set is then powered direct from the 12V line, with the 17V line provided by normal boost action from the line output stage.

SONY CAPACITANCE SWITCHER

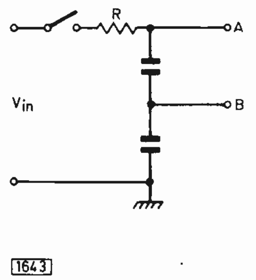
Our next circuit is also used in a small-screen model, this time a colour set, the Sony KV1340UB. Basically, all Sony television sets are designed to run from a supply in the region of 130V, which is a convenient figure for continental and USA/Canada mains supplies: the basic chassis in each case is intended for a wide export market, and is tailored in the sound, tuner, decoder and power supply departments for the various areas of use. For the UK market, the 240V mains supply set Sony an interesting voltage-conversion problem. In tackling this they have used a different principle of operation in almost every model released, and in doing so have run the gamut of virtually all possible techniques from a mains transformer to the unique circuit described here.

Before we can explain the operation of this power supply adequately we must delve for a moment into a little basic theory. Consider the circuit shown in Fig. 4, in which two capacitors in series are connected to a d.c. source via a switch and a resistor. When the switch is closed, charging current will flow through the capacitors, and since they are in series the same charging current must flow through them both. After a time determined by the relationship of the effective total capacitance and the resistor R, the voltage across R will have sunk to virtually zero, and the full d.c. voltage will appear between point A and earth. Now the charge on a capacitor is proportional to charging current and the time during which it flows. Because the charging current and time are the same for both of the series capacitors, the charge on each capacitor will be equal. Total charge in Coulombs is a function of voltage and capacitance, the relationship being that the larger the capacitance, the smaller the voltage for a given charge. If our equally-charged capacitors in Fig. 4 are of different values therefore, it follows that the voltage present across each is inversely proportional to its capacitance. To put it another way, ten volts across 1µF is worth five volts across 2µF, which sounds fair enough! Thus if the upper capacitor in Fig. 4 was 2µF and the lower one 1µF, one-third of the applied voltage would appear across the upper capacitor and two-thirds at point B with respect to earth.

Going off at a tangent for a moment, this charge = voltage × capacitance idea suggests that if we charge a capacitor to a given voltage, then somehow reduce its capacitance (say by further separating its plates), the voltage across it will rise. This is so, and can be demonstrated with an electrostatic voltmeter and variable capacitor: this conjures up visions of mechanical voltage multipliers, which are quite feasible in theory, but of little practical use. Let's get back to the Sony power supply circuit though!

Circuit Operation

The skeleton circuit shown in Fig. 5 illustrates the principle. On the positive half-cycle of the mains input S2 is open while S1 is closed. C1 and C2 now charge in series from the mains, each becoming charged to almost half the peak mains voltage. Thus approximately 150V is developed across each capacitor. One half-cycle later the mains input drives point A negative with respect to ground, and S1 opens while S2 closes. This isolates the circuit from the mains, and connects the two capacitors in parallel: each is charged to about 150V, and the parallel pair discharge through the load which is thus provided with a 150V line.



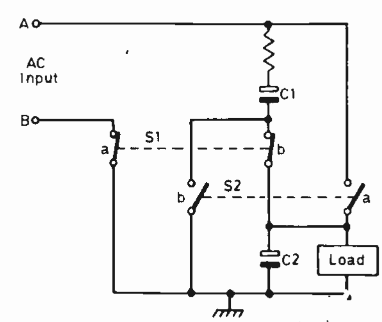


Fig. 4 (left): Series-connected capacitors charged from a d.c. source via a resistor.

Fig. 5 (right): Basic principle of the power supply used in the Sony Model KV1340U portable colour receiver.

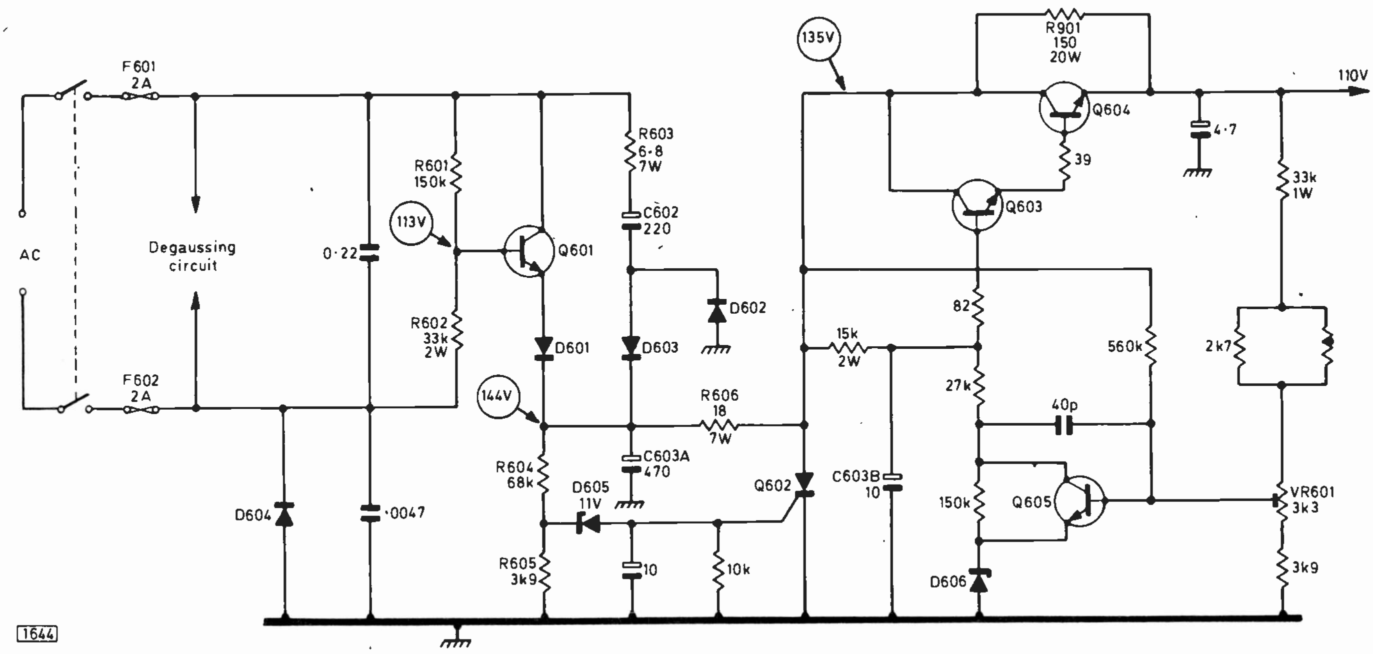


Fig. 6: The Sony KV1340U power supply circuit.

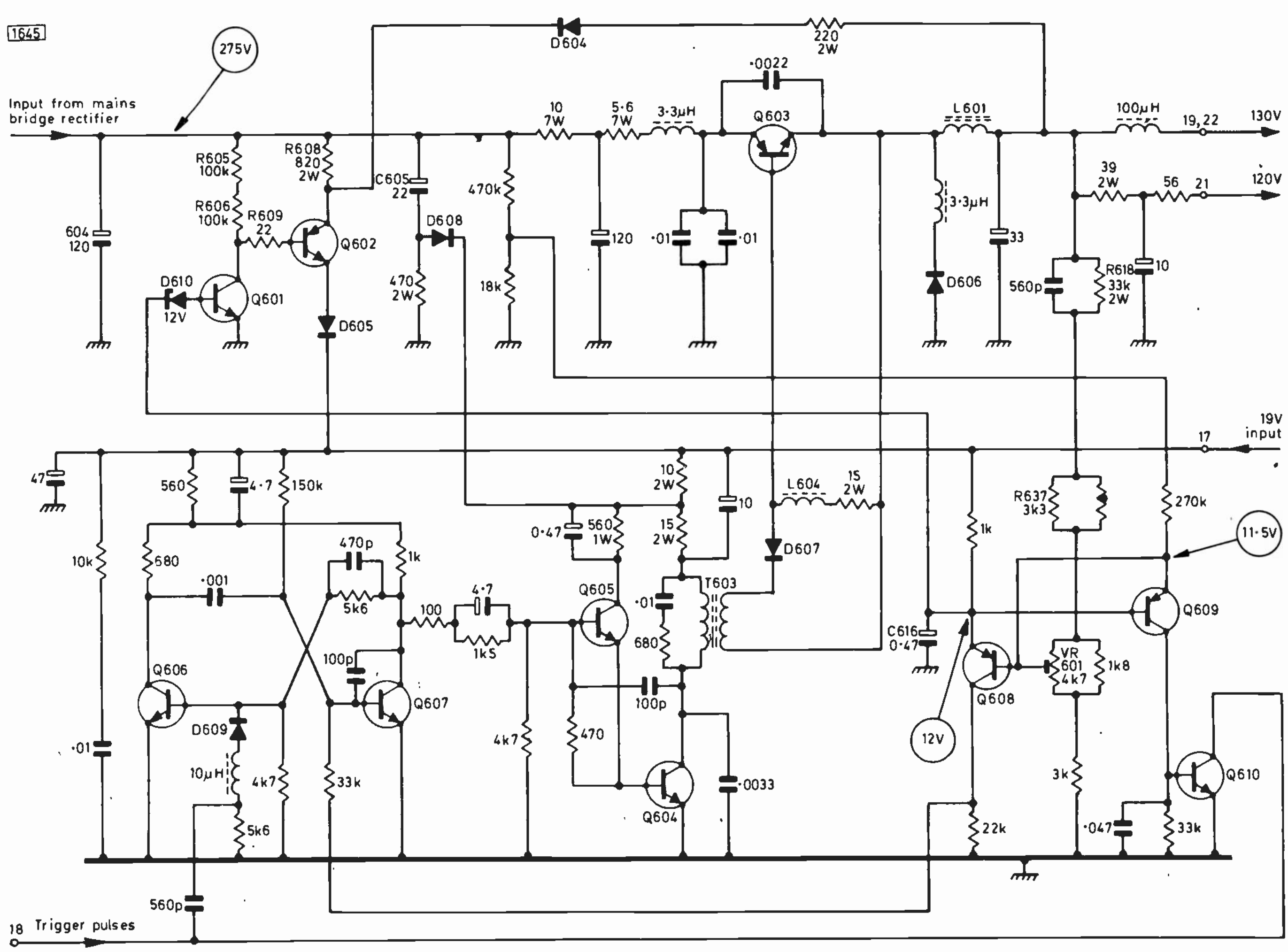


Fig. 7: The Sony Model KV1810U Mk. II power supply circuit.

Fig. 6 shows the actual circuit. C1 and C2 of Fig. 5 are C602 and C603A respectively, Q601 and D602 replace our S2a and b, while D603 and D604 act as S1a and b. On the positive mains excursion, Q601's base is held negative with respect to its emitter by R601/R602, so that the transistor stays off. Charging current flows via R603 and C602, and via the forward-biased D603 and C603A. This is the first phase completed, and about 150V is established across C603A. Now the mains voltage swings through zero and F602 becomes more positive than F601. This reverse biases

D604, isolating the mains input, and turns on Q601 via its base resistor network. The conducting Q601 links together the positive plates of C602 and C603A. C602 cannot instantly discharge, so its negative plate follows in a downward direction, turning D603 off and D602 on, so that C602's negative plate becomes clamped to earth. Our capacitors are now in parallel, and make available on R606 about 140V. It will be noticed that the lower capacitor C603A is more than twice the value of the upper one, C602. This is because the load is still present across C603A (or C2 in Fig. 5) during the initial series-charging phase, and this shunts away some of the charging current for C603A. It's necessary therefore to increase its capacitance to retain the balance between the upper and lower halves of the circuit.

The load is of course the receiver, and interposed between the power supply and the load is the conventional d.c. regulator/filter circuit Q603/4/5. This reduces the h.t. voltage to 110V (adjustable by VR601) and removes the 50Hz ripple.

We have made no mention yet of D601, which plays no part in the switching action. It's included to protect Q601 from excessive reverse base-emitter voltage.

Overvoltage Protection

The potential divider R604, R605 monitors the voltage across C603A, and if this rises towards danger level the 11V zener threshold of D605 is exceeded. This component then passes a current into the gate of the crowbar thyristor Q602 which fires, shorting the 150V line to earth and blowing the mains fuses.

LT and CRT Supplies

The sound output and timebases are operated from the 110V line in this receiver, while supplies for the RGB output stages, the c.r.t. anode potentials, the tube heater and an l.t. line of 17·5V are all derived from the flyback transformer (this is not the line output transformer!). No start-up problems here, as the power unit works wholly at 50Hz mains rate.

This power supply circuit is certainly a neat and relatively simple design, but suffers from the disadvantages of drawing d.c. from the mains and a half-live chassis, an unusual combination. Heavy transient mains consumption, and the ripple-current requirements of the two capacitors involved, suggest that this circuit configuration will not be developed for larger-screen receivers.

A GCS CIRCUIT

For their 114° 18in. Trinitron Model KV1810UB MkII the Sony Corporation came up with another variation on the switch-mode theme. The circuit is shown in Fig.7. The bones of the circuit are the switch Q603, the chopper choke L601 and the recovery (clamp) diode D606. The basic energy store is L601, and the principle of the chopper circuit is the well-known one utilised in the Thorn 3000 chassis and its derivatives.

GCS Characteristics

The novel feature of the circuit is the use of a gate-controlled switch (a Sony special) instead of a conventional transistor as the switch – it's also used as the line output device in this receiver. There is also the need for a start-up feed due to derivation of the secondary supplies from the line output transformer. The GCS is a cross between a transistor and a thyristor – a sort of Japanese Welsh Arab. If the gate is made positive with respect to the cathode, the device will conduct between its anode and cathode and stay latched on, even if the gate current is removed. These are the characteristics of a thyristor, and the similarity is maintained in that the GCS can be turned off by reducing the cathode current below a certain holding level. This property is not used for Q603 though, because the GCS, unlike a thyristor, can be turned off while in full cry if the gate is made sufficiently negative with respect to the cathode.

Circuit Description

Turning in our new-found wisdom to Fig.7 then, the similarity to the Thorn 3000 family will be seen in the line-triggered monostable Q606 and Q607 whose time-constant, and thus mark-space ratio, is governed by the d.c. amplifier Q608. The conduction of Q608 is dependent on the setting of VR601 (set h.t.) and the voltage of the 130V output line sensed via R637 and R618. The monostable's output at Q607 collector is buffered by the emitter-follower Q605 and passed to the chopper driver Q604. Thus we have a square-wave output at T603 secondary.

From this point on all similarity with other circuits ends, for the drive circuit to the chopper GCS must provide a turn-off pulse as well as a triggering pulse. Let's break into the cycle at the point where Q603 is conducting and we require to switch it off. The top end of T603 is so phased that it goes negative at this time, and D607 conducts to drive Q603's gate negative, thus turning it off. Energy is stored in L604 during this period, and at the end of the "space" section of the drive waveform along comes a "mark" and the polarity of the voltage across T603 secondary reverses, cutting off D607. The stored energy in L604 is now released to provide a positive spike to switch on Q603 at its gate, and the cycle is complete. This back-to-front explanation is valid after one half cycle of drive!

Kick-Start

There remains the problem of getting the line oscillator and the switch-mode control circuits off the ground at switch-on. Both are powered from the 19V rail, which is absent until the line output stage fires up. Thus Q601 and the GCS Q602 are provided to form a kick-start mechanism. At switch-on, current flows via R605, R606 and R609 into the gate of the GCS Q602 which conducts, connecting the 19V line via R608 to the 275V line from the mains rectifier bridge. As the 19V rail capacitors charge the voltage rises, until at about 15V (by which time the line oscillator and monostable are banging away) the zener D610 reaches its conduction threshold and passes current into the base of Q601. This npn device promptly turns on and grounds the gate of Q602. As Q602 cathode is at 15V or so, the negative-gate turn-off requirement is met, and with the h.t. and l.t. lines established Q601 stays on, and Q602 and D605 stay off. In fact when the receiver is switched off and the 19V rail falls to a level where D610 comes out of conduction, the kick-start GCS turns on again and conveniently discharges the reservoir capacitor C604 via R608 into the heavily-loaded 19V rail.

This brings us to D604. It spends most of its life reverse biased, but has a brief moment of glory at switch-off. As the

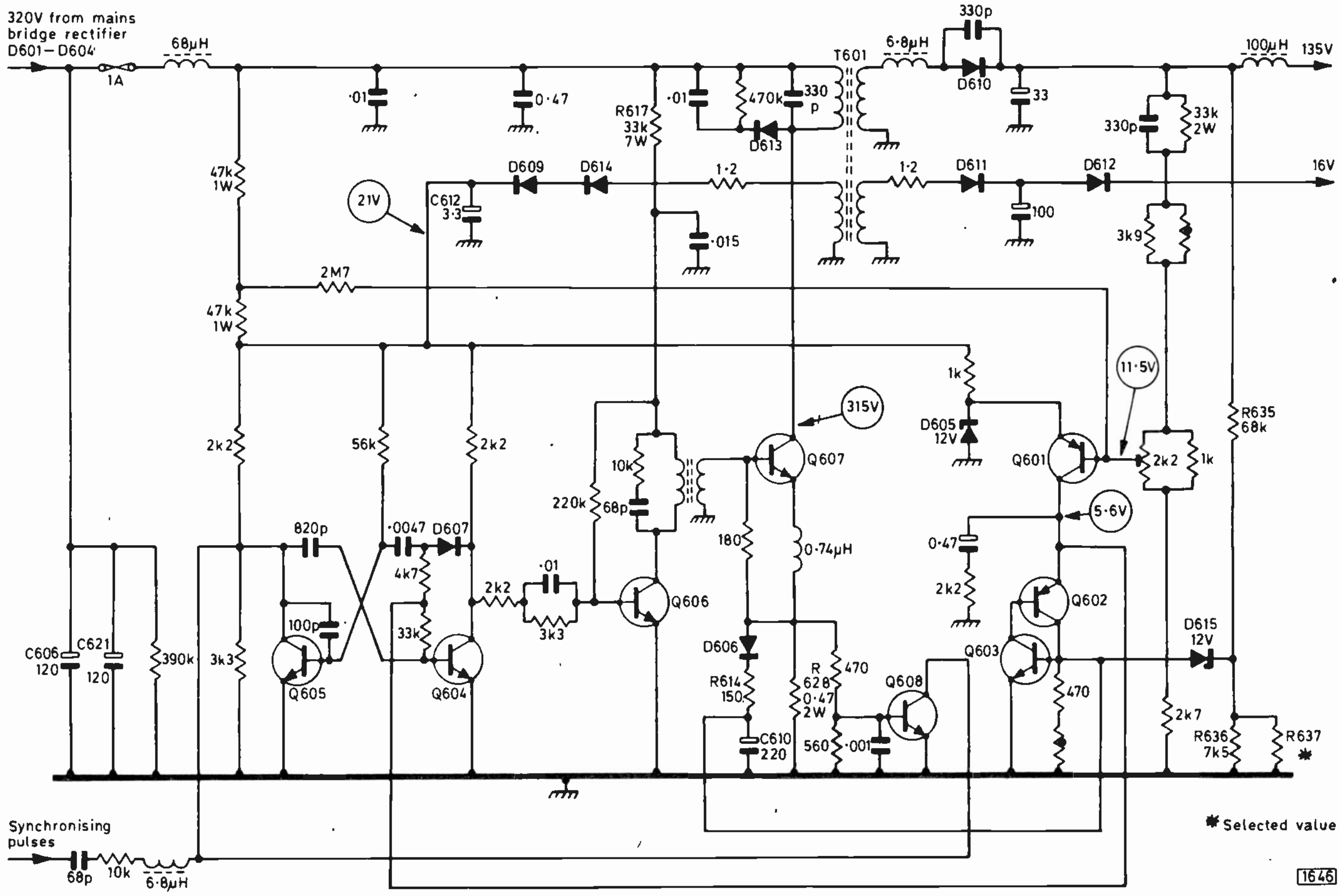


Fig. 8: The Sony Model KV2000U power supply circuit.

supply lines all decay it is important that the line oscillator continues until the bitter end – for reasons which we will explain in the next section. When the set is switched off then, the 275V line decays and Q602 comes into conduction. This connects the cathode of D604 to the 19V line, so that the last dregs of voltage on the 130V output drain into the line oscillator hanging on the 19V line. Thus the drives to the chopper and the line output stage are maintained until there is barely a volt to be had anywhere in the set.

There is an auxiliary start-up supply to the chopper driver department via D608, which furnishes a momentary voltage at switch-on by virtue of the charging current in C605.

Protection

It seems that excessive current consumption is such a remote possibility in this receiver that no over-current precautions are necessary – a very moot point after a year's experience of this set, but that's a different story!

Sony do provide an overvoltage trip however, in the form of Q609 and Q610. D610, whose anode is effectively earthed through the conducting Q601, sets up a stabilised potential of 12V on Q609's base. Under normal circumstances the emitter of this transistor sits at 11·5V, and no base current flows. If the 130V rail rises however, Q609's emitter comes up as well. Soon the base-emitter junction of Q609 becomes forward biased and Q609 conducts, turning on Q610 which grounds the squarewave triggering input and brings the monostable and chopper to a grinding halt. This usually leaves the chopper GCS hard on due to the absence of the switch off pulse from its drive department. The h.t. voltage goes "off the clock", and the line output GCS makes the supreme sacrifice. A puff of smoke and a blown mains fuse, with at best two dead short GCSs, bring down the curtain on the overload protection phase! Plainly this "protection" is something of a misnomer, and the same sequence of events can occur if the line oscillator stops. In fact the line oscillator i.c. is designed to continue in the face of a very low supply voltage. Our previous reference to D604 and its function can now be understood.

Not our favourite switch-mode circuit this one, but interesting nevertheless. We will offer some advice on dealing with this power supply in the servicing section next month.

SONY KV2000UB CIRCUIT

To round up our Sony collection, Fig. 8 shows the switch-mode power supply circuit used in the current Sony 20in. model. In many respects this set-up is conventional, but the protection circuitry is interesting. Basically it's a shunt chopper circuit (the Thorn 3000 chassis uses a series chopper circuit). Let us first describe the operation of the main circuit, starting at the bridge D601-D604 which provides a 320V mains-derived supply across the reservoir capacitors C606 and C621. This voltage is switched across the primary winding of T601 by the chopper output transistor Q607, which operates at a mark-space ratio of almost 1:1. T601 has three secondaries, the main one providing a 135V line via D610. This powers the entire receiver including, indirectly, the scan-derived l.t. lines. The lower secondary provides a kick-start potential for the line generator i.c., while the "third secondary" winding provides 21V for use in the control circuits in the power supply itself.

The drive to the chopper transistor is from Q606, whose base waveform consists of a variable mark-space ratio line-rate squarewave derived from the line synchronised multivibrator Q604/Q605. Unlike the monostable in the 18in. receiver just described, this one is astable, free-running in the absence of synchronising pulses so that the power supply will operate if the line timebase in the receiver is not running. The mark-space ratio is controlled by the conduction of the error amplifier Q601, in similar fashion to the previous circuit.

Safety Circuits

There are three types of overload protection: excess current limiting, over-current cut-out and over-voltage cut-out. The first two depend on the voltage developed across R628 in the emitter return lead of the chopper transistor Q607. The voltage across this resistor is proportional to the current flowing in it, and this reflects the current drawn by the receiver and loading T601.

At normal beam currents, the h.t. current drawn from the 135V line is about 600mA. This corresponds to 200mV across R628. Such phenomena as c.r.t. flashovers cause transient current demands in excess of normal, and these momentarily increase the voltage across R628 to the point where Q608 turns on. This virtually grounds the collector of Q605 in the astable multivibrator, deleting the drive to the chopper. With no emitter current in Q607, the base current in Q608 drops back and it reverts to cut-off. Normal drive is then resumed. The threshold of operation for this circuit is about twice the normal h.t. current.

In the event of a short-circuit line output transistor or other sustained fault, the above action will take place but each time the chopper is reinstated a heavy current will flow through Q607. After about 700ms, C610 will have acquired enough charge via D606 and R614 to turn on Q603, whose collector current flows through the base-emitter junction of the pnp transistor Q602. The latter transistor thus conducts, and latches Q603 on by virtue of its collector current flowing through Q603's base. The pair are now locked in conduction regardless of the external conditions on Q603's base – this will be recognised as normal thyristor action, and in fact the pnpn junctions of Q602 and Q603 form what might be called a discrete thyristor. Our D-I-Y thyristor is now hard on, and with the base of Q604 effectively grounded the astable multivibrator is muted, deleting the chopper drive so that the set cuts off and stays off.

The same transistors are used to shut down the set in the event of the 135V line rising unduly. When the h.t. voltage rises to about 146V, the potential developed by the divider R635/6/7 exceeds the 12V zener breakdown point of D615 and Q603 turns on. This shuts down the power supply as related above.

When the set has been latched off in this way, power can be restored only by switching off the set to allow the capacitors to discharge. At switch-on, conditions will again be sampled, and immediate shutdown will result if the fault remains.

Next Month's Circuits

So much then for the wonders of the Orient. We will return to these circuits when we discuss servicing. Before doing so next month we will be taking a look at an up-to-date switch-mode power supply used in a UK chassis – the ITT CVC20.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

As May approaches there are increasing indications that the coming Sporadic E season will be a good one. Personally I feel that 1977 will provide us with an extremely active season. There have already been several SpE openings which have given quite strong signals from most parts of Europe. Meteor Shower reception has also had its moments. The most important recent MS reception was when Clive Athowe (Norwich) logged a two second burst from the Rumanian Ploesti ch. R6 transmitter (150kW e.r.p.) on March 24th at 1009 BST. The signal consisted of the monoscope test card and was accompanied by a Russian (TSS) signal on ch. R1. The distance travelled by the ch. R6 signal was over 1,200 miles and must constitute a new record for Band III reception. Our congratulations to Clive.

Report on the Month

Rather than list daily reception I'll give a summary of the more important signals received here during the month – yet again I'm short of space. There was something present most days. Some mornings produced virtually nothing, while other days were very active with MS bursts. The predominant signal seems to have been CST (Czechoslovakia) with the EZO pattern on ch. R1, often pinging with TSS (USSR) on programme material. There was an excellent SpE opening on the 19th – though personally I missed this – with excellent signals from RIA (Italy) on ch. IA, JRT (Yugoslavia) on chs. E3 and E4, MTV (Hungary) ch. R1, ORF (Austria) ch. E2a and West Germany ch. E2 during the late afternoon.

A Mystery Signal

The evening of the 24th produced a most unusual period of reception which I'm still uncertain about. Signals from a southerly direction were first noted at about 1845, with a characteristic multiple image effect and fading into the noise. A coloured announcer appeared at 1900, followed by a musical concert. Soon after, RTVE (Spain) was logged with football and commercials on ch. E3. The conclusion of the concert brought captions in English! Unfortunately the nature of the signal made exact identification impossible, and following a "Skippy" programme it faded out. Did anyone else see this mystery signal?

Belgium changes Systems

April 26th saw the start of Belgian operation on System B. The ch. E8 and E10 outlets were observed with the PM5544 test pattern during the early morning, the E8 transmission carrying the identification "WAV 8". It seems that the ch. E2 outlet will continue using System C until the end of the year, when it will be dismantled.

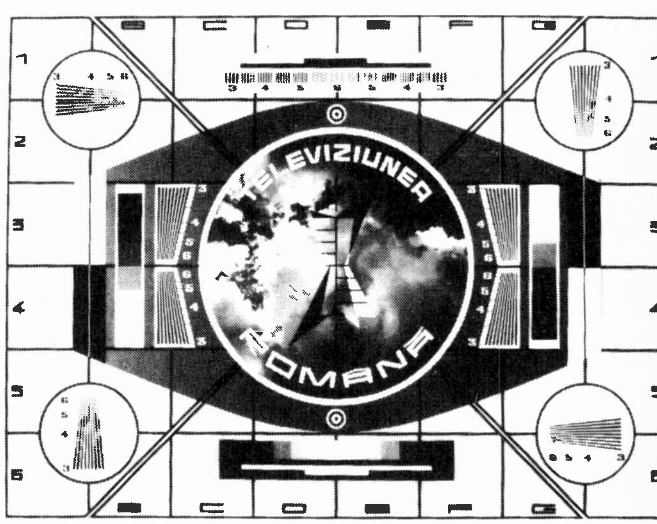
The Annan Report

One topic in the Annan report is of interest to us. The 405-line service is due to end in the early 1980s. Annan suggests that there is a need for a fifth 625-line channel with a more regional flavour. This could use Band III, and Band I where necessary – finance allowing. I feel that the important words are: "It is difficult to foresee how much of v.h.f. Band I will be needed for the fifth off-air television service, but some frequencies in Band I might well be available for other services".

News from Abroad

Republic of Guinea: The Republic is to start TV transmissions late this summer, though it's planned to have a basic system in operation in the Conakry area (the capital) in time for the Independence Day Anniversary Celebrations on May 14th. Marconi supplied much of the studio equipment.

Eastern Europe: A 500ft. tower has been completed for CST1 and CST2 (Czechoslovakia) on Mt. Klet near Cesky Krumlov (Southern Bohemia). Near Kosice the new Cizatice transmitter has come into operation – channels unknown. TVP2 (Poland) at Lebork is now operating. A new studio centre is being built at Riga hopefully improving reception in Latvia, USSR. *Broadcast* magazine has



The Televiziunea Romana (Rumania) monochrome test card. Photograph courtesy Brian Fitch.

pointed out that our caption on page 257, March issue is incorrect. The programme title "Vremya" is a weekly current affairs show produced at studio 5 of the Ostankino Centre, Moscow. Soviet TV's frequent news bulletins – at 1800 and 2000 local time on the first network – are identified by the word "Novosty" which on the screen looks like "Hobosti". The background graphic, a solarised animation of a satellite earth station, is the same as used for "Vremya".

Twenty-first Sunspot Cycle

Speculation continues as to whether the new sunspot cycle (the 21st) will provide a low or a high count. A high count is what we hope for since the m.u.f. (maximum useable frequency) of the F2 layer then rises sufficiently to reflect the lower v.h.f. signals over vast distances. The magazine *Nature* (February 1977) published a letter claiming that a formula which suggests that the new cycle will have an average high count (i.e. at peak time) of 195 – similar to cycle 19 which was at its peak in the late 1950s – has been derived. At its peak, cycle 19 produced v.h.f. propagation over paths of several thousand miles at up to 60MHz. We can but hope! The count is at present increasing and the maximum activity will be in 1981/2.

New EBU Listings

Finland: Kruunupyy YLE-2 ch. E30 200 kW e.r.p. (23E31 63N44); Pihtipudas YLE-2 ch. E32 1000kW e.r.p. (25E39 63N17). Both with horizontal polarisation.
Iceland: The ch. A2 AFRTS air base TV transmitter has closed (2mW).
Malta: Radio TV Indipendente (Tivumalta Ltd) ch. E21 10kW (horizontal).
Switzerland: La Dole ch. E4 reduction in e.r.p. from 150kW to 144kW.

Correspondents' Comments

Hugh Cocks has found that when making the Tru-Match type of wideband Band I array placing the smaller h.f. resonator some 3in. in front of the main dipole rather than 3in. below gives a noticeable increase in performance on ch. E4.

Earnie Earnshaw (Newcastle on Tyne) comments that he is astonished at the high prices quoted for set conversion and the supply of foreign receivers. He has obtained a Hitachi portable from West Germany fitted with both v.h.f. and u.h.f. tuners and with separate i.f. strips for systems B, G and I, the latter being selected via a single push button. It's similar to the model P20 sold in the UK but costs just £4.50 more than the UK price for the P20! The receiver can be obtained through Hitachi Sales (Europa) GmbH, Kleine Bahnstrasse 8, 2 Hamburg 54, West Germany – not from Hitachi UK.

Spectrum Analyser

Alan Latham in Abu Dhabi has constructed a spectrum analyser for TV use, using a 0-30V tuning line and a varactor v.h.f. tuner. He found that a suitable 30V sweep could easily be obtained by differentiating the voltage across the field scan coils. The tuner can thus be operated either normally, via a 30V tuning line, for single channel use, or be switched to analyse the full bandwidth. The spectrum appears as horizontal black bars and white spaces, the bars for transmissions and the white spaces for unused channels.

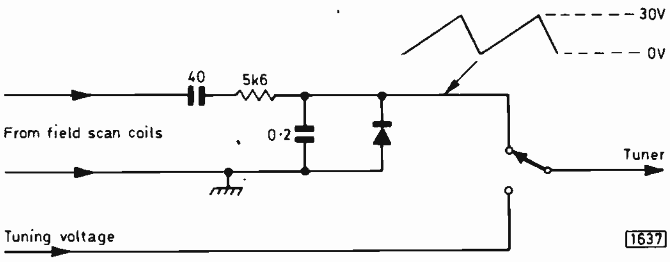


Fig. 1: Idea suggested by A. J. Latham for obtaining a 30V sawtooth to modulate the tuning voltage input to a varicap tuner, enabling it to be used in a spectrum analyser arrangement. The voltage across the field scan coils is integrated and clamped to give a field-frequency sawtooth of 0-30V.

We do not advise modifying TV sets for this purpose unless you are fully experienced in such work. See Fig. 1.

More on Satellites

Information has been coming in on the results of the recent conference in Geneva held under the auspices of the ITU. Much of this information is on future plans for an eventual satellite broadcasting service – still very much in the planning stage. The "Ariane Large Satellite" will be launched in October 1980 however and will carry high output equipment (450W) for TV/radio transmissions in the 12GHz band. Much of this information is detailed, giving considerable insight into the future of broadcasting in the forthcoming decades, but is best left to a separate article.

Philips have available (to order, price unknown) "direct to home" satellite TV reception equipment covering 860MHz (ATS), 2·6GHz and 12GHz. Head converters change down to 120MHz, though the 12GHz unit has an i.f. of 330-470MHz. The array consists of a 1·6m diameter dish with a gain of 44dB (isotropic) and with 60% efficiency. Philips initially designed for vertical polarisation but the conference decided on circular polarisation.

HOW TO DX – PART 3

Signal preamplifiers are basically used to lift the level of weak signals sufficiently to obtain pictures with the minimum noise (grain, snow). This is because noise in the first stage of a receiver is amplified throughout the succeeding stages: by adding at the input an amplifier designed for minimum noise the overall noise performance of the receiving installation is improved. In addition, in the case of long-distance television many of the signals are so weak that amplification at the aerial is essential if they are not to be lost in the feeder prior to arriving at the set's aerial input socket.

The noise performance of modern, transistor tuners can be very good, especially at u.h.f., and for this reason the addition of a preamplifier may make little difference to picture quality. With valve tuners however the addition of a low-noise preamplifier can give a dramatic improvement.

Performance Characteristics

In considering the purchase of a preamplifier thought has to be given to the noise figure as well as to the gain therefore. Another point is the ability of the amplifier to handle strong signals. Most of us live in areas served by at least one high-power u.h.f. transmitter, apart from the 405-line transmissions and a minimum of three v.h.f./f.m. radio transmissions present. The problem is what happens when the amplifier receives strong local signals in addition to the weak distant signals we're interested in. The characteristic of importance here is linearity. Any non-linearity will result in some mixing of the unwanted strong signals(s) and the wanted weak signal.

Gain

Amplifier gain is normally quoted in decibels (dBs), often related to a basic reference point, for ease say 1mV. If you look at a dB/voltage chart you will see that a gain of 6dB is twice, 12dB 3·98 times (say four) and 18dB 7·94 times (say eight). Giving the reference 1mV to these gains gives 6dBmV 2mV (twice 1mV), 12dBmV 4mV (four times 1mV) and so on.

Noise Figure

An amplifier's noise figure indicates how much noise it adds to the weak signal passing through: the lower the noise the less the grain on the picture – or the hiss on the sound channel. 75Ω input/output figures are normally used for aerials and amplifiers. Aerials are designed to maintain as nearly as possible a 75Ω output impedance over the bandwidth covered, so we use a low-loss coaxial feeder with a 75Ω characteristic impedance. The amplifier's input is designed to match this 75Ω impedance, and since the input at the receiver is 75Ω the amplifier's output is at the same figure. The aim is that with all the items matched there is maximum signal transfer through the system and minimum noise. Ideally then, the amplifier will see a 75Ω source at its input. If we connect a non-inductive 75Ω resistor here instead of an aerial we will be presenting to the amplifier a 1·25μV noise signal (a 75Ω resistor gives an *open-circuit* noise voltage of 2·5μV at 5MHz bandwidth). This, related to 1mV, is 800 times lower, which in decibel terms is –58dB (signal-to-noise figure).

Cross-modulation

Cross-modulation occurs when the signals entering the amplifier exceed its signal handling capability. Remember that the amplifier is a broadband device, so that strong local signals will be entering it in addition to the weak signal you're interested in. Thus the signal you're trying to receive may suffer from video buzz, excessive contrast etc. due to the other signals present, while these may also appear in weakened form – with all three u.h.f. transmissions in operation you may see all three pictures floating over each other on channels other than their own. Figures are often quoted for maximum output and mean output. The former usually indicates the amplifier's handling capability with a single input signal, and the latter its performance with a certain number of signals. Take for instance the Labgear CM6040/WB wideband masthead u.h.f. amplifier. The peak handling capability is quoted as 167mV (44·5dBmV) whereas with four signals present – as would be the case with the full local u.h.f. group on-air – the handling capability is derated to 94mV input (39·5dBmV). This amplifier is a two-stage unit. The single-stage CM6000 has lower ratings – 25mV (28dBmV) peak and 14mV (23dBmV) mean. Thus the CM6040 will not produce cross-modulation until the 90mV input signal level is reached while the CM6000 will start overloading at 14mV. The overall results obtained depend on the tuner's overload figures as well. These vary with different types of tuner. Despite its high noise figure, an old valve tuner will be less likely to overload than a bipolar transistor tuner. I have recently seen the specification of a Telefunken varicap tuner which uses f.e.t.s at v.h.f. and bipolar transistors at u.h.f. The cross-modulation figures given for an interfering signal two channels away from the wanted one are typically 100mV in Band I and Band III, dropping to 15mV at u.h.f. This is for 1% cross-modulation against a wanted signal of 1·5mV.

Choosing an Amplifier

In deciding on an amplifier therefore we have to consider gain, noise performance – remembering that with increasing bandwidth noise increases and gain falls – and cross-modulation performance also taking into account the tuner.

There is a large range of signal preamplifiers on the market. At u.h.f., and certainly where long coaxial feeder runs are involved, a masthead amplifier is essential. For Band III such an amplifier is helpful while for Band I it's unnecessary. The recommended approach therefore is to use a u.h.f. masthead unit – type depending on the aerial system – and for v.h.f. an indoor amplifier such as a wideband distribution type – this has the added bonus of a little extra amplification at u.h.f. if necessary. To avoid wear and possible intermittent contacts a separate aerial connection panel with the aerials, amplifier inputs and output and receiver input is recommended. Apart from operational ease this will avoid damaging the amplifier's sockets, particularly where these are soldered directly to the chassis.

If a single, wideband u.h.f. aerial such as the Antiference XG21W or Wolsey Colour King is used the obvious thing is to select a wideband amplifier, and unless you are unfortunate enough to live in the shadow of Crystal Palace or one of its brothers a two-stage unit will give higher gain with better noise and cross-modulation performance. Examples are the Wolsey Supa Nova u.h.f. amplifier or the Labgear amplifier previously mentioned. If you are some miles from your local transmitter and use separate aerials such as a local group A and a wideband group E, I suggest the Supa Nova type for wideband operation and a lower-gain, single-stage unit for group A. Supa Novas could be used with both aerials, but some form of attenuation and filtering/trapping may be necessary on channels adjacent to the local ones. Finance will dictate the eventual choice, and if only a single masthead amplifier can be afforded the two-stage Supa Nova approach should be adopted with signal tailoring as necessary indoors.

Reliability

Masthead amplifiers are reliable and do not nowadays suffer from the gain variations (i.e. falling during the cold Winter months) common years ago. Even close lightning strikes do not normally affect them. Two years ago the local brewery some ninety yards away was struck and this had no effect on the Wolsey Orbit amplifier I was at the time using atop the 50ft. mast!

Build or Buy?

It is easiest to buy a ready-made masthead unit with its custom made weatherproof housing, saving your constructional efforts for the indoor amplifiers and associated equipment. Most aerial manufacturers have a range of amplifiers. If you'd like me to go farther into the subject of decibels and noise, let me know and I'll put something extra in the concluding part. Those interested in construction will find a number of suitable designs in previous issues of the magazine.

Service Notebook

G. R. Wilding

Avo Repairs

Tens of thousands of big Avos are used in the TV service trade alone. Their Bakelite cases are extremely tough, but even so from time to time one will get dropped once too often from too great a height and, though the meter movement may be unaffected, the case may crack or break. It happened to me recently when I caught one of the leads in the car boot lid – the instrument was torn from my hand and hit the road with such force that both the case and the window glass were broken. The meter continued to work on all ranges however so replacement parts plus a new set of leads were obtained from the Avo spares and repairs division – the London Instrument Repair Centre, Archcliffe Road, Dover, Kent. The charges are very reasonable, so it's worth knowing about this service.

After fitting the new glass and case we decided to repaint the range markings etc. which had become faint and discoloured. The drill is to completely scrape out all the old lettering, swamp the indented printing with a quick drying hard enamel, then wipe off the surplus with a non-fluffy piece of material. The enamel sold in miniature tins for model makers is usually quite effective. Avo do not supply paint for marking in but suggest using a white crayon, one proprietary make being Stanol, made by the Cosmic Crayon Co. Ltd. and available from most large stationers etc. This is suitable for temperate climates but not in the tropics – nor, probably, the rear window ledge of a car at the height of the summer!

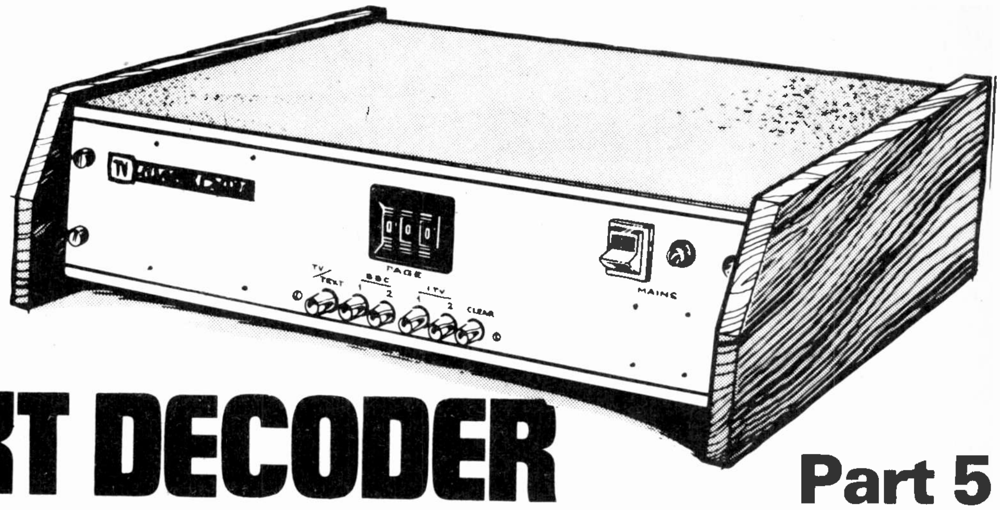
Ragged Verticals

No line or field sync on a set fitted with the Thorn 1400 chassis was found to be due to absence of voltage at the screen grid of the sync separator section of the 30FL1, the feed resistor being open-circuit. On replacing it the line lock was solid but the verticals all had a ragged edge – particularly noticeable on the test card. In most sets this would place suspicion on the line oscillator and flywheel sync circuits, but in these sets the cause can be a faulty e.h.t. tripler which can be quite blameless in other respects – i.e. full e.h.t. and no ballooning on increasing the brightness to a high level. On fitting a new tripler the ragged edge to the verticals completely disappeared.

Weak Line Sync

A Pye hybrid colour receiver (697 chassis) had good field but weak line sync. Now this is very often due to the 47kΩ pulse feedback resistor R203 to the flywheel sync diodes. The resistor and diodes, on the vertical line timebase panel, can be easily checked but proved to be o.k. The PCF802 line oscillator valve was the next suspect, and a replacement cured the trouble. Why not, as is the usual procedure, check the valve first? Well it's possibly more difficult to get at it in this chassis than is any valve in any modern set, so it pays to check the components previously mentioned first.

THE TV TELETEXT DECODER Part 5



Steve A. MONEY T. Eng. (CEI)

HAVING selected the desired page of data from the incoming Teletext transmission and stored it in the memory card we now have to produce a display of the corresponding text on the television screen. This is the function of the third logic card.

Character Generation

The symbols displayed on the screen are made up from arrays of illuminated dots which are selected to give the shape of the desired symbol. In some Teletext decoders each character is displayed using an array of 35 dots arranged in seven horizontal rows of five dots each. When both upper and lower case letters are required however the array has to be made larger to cater for the descending tails of some of the lower case letters such as g and y. In addition, it's usual to leave one blank row of dots between successive rows of text in order to separate the rows and make them more readable. In the same way a single column of blank dots is usually included between adjacent characters to separate them. Allowing for these factors the total size of the dot array becomes six wide by ten rows high.

For convenience each horizontal row of dots in a row of text occupies one line scan. Thus a row of text uses ten lines and the whole page takes up 240 lines on the screen.

The complete set of characters used for Teletext, with the corresponding binary codes, are shown in Table 1. It will be seen that there are a total of 96 different letters, numbers and other signs.

To display a symbol the first thing we have to do is to convert the binary number obtained from the memory card into the corresponding pattern of dots needed to reproduce the required symbol on the screen. The most convenient way of achieving this is to have all the symbol dot patterns stored in a large memory array from which the desired dot pattern can be selected by applying the appropriate binary number to the memory address inputs. A large memory array such as this can be produced quite readily on a large scale integrated circuit. The dot patterns will be permanently built into the memory when it is made, i.e. the circuit is a Read Only memory or ROM. When this type of memory is used to store character dot patterns it is usually called a character generator ROM.

In the original prototype of the *Television* Teletext decoder the character generator used was a Signetics 2513. This produces only upper case letters plus the numbers and signs. Some of the signs produced by the 2513 are different from those in the standard Teletext character set. The design of the display card has since been updated to use the Texas type X887 (SN74S262N) ROM which was designed for use with the Tifax Teletext module. This character generator provides all 96 Teletext characters, including the recently changed symbols, to exactly the Teletext specification.

A character generator device is arranged to give only one row of five dots at a time from the stored array. This fits conveniently with our television scan since we can display only one row of dots in the line of text during a line scan. On the next line scan the next lower row of dots in each of the character arrays will be traced out on the screen. The particular row of dots which has to be provided for each symbol array is determined by some form of counter operating from the line sync pulses.

Two sets of address signals are normally applied to the ROM. One selects the dot array and is controlled by the binary code of the character to be displayed. The second tells the ROM which row of dots in the character array is to be presented at the output, and is driven by the signal from the line scan counter as successive rows of dots for the line of text are scanned through on the screen.

Let us now look at the circuit operation and see how the character display is actually produced.

Circuit Operation

Fig. 1 shows the complete circuit of the display logic board.

To produce the dot patterns on the screen we start off with a dot clock generator which consists of the two monostable circuits of a 74123 (IC17) connected back-to-back to form a free-running oscillator.

One complete line scan period takes up 64μs, but the part which is visible on the screen is usually only about 51μs or so (depending upon the setting of the width control). If we allow for margins at each side it is convenient to make the text display take up 40μs of the line scan. With 40 characters in a row of text this allows 1μs for each character space. If we assume six dots per character space, five for the symbol and one for spacing, the dot clock needs to be running at 6MHz. The frequency of oscillator IC17 is governed by RV2, R7, R8 and C8. Adjustment of RV2 will alter the frequency of the dot clock and can thus be used to alter the width of the text display.

To produce a centred display we need a blank margin at the top of the screen. Two 74177 counters, IC18 and IC19, control the size of this margin. When the field sync pulse occurs IC19 will be set at a count of five whilst the B, C and D sections of IC18 will all be set at 0. The A section of IC18 will be set at 1. Line sync pulses are applied to the input of IC19 so that the counters count off the line sync pulses. After 58 line pulses starting from the end of the field sync, stage D of IC18 goes to 1 whilst stage A goes to 0. The signal from A stops IC19 from any further counting action whilst the signal from stage D releases the dot clock circuits and allows the text display to start. This action produces the required blank margin at the top of the page display on the screen.

A second margin is needed at the left hand side of the screen to centre the display horizontally. This margin is produced by monostable IC16, which is triggered by every line sync pulse. When triggered, IC16 stops the dot clock generator for a period of about 17μs after the line sync pulse. This produces the blank margin at the left side of the screen. The width of this margin is controlled by RV1 which acts as a horizontal shift control for the text display.

To produce a clock pulse once for every character scanned on the screen, the dot clock is divided down by six in the 7492 counter IC12. This character clock is used to advance the memory card address circuits via output DCK, so that the next character to be displayed is selected from the memory ready for display.

The dot pattern from the character ROM IC2 is loaded in parallel into the eight bit shift register IC1 by the character clock pulse from the 7492. Once loaded, the dot pattern is shifted out of the register at the dot clock rate as a serial pattern of 1s and 0s which will form the video signal for the character display, producing the bright and dark dots on the screen. As the dot pattern for the symbol is clocked out of the register it is replaced by 0s and at the end of the character one of these is used to form the space between adjacent symbols.

				B7	0	0	0	0	1	1	1	1
				B6	0	0	1	1	0	0	1	1
				B5	0	1	0	1	0	1	0	1
B4	B3	B2	B1	col / row		1	2	3	4	5	6	7
0	0	0	0	0			sp	0	a	P	—	p
0	0	0	1	1			!	1	A	Q	a	q
0	0	1	0	2			·	2	B	R	b	r
0	0	1	1	3			£	3	C	S	c	s
0	1	0	0	4			$	4	D	T	d	t
0	1	0	1	5			%	5	E	U	e	u
0	1	1	0	6			&	6	F	V	f	v
0	1	1	1	7			,	7	G	W	g	w
1	0	0	0	8			(	8	H	X	h	x
1	0	0	1	9			)	9	I	Y	i	y
1	0	1	0	10			*	:	J	Z	j	z
1	0	1	1	11			+	;	K	←	k	1/4
1	1	0	0	12			'	<	L	1/2	l	"
1	1	0	1	13			−	=	M	→	m	3/4
1	1	1	0	14			.	>	N	↑	n	÷
1	1	1	1	15			/	?	O	#	o	■

TMB643

Table 1. Teletext text characters.

Normally the page memory and the character ROM will take about 500 to 700ns to set up a new character dot pattern after the memory address has been changed. To allow for this delay the memory address is updated as soon as the pattern of dots for the current symbol has been loaded into the output shift register. By the time that character has been scanned on the screen the memory and ROM circuits will have the new dot pattern ready for the next character. The loading of the shift register is arranged to occur at the time it is providing the blank space between the characters, so that no part of the character pattern is lost during the loading operation.

To provide the row address for the character ROM the divide by ten counter IC15 is used. This counts off the line scans during the display of each row of text. The 7490 IC15 is set to zero during the upper margin period so that it always starts off from zero at the start of the first row of text in the page. At every tenth line scan a signal from the 7490 row counter is fed out via IC11d to produce a Row Clock (RCK) which updates the memory address circuits and selects the next row of text to be displayed.

After the 24th row of text has been scanned out on the screen an End of Page (EOP) pulse from the memory card resets IC18, which in turn stops the dot clock generator and blanks the rest of the field scan to produce the margin at the bottom of the page.

In order to ensure that the memory address circuits always start off from row 0 during a display scan a Row Address Clear signal is generated by IC18 and IC8d. This pulse occurs at line sync pulse number 42 after the field sync pulse and before the start of the text display. This makes sure that the header row (row 0) is always displayed at the top of the screen.

To ensure that the displayed text remains steady on the screen, the dot clock oscillator and character clock divider are both locked to the line sync pulses via the left margin generator IC16. If the dot clock generator is allowed to run free, the characters will have wavy edges as the dot frequency runs in and out of sync with the line scans.

The remainder of the display card logic is concerned with the generation of graphics and the blanking of the control codes, which must not be displayed on the screen. We shall examine these circuits next month and also deal with the construction of this card.

★ Display Card Components List

Resistors: All ¼W 5%

R1 1kΩ
R2 4·7kΩ
R3 5·6kΩ
R4 5·6kΩ
R5 10kΩ
R6 10kΩ
R7 4·7kΩ
R8 4·7kΩ
RV1 10kΩ subminiature horizontal preset
RV2 1kΩ subminiature horizontal preset

Capacitors

C1 150pF polystyrene
C2 330pF polystyrene
C3 0·1μF ceramic disc
C4 0·1μF ceramic disc
C5 0·1μF ceramic disc
C6 2200pF polystyrene
C7 100μF 6V electrolytic
C8 10pF polystyrene

Diodes

D1, 2, 3 OA91

Integrated Circuits

IC1 74165
IC2 SN74S262N
IC3 74153
IC4 7474
IC5 7412
IC6 7402
IC7 7474
IC8 7400
IC9 7474
IC10 7408
IC11 7404
IC12 7492
IC13 7412
IC14 7473
IC15 7490
IC16 74121
IC17 74123
IC18 74177
IC19 74177

Miscellaneous

PCB type DO13
Soldercon sockets.

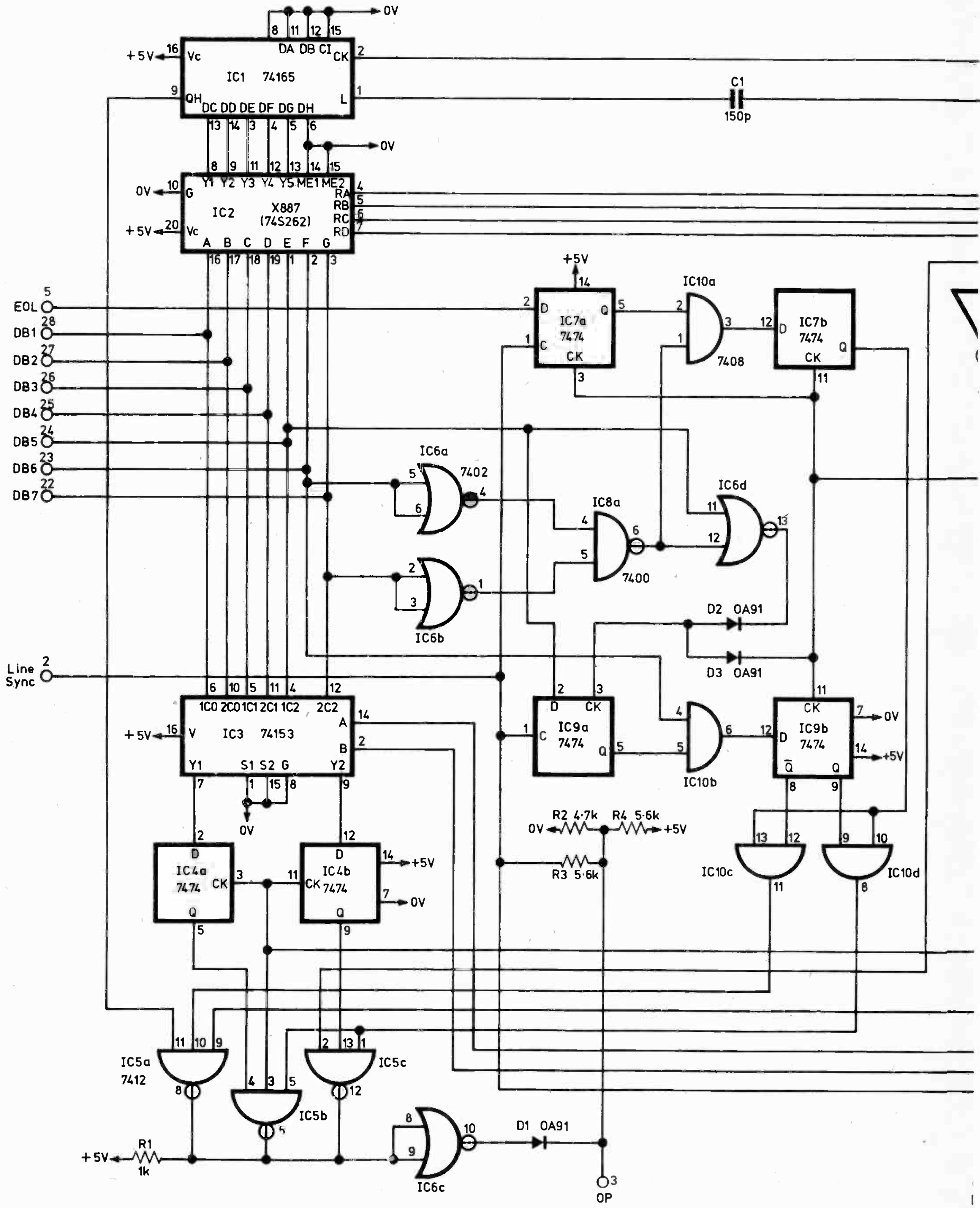
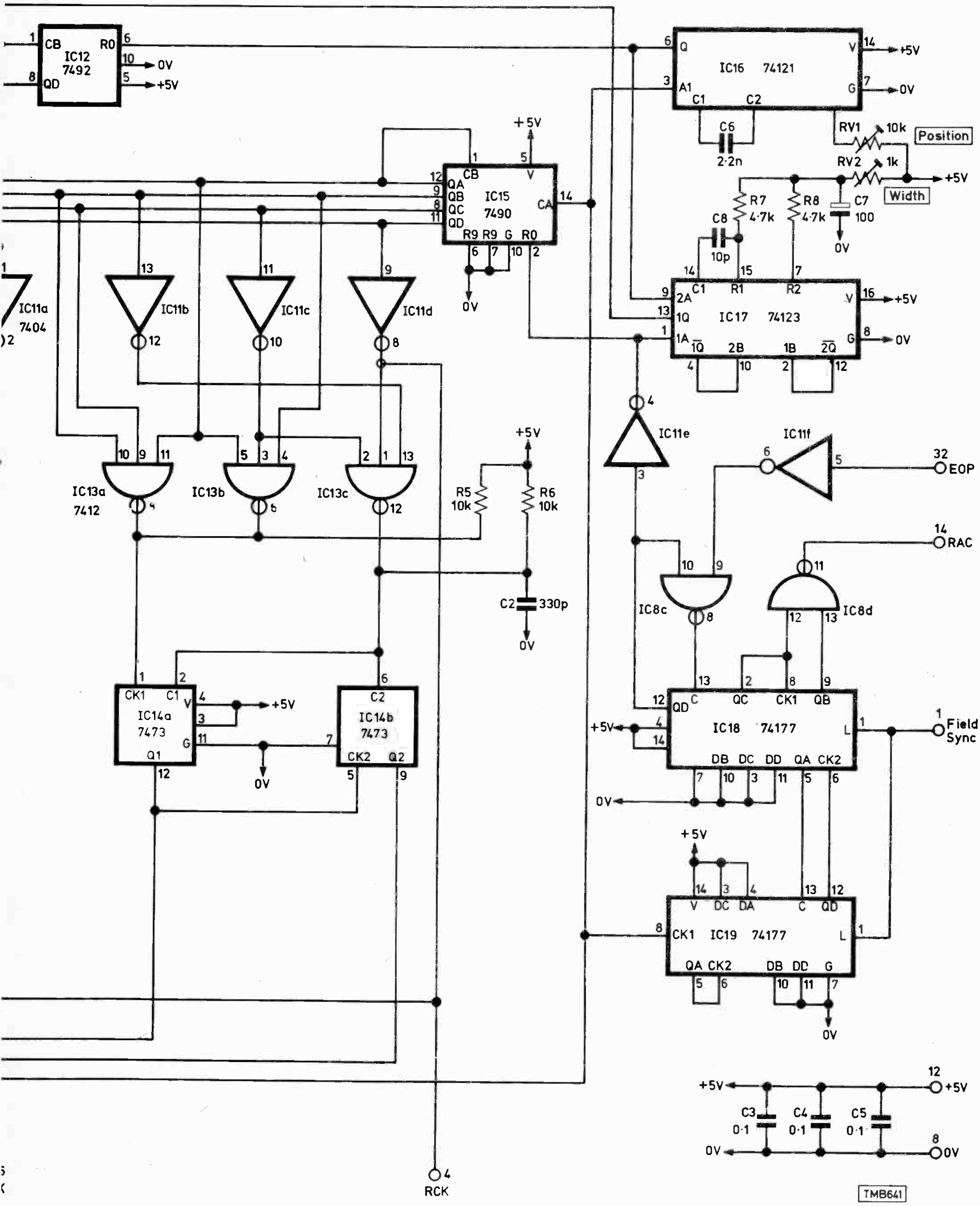


Fig. 1. Complete circuit diagran



f the display logic card.

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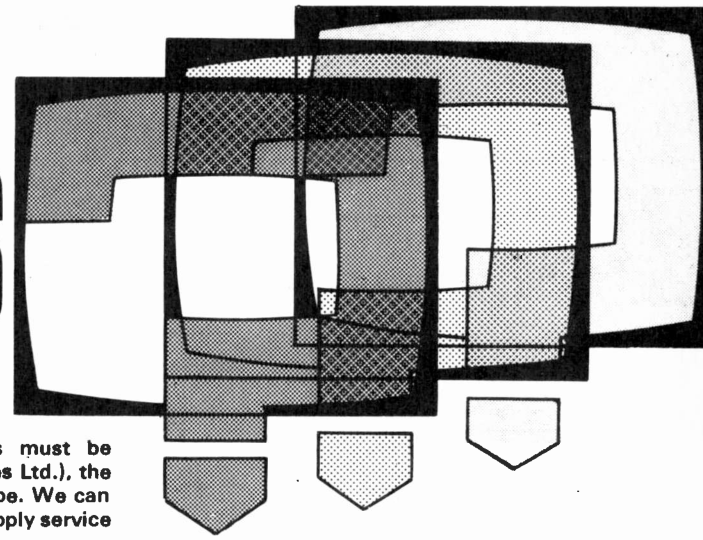

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THORN 1590 CHASSIS

There are white lines about three-quarters of an inch apart, from left to right diagonally, across the screen. The lines vary in intensity with changes in picture contrast. Any ideas for removing them?

The lines are caused by the field flyback appearing on the screen because it's not being blanked out. For field flyback blanking, a pulse is applied from the field output stage to the emitter of the video output transistor. There are two coupling components, C82 (0·1μF) and R114 (12kΩ). Either the capacitor is faulty or not connected, or the circuit is not completed electrically.

PHILIPS 210 CHASSIS

When the brightness or contrast controls are adjusted for a normal picture two pictures appear with a sideways wobble. On increasing or decreasing either control the raster returns to normal. All the line timebase valves and the sync/video valve have been replaced, and the components in the line oscillator, video and sync circuits checked.

There is a waveform shaping network from the control grid of the PL504 line output valve to chassis. It consists of 220pF (C2062) in series with 82kΩ (R2172). The trouble is likely to be due to the capacitor: try shunting another 220pF one across it.

THORN 3500 CHASSIS

The trouble with this set is wrong colours due to loss of green. Unfortunately the fault is intermittent, making fault finding awkward.

We have had several cases of intermittent loss of one colour on this chassis due to leakage across the switches connected to the sliders of the c.r.t. first anode preset controls. These are about half way up the left side of the convergence board. The green one is the centre one and it is a simple matter to cut the print under the switch (it can be joined up later) to prove whether the switch is responsible for the loss of first anode voltage, if indeed this is much lower than the red and blue first anode voltages – the drill is to check these voltages. If they are roughly the same, clearing this part of the circuit, check the green output transistor VT212 whose collector voltage, with no signal input, should be 160V. If this is in order check the green channel clamp diode W207.

GEC 2000 SERIES

The fault with this set is lack of width. Both the line output valve and the boost diode have been replaced without improving matters. On turning up the brightness, the picture balloons and goes out of focus, leaving a dark area in the centre of the screen even with the contrast control turned right up. Is the v.d.r. in the width circuit suspect?

The problem is poor e.h.t. regulation along with lack of width. The first suspect should be the DY86 e.h.t. rectifier – also make sure that the 0·4Ω resistor in series with its heater is in order. The line output transformer could be defective but before condemning it we suggest you check the width control and its 470kΩ series resistor and the high-value resistors (3·3MΩ and 1MΩ) in the line output valve's control grid circuit. The v.d.r. could be at fault but this is not common.

THORN 3500 CHASSIS

There was about three quarters of an inch of foldover at the bottom of the picture. I got rid of this by adjusting the field timebase preset controls, but of course the linearity is now wrong.

The field charging capacitors C427 (25μF) and C428 (10μF) may be defective – as these charge up, the driver transistor is driven towards cut-off. C432 (250μF) which decouples the supply to the field output stage can also cause this problem. Finally, suspect the field output transistor VT424 (BD116).

DECCA 30 SERIES

The trouble with this set is that the h.t. fuse F1 keeps on blowing at switch on – accompanied by a slightly acrid smell. The PCF802 line oscillator valve glows brightly when this happens, but this might not be related to the fuse blowing.

If a cold resistance check does not reveal a short-circuit across the h.t. line, check the PL509 line output valve, the line output transformer tuning capacitor C435 (150pF) which is on the transformer assembly and the boost capacitor C436 (0·22μF) which is on the timebase panel. The PCF802 could be faulty, drawing excessive current and thus glowing and blowing the fuse: a leak in the pentode section's control grid coupling capacitor C427 (470pF) could have the same effect.

PHILIPS 320 SERIES

Sometimes when the set is switched on there is a white raster with black specs on the screen instead of a picture, and a loud rushing noise on the sound. By rotating the channel selector to another channel, usually BBC-2, then back again normal results are obtained. Also a slight background noise occurs, with a small drop in the volume level, after about twenty minutes. This can be cleared by rotating the selector to another channel and back again or by moving the fine tuner slightly – it may be necessary to do this several times before the set settles down.

In some sets the tuning range control R2114 is changed to a 1·5kΩ fixed resistor, with a 27kΩ resistor (R2115) added in series with the tuning voltage feed to the tuner, i.e. between pin 4 of plug B and the junction of C2104/pin F of the tuner. See that this is so in your tuner, and set the h.t. rail to 158V. If the trouble continues, check the 22kΩ resistor R2111 from HT1 to the tuning voltage circuit and the TAA550 regulator. If these items are in order, replace the tuner.

THORN 3000 CHASSIS

The picture keeps pulling (jerking) to the side at irregular intervals. As it pulls to the side colour is lost and the picture often breaks up completely for a few seconds. The fault developed gradually over several weeks – at first there were periods of several days between jerky spells but the fault is now there almost constantly. Adjusting the line hold control gives some improvement but this lasts for only a few seconds or minutes.

The symptom is called line twitch and can be caused by several components on the line timebase board. In order of likelihood these are as follows: the two 22μF electrolytics C506 and C511 in the flywheel filter and reactance transistor circuits, the flywheel sync discriminator diodes W501 and W502, the supply line decoupler C508 (100μF), and the reactance transistor VT501 (BC183LA).

BUSH TV161 SERIES

Once the picture has come on the field starts to run at a very fast speed. After a further four minutes or so the set will lock, remaining stable except on very dark scenes.

A failing PCL805 field timebase valve is the most common cause of this symptom. Other possibilities are: the interlace diode 3MR3, the field sync pulse coupling capacitor 3C29, and the PFL200 video/sync valve and its associated screen grid and cathode decoupling electrolytics 2C48 (8μF), 2C44 (10μF) and 2C45 (320μF).

GRUNDIG 5011GB

About a quarter of an hour after switching on there is a pronounced whistle, lasting for perhaps half an hour. A vertical bar, slightly brighter than the overall picture brightness and approximately half an inch wide, frequently appears to the left of centre on the screen.

There is a clip on the top of the input/commutating transformer 9245-834·21 in the line output stage. Check that this is secure and that the cores of the other wound components in the line output stage are neither cracked nor loose. Check Tr506 (BF259) which drives the width stabilising transductor, and the associated diodes, particularly Di504 (1N4004) which is in series with the transductor.

THORN 1590 CHASSIS

The problem is that the 2·5A fuse between the rectifiers and the regulator blows when the set is switched on – the 250mA mains fuse remains intact. I take it there is a short-circuit somewhere but everything seems to be in order.

Towards the right side there is a large metal heatsink with the AU113 line output transistor mounted on it. The transistor is secured by two nuts and screws. Only one screw and nut is in actual contact with the print. Remove these, thus isolating the transistor's collector, then check whether the fuse still blows. If it doesn't, check the transistor for a collector-emitter short. If the transistor is all right check the two rectifiers W13 and W14 which are fed from the line output transformer. If one of these is found to be short-circuit check its reservoir capacitor, C110 (10μF) and C111 (1μF) respectively.

GEC HYBRID COLOUR CHASSIS

The problem with this set is that line hold is lost after two-three hours and by this time the hold control is at the end of the track. There is also tearing and bending of the top verticals at intervals. If the set is allowed to cool down the control and the set operate normally.

The items to check are the PCF802 line oscillator valve, C508 (4μF) which decouples the supply to the oscillator, the line sync discriminator diodes D500a/b, R503 which is in series with the hold control and R502 which is in series with its slider, the sync separator's collector resistors R500 and R501, and the reference pulse feedback resistor R507. The process could be speeded up by heating the individual items with a hairdryer and rapidly cooling with a freezer aerosol.

PHILIPS 210 CHASSIS

The sound behaves oddly on this set. After switching on, the sound appears just after the vision on 625 lines but takes six minutes to appear on 405 lines. When the set has been operating for a while switching from 405 to 625 is normal but on switching from 625 to 405 lines there is a delay of about thirty seconds in the appearance of the sound. I've changed the sound output valve and probed for dry-joints, but nothing has come to light.

Fixed bias is applied to the first sound i.f. transistor on 625 lines, but on 405 lines the transistor is biased by an amplified a.g.c. feed which comes from the cathode of the triode section of the PCL82 audio valve. When this valve is operating normally there should be 2·1V across the triode's cathode bias resistor R2099. It's anode load resistor R2101 should have a value of 100kΩ, giving 135V at the anode. Also check the cathode decoupler C2020 (25μF) and R2090 (1MΩ) via which the triode's control grid is returned to chassis on 405 lines.

KB VC1 CHASSIS

This set works well on 405 lines but on switching to 625 lines the field collapses, leaving a horizontal white line across the screen. The system switching seems to be o.k. and the scan coils and field output valve have been checked by substitution.

On 625 lines an extra preset height control R147 (300kΩ) is added in the feed from the boost rail to the field charging circuit. Check this control, which is second from the right at the back of the set.

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 2701 (Thorn 2000 chassis) was giving a predominantly red display which could not be fully corrected by adjusting the appropriate presets. This chassis, like the KB CK500 in last month's Test Case, *uses primary-colour drive to the tube cathodes (in fact it was one of the first receivers to use this sort of drive). It differs in detail from the KB chassis in that a colour-difference preamplifier is employed while the primary-colour matrixing occurs in the lower transistor in each of the cascode output stages. Video gain for each colour is controlled by a preset between the output of the colour-difference preamplifier (VT7/VT8 in the red channel, see Fig. 1), and the emitter of the matrixing transistor, to whose base the luminance signal is applied. Clamping is by a transistor whose base is driven by +30V line pulses. The transistor is VT9 in the red channel.*

Red video bias is controlled by a preset (R42) in the clamp transistor's base circuit. There is also a tint control which provides a differential change in the clamp transistor biasing between the red and blue channels.

Tests revealed that the c.r.t.'s red cathode was below the correct voltage, meaning that there was excessive drive to the c.r.t.'s red gun.

Standing bias is applied to the clamp transistor base from a potential divider circuit consisting of R41, R42, R44 and R45. The voltage at the junction of R44/R45 is coupled to the base of VT9 via W4 and the parallel combination W3/R40. R45 and C20 at the bottom of the potential divider chain provide a time-constant for the clamping action. The bias for VT7 provided by the clamp action is developed across C18.

Having in mind the general circuit round the troubled area, have you any idea of the component most likely to be responsible for the symptom? See next month's Television *for the solution and for a further item in the* Test Case *series.*

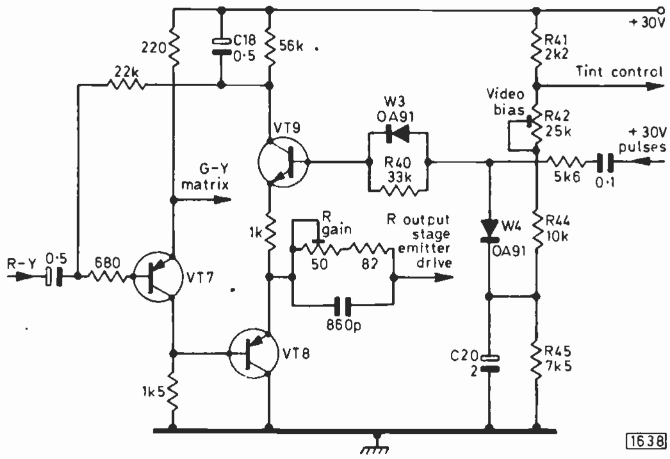

Fig. 1: R–Y preamplifier and clamp circuit used in the Thorn 2000 dual-standard colour chassis. The clamp transistor VT9 is cut off except when a 30V line frequency clamp pulse appears at its base, VT8 conducting via the cascode pair of transistors in the R output stage. When VT9 conducts, C18 is charged to the potential at the junction of R44/R45, set by the video bias control R42. The voltage on C18 sets VT7's base bias and the conditions in the following d.c. coupled stages.

SOLUTION TO TEST CASE 174
(page 441 last month)

The Test Case report last month included two clues to the cause of the fault. One was that it was the background of the display which was tinted. The other was that the primary-colour signal, after the matrix stage, was capacitively coupled to the blue driver stage.

By using a colour-bar generator and checking the amplitude of the blue signal at various points from the matrix to the tube's blue gun cathode it was found that the amplitude of the signal was greater at the matrix stage output than at the input to the blue driver stage. The coupling here is by a $2{\cdot}2\mu$F capacitor (C187d). This was found to have an intermittent fault, falling in capacitance as the temperature increased. Replacing the capacitor restored the blue drive and allowed the blue drive preset to be set more towards the centre of its range.

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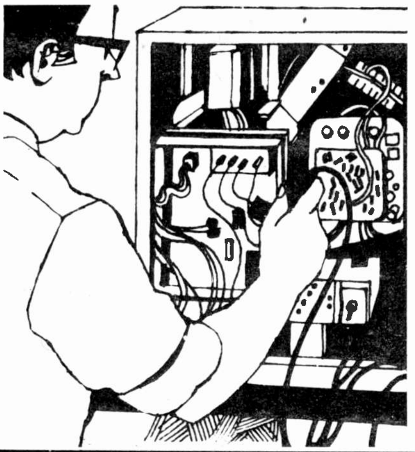

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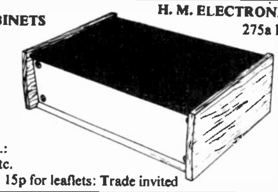

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