FEBRUARY 1979 Australia 85c; Malaysia $2.50; New Zealand 85c 50p

TELEVISION

SERVICING · VIDEO · CONSTRUCTION · DEVELOPMENTS

Commander-8
Remote Control System

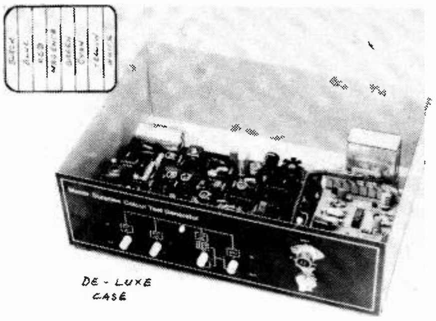
FET Meter Adaptor

Sony Betamax VCR

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 + £1.00 P/Packing.

CASES, ALUMINIUM £2.40, DE-LUXE £4.80, BATT. HOLDERS £1.50. ADD 8% VAT TO ALL PRICES!

ALSO THE MK3 COLOUR BAR GENERATOR KIT FOR ADDITION TO MANOR SUPPLIES CROSS HATCH UNITS. £25.00 + £1.00 p.p. CASE EXTRA £1.40. BATT. HOLDERS £1.50. ADD 8% VAT TO ALL PRICES.

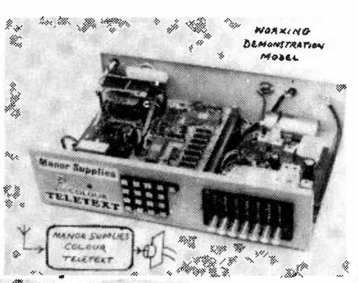
- ★★ Kits include drilled P.C. board, with full circuit data, assembly and setting up instructions.
- ★★ All special parts such as coils and modulator supplied complete and tested, ready for use.
- ★★ Designed to professional standards.
- ★★ Demonstration models at 172 West End Lane, NW6.
- ★★ Every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

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

ALTERNATIVE MAINS SUPPLY KIT £5.28 + 8% VAT + 65p P/P. VHF MODULATOR (CH1 to 4) FOR OVERSEAS £3.50. INFORMATION ON VIDEO TAKE-OFF FOR C.C.T.V.

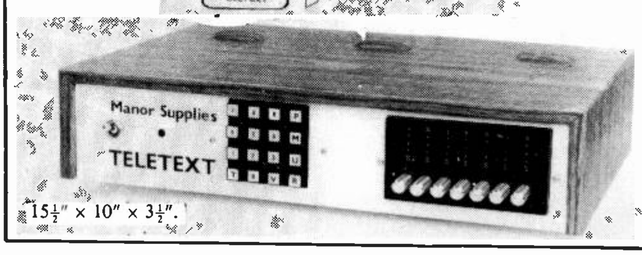
MANOR SUPPLIES TELETEXT KIT (incl TEXAS DECODER). Full facilities in colour. External unit. AE input to set. Write or call for further information. See working demonstration model! Easy to build and results guaranteed for every completed unit.

Texas XM11 Decoder £130.00 p.p. £1.00.
Auxiliary Units. £88.00 p.p. £1.50
De-Luxe Case £14.80 p.p. £1.00.
Add 12½% VAT.
Separate Price List for Individual Units available.



Changes from Teletext to picture without switching aerials.

Armchair control of Teletext and T.V. stations.



COLOUR, UHF & TELEVISION SPARES

NEW 'TELEVISION' COLOUR RECEIVER PROJECT PARTS BEING SUPPLIED. SEND OR PHONE FOR LIST (FUTURE TECHNICAL ADVICE & SERVICE FOR M.S. CUSTOMERS).

NEW SAW FILTER IF AMPLIFIER PLUS TUNER COMPLETE AND TESTED FOR SOUND & VISION **£28.50** p.p. 95p.

T.V. PORTABLE PROJECT PARTS AVAILABLE. SEND OR PHONE FOR LIST. WORKING MODEL ON VIEW AT 172 WEST END LANE, NW6.

TV TEST GENERATOR UHF MODULATOR **£3.50** p.p. 35p.*

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. p.p.* (ALUM. CASE **£2.00** p.p. 75p.*). COMPLETE TESTED UNITS, READY FOR USE (DE LUXE CASE) **£20.80** p.p. £1.00.* ADDITIONAL GREY SCALE KIT **£2.90** p.p. 30p.*

UHF SIGNAL STRENGTH METER KIT £16.80 (ALSO VHF VERSION* ALUM CASE **£1.40,** DE-LUXE CASE **£4.80** p.p. £1.00.)

CRT TESTER & REACTIVATOR PROJECT KIT £19.80 p.p. £1.30*

"TELEVISION" COLOUR SET PROJECT (1974) SPARE PARTS STILL AVAILABLE.

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 **£14.80** p.p. 95p.

STABILISER UNITS, "add on" kit for either 40V or 20V, **£2.80** p.p. 35p.

PHILIPS 210 or 300 Series IF Panels **£2.50** p.p. £1.00.

PHILIPS 210, 300 Series Frame T.B. Panels **£1.00** p.p. 65p.

PHILIPS 19TG 170 Series Timebase Panels **£2.50** p.p. 90p.

BUSH A823 (A807) Decoder Panel **£7.50** p.p. £1.00.

BUSH A823 SCAN CONTROL PANEL **£2.50,** p.p. 75p.

BUSH 161 TIMEBASE PANEL A634 **£3.80** p.p. 90p.

GEC 2010 SERIES TIME BASE PANEL **£1.00** p.p. 85p.

GEC 2040 Surplus Panels, ex-rental. Decoder **£5.00** p.p. 90p.

GEC 2040 Convergence Control Panel **£2.50** p.p. 90p.

DECCA CTV25 Single Stand. IF Panel **£3.80** p.p. 65p.

DECCA Colour T.V. Thyristor Power Supply. HT, LT etc. **£3.80** p.p. 95p.

BUSH TV 300 portable Panel incl. circuit **£5.00** p.p. 95p.

BUSH TV 312 IF Panel (Single I.C.) incl. circuit **£5.00** p.p. 65p.

BUSH Mains Stabilised Power Supply Unit 6V & 9V. **£4.80** p.p. 85p

BUSH TV Portable Eleven Volt Stab. Power Supply Unit **£3.80** p.p. £1.00.

PYE 697 Line T.B. P.C.B. for spares, **£1.50** p.p. £1.00.

MULLARD AT1022 Colour Scan Coils **£6.00** p.p. £1.20, AT1023/05 Convergence Yoke **£2.50** p.p. 85p, AT1025/06 Blue Lat. **75p** p.p.35p, Delay Lines, DL1E **90p,** DL20, DL50 **£3.50** p.p. 75p.

PHILIPS G6 single standard convergence panel, incl. 16 controls, switches etc., and circuits **£3.75** p.p. 85p, or incl. yoke, **£5.00. G8** Decoder panels ex Rental **£5.00.** Decoder panels for spares **£2.50** p.p. 85p.

VARICAP, Mullard ELC1043/05 UHF tuner **£5.50,** G.I. type (equiv. 1043/05) **£3.50** p.p. 35p. Control units, 3PSN **£1.25,** 4PSN **£1.50,** 5PSN **£1.80. Special offer** 6PSN **£1.00,** 7PSN De Luxe **£2.80** p.p. 35p. TAA 550 **50p** p.p. 15p. Salv. UHF varicap tuners **£1.50** p.p. 35p.

BUSH "Touch Tune" assembly, incl. circuit **£5.00** p.p. 75p.

VHF, ELC 1042 **£5.80,** p.p. 35p, on Pye P.C.B. **£5.80** p.p. 85p.

VARICAP UHF/VHF ELC 2000S **£8.50** p.p. 65p.

UHF/625 Tuners, many different types in stock. Lists available. UHF tuners transisted. incl. s/m drive, **£2.85;** Mullard 4 position push button **£2.50,** 6 position push-button **£4.50** p.p. 90p. AE ISOL **30p** p.p. 20p.

TRANSISTORISED 625 IF for T.V., sound, tested. **£6.80** p.p. 65p.

PHILIPS 625 IF Panel incl. circuit **50p** p.p. 65p.

TBA "Q" I.C.s. 480, 530, 540, **£1.60,** 270, 560C, 920 **£2.40** p.p. 25p

HELICAL POTS, 100K. 4 for **£1.20** p.p. 20p.

RBM 774 250R Mains Droppers, four for **£1.00** p.p. 35p.

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BUSH 145 to 186SS series **£6.95**
BUSH, MURPHY A816 series **£8.50**
DECCA DR1, 2, 3, 121/123, 20/24, MS1700, 2001, 2401 .... **£6.80**
DECCA MS2000, 2400 .... **£5.80**
FERG., HMV, MARCONI, ULTRA 900, 950, Mk. 1 .... **£5.90**
950II, 1400, 1500, 1590 .... **£5.90**
GEC 2000, 2047 series, etc. **£6.80**
INDESIT 20/24EGB **£6.80**
ITT/KB VC2 to 53, 100, 200, 300 **£6.80**
MURPHY 1910 to 2417 series **£6.95**
PHILIPS 19TG121 to 19TG156 . **£4.80**
PHILIPS 19TG170, 210, 300 ...... **£6.80**
PYE 368, 169, 769 series **£6.80**
PYE 40, 67 series (36 to 55) **£3.80**
PAM, INVICTA, EKCO, FERRANTI equivalents as above.
SOBELL 1000 series **£6.80**
STELLA 1043/2149 .... **£6.80**

SPECIAL OFFERS
BUSH TV125 to 139 .... **£2.80**
GEC 448/452 .... **£1.50**
KB VCI, VCII (003) **£2.80**
MURPHY 849 to 939 ..... **£2.80**
SOBELL 195, 282 to 8 .... **£1.50**
MANY OTHERS STILL AVAILABLE

COLOUR LOPTS p.p. £1.00.
BUSH CTV 25 Mk3 .... **£8.20**
BUSH 182 to 1122 etc..... **£9.80**
MURPHY Equivalents.... **£9.80**
DECCA "Bradford" (state Model No. etc) ... **£7.80**
GEC 2110 Series............. **£7.60**
GEC 2028, 2040 .... **£9.20**
ITT CVC 5 to 9 .... **£5.80**
PYE 691, 693, 697 .... **£17.80**
PHILIPS G6 SS or DS.. **£17.80**
PHILIPS G8.................. **£8.50**
THORN 8500............... **£10.80**

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THORN 950 3 Stick Tray **£2.40** p.p. 50p. Others available.

6·3V CRT Boost Transformers **£2.90** p.p. 75p., Auto type **£1.80** p.p. 45p.

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THOUSANDS OF ADDITIONAL ITEMS AVAILABLE NOT NORMALLY ADVERTISED

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

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

TELEVISION

February 1979

Vol. 29, No. 4
Issue 340

this month

OUR NEXT ISSUE DATED MARCH WILL BE PUBLISHED ON FEBRUARY 19

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THE UNBEATABLE BRIARWOOD SERVICE

EX-EQUIPMENT SPARES

MISC. S/Output Trans. £1 + VAT + £1 P&P F/Output Trans. £1.25 + VAT + £1 P&P. Scancoils £1.50 + VAT + £1 P&P. Other spares available, please write or phone for details.

MONO TUBES (tested)
19" Rimguard £3.00
23" Rimguard £4.00
20" Rimguard £5.00
24" Rimguard £6.00
+£3.00 P.&P.

MONO TUNERS
6-button integrated all at £6.50
U.H.F. P/Button D/S £4.50. U.H.F. P/Button S/S £6.50. Rotary £3.00 + £1 P&P.

MONO LOPTS
All D/Standard Lopts at £4.00 + £1 P.&P. All S/Standard at £4.00 + £1 P.&P.

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PCL82	0.10	PCF802	0.10	PCC86	0.10	EY86/7	0.10	30PL1	0.25	PL509	1.00
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PCL85	0.10	PCF808	0.25	EF80	0.10	PY800/1	0.10	30FL1/2	0.25	PL508	0.50
PCL86	0.10	PCF80	0.10	EF85	0.10	PL36	0.25	ECC82	0.10	PCH200	0.50
PFL200	0.10	PCC189	0.10	EF183	0.10	PL504	0.25	ECC81	0.10	PCF200	0.50
PCF801	0.10	PCC86	0.10	EF184	0.10	PL81	0.10	ECH81	0.10	CEY51	0.15
30C1	0.10	30C15	0.10	6BW7	0.10	6/30L2	0.10	ECL80	0.10		
30C17	0.10	30C18	0.25	ECC85	0.10	U26	0.10	ECL82	0.10		
PL83	0.10	PL84	0.10	EH90	0.10						

Please note there is 25p Postage and Packing per order.

WE DO NOT SELL RUBBISH AT BRIARWOOD TV

D/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	EHT	REG	CON	S/OUTPUT	POWER	L/TB	F/TB
Bush/Murphy	6.50	6.50	6.50	—	—	6.50	1.50	6.50	—	—
GEC/Sobell	6.50	7.50	—	—	—	6.50	—	—	—	7.50
Philips	6.50	9.50	—	—	—	7.50	—	—	—	6.50
Decca	6.50	12.50	12.50	—	—	6.50	2.00 (19" only)	8.00	—	6.00
Thorn 2000	6.50	7.50	7.50	6.50	6.50	7.00	—	8.00	15.00	6.50
Pye	7.50	7.50	9.50	—	—	6.50	—	—	—	7.50
Baird	6.50	8.50	8.50	—	—	6.50	—	—	—	6.00

Postage & Packing £1.25

S/STANDARD COLOUR SPARE PANELS

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

Korting and other foreign panels available on request.

Postage & Packing £1.25

COLOUR TUBES
19" £18.00
19" A49, 192 £20.00
20" £20.00
22" £22.00
25" £18.00
26" £28.00
Plus P&P £4.

COLOUR TUNERS
Bush £6.50
GEC £6.50
Philips G6 S/S £6.50
Thorn 3000 £6.50
Pye 691/697 £7.50
Some new tuners in stock, can supply on request. Many Foreign Tuners also available on request. Plus P&P £1.

COLOUR LOPTS
Most Lopts available from £7.00. Both British & Foreign makes. Please ring or write, P&P per Lopt £1.

MISC.
S/Output transformer from £1.50.
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P&P £1.
Other spares available on request.

G8 PANELS SPECIAL OFFER
CHROMA £12.00
I.F. £10.00
POSTAGE & PACKING £1.25 PER PANEL.

MAIL ORDER T.Vs. IN GOOD WORKING ORDER

COLOUR

Pye	19"	£60.00	22"	£65.00	26"	£75.00
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Bush	19"	£80.00	22"	£80.00	26"	£90.00
Philips	G6	—	22"	£63.00	26"	£70.00

Many other makes & models available.
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Briarwood T.V. Limited
Britain's Mail Order T.V. Specialists
BRIARWOOD

THE PROFESSIONAL CHOICE. NATIONWIDE

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AC107	0.23
AC113	0.17
AC115	0.17
AC117	0.24
AC125	0.20
AC126	0.18
AC127	0.19
AC128	0.17
AC131	0.13
AC141	0.23
AC142	0.19
AC141K	0.29
AC142K	0.29
AC151	0.17
AC165	0.16
AC166	0.16
AC168	0.17
AC176	0.17
AC176K	0.28
AC178	0.16
AC186	0.26
AC187	0.21
AC188	0.20
AC187K	0.34
AC188K	0.34
AD130	0.50
AD140	0.65
AD142	0.73
AD143	0.70
AD145	0.70
AD149	0.64
AD161	0.41
AD162	0.48
AD161 } AD162 }	1.30
AF106	0.42
AF114	0.23
AF115	0.22
AF116	0.22
AF117	0.30
AF118	0.40
AF121	0.43
AF124	0.33
AF125	0.29
AF126	0.29
AF127	0.29
AF139	0.39
AF151	0.24

TYPE	PRICE £
AF170	0.25
AF172	0.20
AF178	0.49
AF180	0.60
AF181	0.30
AF186	0.29
AF239	0.43
AU113	1.29
BA130	0.08
BA145	0.14
BA148	0.17
BA155	0.10
BAX13	0.05
BAX16	0.08
BC107	0.12
BC108	0.12
BC109	0.12
BC113	0.12
BC114	0.14
BC115	0.12
BC116	0.12
BC117	0.13
BC119	0.24
BC125	0.15
BC126	0.09
BC136	0.14
BC137	0.14
BC138	0.24
BC139	0.21
BC140	0.31
BC141	0.22
BC142	0.19
BC143	0.19
BC147	0.09
BC148	0.09
BC149	0.09
BC153	0.12
BC154	0.12
BC157	0.10
BC158	0.11
BC159	0.11
BC160	0.28
BC161	0.28
BC167	0.13
BC168	0.10
BC169C	0.12
BC171	0.12

TYPE	PRICE £
BC172	0.12
BC173	0.15
BC177	0.14
BC178	0.14
BC179	0.14
BC182L	0.08
BC183L	0.07
BC184L	0.11
BC186	0.18
BC187	0.18
BC209	0.14
BC212	0.13
BC213L	0.09
BC214L	0.14
BC237	0.07
BC240	0.31
BC281	0.24
BC262	0.20
BC263B	0.20
BC267	0.19
BC301	0.26
BC302	0.30
BC307	0.10
BC337	0.13
BC338	0.09
BC307A	0.12
BC308A	0.12
BC309	0.14
BC547	0.09
BC548	0.11
BC549	0.11
BC557	0.11
BD112	0.39
BD113	0.65
BD115	0.40
BD116	0.47
BD124	1.30
BD131	0.32
BD132	0.34
BD133	0.37
BD135	0.26
BD136	0.26
BD137	0.26
BD138	0.26
BD139	0.40
BD140	0.28
BD144	1.39
BD145	0.30

TYPE	PRICE £
BD222/T1P31A	0.39
BD225/T1P31A	0.39
BD234	0.34
BD222	0.50
BDX22	0.73
BDX32	1.98
BDY18	0.75
BDY60	0.80
BF115	0.24
BF121	0.21
BF154	0.19
BF158	0.19
BF159	0.24
BF160	0.23
BF163	0.23
BF164	0.17
BF167	0.23
BF173	0.21
BF177	0.26
BF178	0.24
BF179	0.28
BF180	0.30
BF181	0.34
BF182	0.30
BF183	0.29
BF184	0.23
BF185	0.29
BF186	0.30
BF194	0.09
BF195	0.09
BF196	0.12
BF197	0.10
BF198	0.15
BF199	0.14
BF200	0.28
BF216	0.12
BF217	0.12
BF218	0.12
BF219	0.12
BF220	0.12
BF222	0.12
BF221	0.21
BF224	0.12
BF256	0.37
BF258	0.27
BF259	0.27

TYPE	PRICE £
BF260	0.24
BF262	0.28
BF263	0.25
BF271	0.20
BF273	0.12
BF336	0.35
BF337	0.24
BF338	0.29
BFT42	0.26
BFT43	0.24
BFX84	0.27
BFX85	0.27
BFX88	0.24
BFY37	0.22
BFY50	0.18
BFY51	0.17
BFY52	0.18
BFY53	0.27
BFY55	0.27
BHA0002	1.90
BR100	0.20
BSX20	0.23
BSX76	0.23
BSY84	0.36
BT106	1.18
BT108	1.23
BT109	1.09
BT116	1.23
BT120	2.08
BU105/02	1.87
BU105/04	2.25
BU126	1.40
BU205	1.97
BU208	2.49
BY126	0.09
BY127	0.10
OC22	1.10
OC23	1.30
OC24	1.30
OC25	1.00
OC26	1.00
OC28	1.00
OC35	1.00
OC36	0.90
OC38	0.90
OC42	0.45
OC44	0.20

TYPE	PRICE £
OC45	0.20
OC46	0.35
OC70	0.22
OC71	0.28
OC72	0.35
OC74	0.35
OC75	0.35
OC76	0.35
OC77	0.50
OC78	0.13
OC81	0.20
OC810	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
OA91	0.05
BRC4443	0.65
R2008B	1.50
R2010B	1.50
R2305	0.38
R2305/BD222	0.37
SCR957	0.81
TIP31A	0.38
TIP32A	0.36
TIP3055	0.53
T1590	0.19
T1591	0.19
TV106	1.09

SPECIAL OFFER

SL901B	3.50
SL917B	5.00

DIODES

1N4001	0.04
1N4002	0.04
1N4003	0.06
1N4004	0.07
1N4005	0.07
1N4006	0.08
1N4007	0.08
1N4148	0.03
1N4751A	0.11
1N5401	0.10
1N5404	0.12
1N5406	0.13
1N5408	0.16

VALVES

DY87	0.52
DY802	0.64
ECC82	0.52
EF80	0.40
EF183	0.60
EF184	0.60
EH90	0.60
PC86	0.76
PC88	0.76
PCC89	0.65
PCC189	0.65
PCF80	0.70
PCF86	0.68
PCF801	0.70
PCF802	0.74
PCL82	0.67
PCL84	0.75
PCL86	0.78
PCL805	0.75
PLF200	1.00
PL36	0.90
PL84	0.74
PL504	1.10
PL509	2.45
PY88	0.63
PY500A	1.60
PY81/800	0.57

SPECIAL OFFER

Philips PL802 2.55

E.H.T. TRAYS MONO

950 MK2 1400	2.26
1500 18" 19" stick	2.37
1500 24" 5 stick	2.48
Single stick Thorn TV 11.16K 70V	0.75
TV20 2 MT	0.75
TV20 16K 18V	0.75

IC's

SN76013N	1.20
SN76013ND	1.00
SN76023N	1.20
SN76023ND	1.00
SN76226DN	1.50
SN76227N	1.20
TBA341	0.97
TBA520Q	1.10
TBA530Q	1.10
TBA540Q	1.45
TBA550Q	1.40
TBA560CQ	1.50
TBA570Q	1.00
TBA800	1.00
TBA810	1.50
TBA920Q	1.50
TBA990Q	1.50
TCA270SQ	1.45
TCA270SA	1.45
TCA1327B	1.00

E.H.T. TRAYS COLOUR

Pye 731	5.20
Pye 691/693	4.50
Decca (large screen) CS2030/2232/2630/2632/2230/2233/2631	5.67
Philips G8 520/40/50	5.66
Philips G9	5.79
GEC C2110	5.50
GEC Hybrid CTV	5.40
Thorn 3000/3500	5.50
Thorn 800	2.42
Thorn 8500	5.23
Thorn 9000	6.10
GEC TVM 25	2.50
ITT/KB CVC 5/7/8/9	5.50
RRI (RBM) A823	5.89
Bang & Olufsen 4/5000 Grundig 5010/5011/5012/6011/6012/7200/2052/2210/2252R Tandberg (radionette) Autovox	6.60
Grundig 3000/3010 Saba 2705/3715 Telefunken 709/710/717/2000	6.80
Korting	6.80

All transistors, IC's, offered are new and branded. Manufactured by Mullard, I.T.T., Texas, Motorola etc. Please add 12½% VAT to all items and overseas at cost P & P U.K. 25p per order, overseas allow for package and postage. Cash with all orders. All prices subject to alteration without notice.

TELEVISION SALE
DISCOUNT FOR QUANTITY

Please note all mono sets sold as 100% comp.
No broken masks, no broken panels etc.
Colour sets sold with good c.r.t.s and 100% comp.

Working Mono £3.00 extra
Working Colour £15.00 extra.
Supplied in 1's or 100's.

MONO Rotaries 19" & 23"

GEC	£3.00
Thorn 950 etc.	3.00
K.B.	3.00
Pye	3.00
Thorn 1400	4.50

D/S P/B 19" 23"

Thorn 1400	7.00
Bush 161 etc.	7.00
Baird 660 etc.	7.00
Philips 210 etc.	7.00
Pye Olympic etc.	7.00

D/S P/B 20" 24"

Bush	10.00
GEC	10.00
Philips	10.00
Pye	10.00
Thorn	10.00

S/S 20" 24"

Bush 313 etc.	£12.00
Pye 169 chassis	12.00
Thorn 1500	12.00
GEC series 1 & 2	12.00
Decca MS series	12.00

S/S COLOUR

	19" £	20" £	22" £	25" £	26" £
GEC	45	55	55	45	60
Philips	—	—	45	45	60
Thorn	65	—	65	65	85
Bush	60	—	65	65	70
Kort	—	—	65	—	75
Pye Mechanical	45	—	55	—	60
Pye Varicap	60	—	65	—	70

MAINS DROPPERS

Mono

Bush 161	60p
Philips 210 30+125+2K85	45p
Philips 210 118R+148R	40p
Thorn 1400	75p
GEC 2018	55p
Decca 2K5+90+100+167+5	72p
Thorn 1500	60p

Colour

Bush A823	72p
Pye 723 27Ω+56Ω	47p
GEC 2110 –41Ω	45p
GEC 2110 –12R5+12R5	47p
GEC2110 –27R5	45p
Thorn 3500	54p
Thorn 8000	54p
Thorn 8500	54p
Philips G8 47R	25p
Philips G8 2.2+68	36p

All plus VAT at 12½%.

WHY NOT TRY OUR EXPRESS MAIL ORDER ON ANY OF THE ITEMS LISTED.

EXPORT COLOUR & MONO T.V.s AVAILABLE READY FOR USE OVERSEAS

TELEVISION

Briarwood House Preston Street
Bradford West Yorkshire BD7 1NS
Tel. Bradford 306018 (STD code 0274)

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.48
AC117	0.38
AC126	0.36
AC127	0.54
AC128	0.46
AC128K	0.55
AC141	0.65
AC141K	0.70
AC142	0.60
AC142K	0.65
AC151	0.31
AC152	0.36
AC153	0.42
AC153K	0.52
AC154	0.41
AC176	0.45
AC178	0.51
AC179	0.55
AC187	0.56
AC187K	0.65
AC188	0.52
AC188K	0.61
AC193K	0.70
AC194K	0.74
ACY17	1.20
ACY19	0.95
ACY28	0.98
ACY39	2.02
AD140	1.79
AD142	1.90
AD143	1.78
AD149	1.92
AD161	0.66
AD161/162	1.22
AD162	0.71
AF114	0.35
AF115	0.35
AF116	0.41
AF117	0.42
AF118	0.98
AF121	0.68
AF124	0.38
AF125	0.38
AF126	0.36
AF127	0.86
AF139	0.58
AF147	0.52
AF149	0.45
AF178	1.35
AF179	1.36
AF180	1.35
AF181	1.33
AF186	1.48
AF202	0.27
AF239	0.73
AF240	1.40
AF279S	0.91
AL100	1.30
AL103	1.58

Type	Price (£)
AU103	2.40
AU107	2.75
AU110	2.40
AU113	2.60
BC107*	0.16
BC108*	0.15
BC109*	0.16
BC113	†0.22
BC114	†0.22
BC115	†0.24
BC116*	†0.25
BC117	†0.30
BC118	†0.24
BC119	†0.34
BC125*	†0.30
BC126	†0.30
BC132	†0.20
BC134	†0.22
BC135	†0.21
BC136	†0.22
BC137	†0.30
BC138	†0.35
BC140	0.36
BC141	0.44
BC142	0.35
BC143	0.38
BC147*	†0.12
BC148*	†0.12
BC149*	†0.13
BC152	†0.42
BC153	†0.38
BC154	†0.41
BC157*	†0.13
BC158*	†0.12
BC159*	†0.14
BC160	0.52
BC161	†0.58
BC167B	†0.15
BC168B	†0.14
BC169C	†0.15
BC170*	†0.15
BC171*	†0.15
BC172*	†0.14
BC173*	†0.22
BC174A & B	†0.26
BC176	0.22
BC177*	0.20
BC178*	0.22
BC179*	0.28
BC182*	†0.15
BC182L*	†0.15
BC183*	†0.14
BC183L*	†0.14
BC184*	†0.15
BC184L*	†0.15
BC185	0.36
BC186	0.25
BC187	0.27

Type	Price (£)
BC192	0.56
BC204*	†0.39
BC205*	†0.39
BC206*	†0.37
BC207*	†0.39
BC208*	†0.37
BC209*	†0.39
BC211*	†0.36
BC212*	†0.17
BC212L*	†0.17
BC213*	†0.16
BC213L*	†0.16
BC214*	†0.18
BC214L*	†0.18
BC225	†0.42
BC237*	†0.18
BC238*	†0.15
BC239*	†0.22
BC251*	†0.25
BC252*	†0.26
BC253*	†0.38
BC261A*	†0.28
BC262A*	†0.28
BC263*	†0.26
BC267*	0.20
BC268*	0.28
BC286	0.40
BC287	0.49
BC291	0.27
BC294	†0.37
BC297	0.36
BC300	0.62
BC301	0.38
BC302	0.86
BC303	0.64
BC304	0.44
BC307*	†0.17
BC308*	†0.14
BC309*	†0.18
BC317*	†0.15
BC318*	†0.15
BC319*	†0.19
BC320	†0.17
BC321A&B	†0.18
BC322	†0.28
BC323	1.15
BC327	†0.16
BC328	†0.18
BC337	†0.17
BC338	†0.17
BC340	0.19
BC347*	†0.17
BC348A & B	†0.17
BC349B	†0.17
BC350*	†0.24
BC351*	†0.22
BC352A*	†0.24
BC360	0.59

Type	Price (£)
BC377	0.29
BC394	0.39
BC440	0.52
BC441	0.59
BC461	0.78
BC477	0.30
BC478	0.25
BC479	0.33
BC547*	†0.13
BC548*	†0.13
BC549*	†0.15
BC550	†0.24
BC556	†0.23
BC557*	†0.16
BC558*	†0.16
BC559*	0.17
BCY10	0.30
BCY30A	1.06
BCY32A	1.19
BCY34A	1.02
BCY72	0.27
BD115	1.35
BD123	1.50
BD124	1.85
BD130Y	1.56
BD131	0.58
BD132	0.68
BD133	0.70
BD135	†0.37
BD136	†0.38
BD137	0.40
BD138	0.42
BD139	0.46
BD140	0.50
BD144	2.24
BD145	0.75
BD150A*	†0.51
BD155	†0.90
BD157	0.51
BD158	0.75
BD159	0.68
BD160	2.69
BD163	0.67
BD165	0.66
BD166	0.68
BD175	0.90
BD177	0.58
BD178	0.92
BD181	1.94
BD182	2.10
BD183	1.34
BD184	2.30
BD187	1.20
BD188	1.25
BD189	0.71
BD222	0.91
BD225	0.91
BD232	0.91
BD233	0.62

Type	Price (£)
BD234	0.68
BD235	0.63
BD236	0.63
BD237	0.68
BD238	0.68
BD253	1.58
BD410	1.65
BD433	0.65
BD435	0.70
BD436	0.71
BD437	0.74
BD438	0.75
BD519	0.88
BD520	0.88
BD599	0.87
BD600	1.23
BD663BR	0.86
BDX18	1.55
BDX32	2.95
BDY16A	0.63
BDY18	1.55
BDY20	2.29
BDY38	1.38
BF115	0.48
BF117	0.45
BF120	0.55
BF121	0.85
BF123	0.48
BF125	0.68
BF127	0.51
BF137F	0.78
BF152	†0.19
BF158	†0.25
BF159	†0.27
BF160	†0.20
BF161	0.84
BF163	†0.65
BF164	†0.95
BF166	0.50
BF167	0.38
BF173	0.35
BF177	0.36
BF178	0.46
BF179	0.58
BF180	0.53
BF181	0.53
BF182	0.44
BF183	0.52
BF184	0.44
BF185	0.42
BF186	0.42
BF194*	†0.14
BF195*	†0.13
BF196	†0.14
BF197	†0.15
BF198	†0.29
BF199	†0.29
BF200	†0.25
BF218	†0.42

Type	Price (£)
BF222	†0.51
BF224 & J	†0.22
BF240	†0.32
BF241	†0.31
BF244*	†0.51
BF245*	†0.43
BF254	†0.48
BF255	†0.58
BF256L*	†0.49
BF257	†0.44
BF258	0.52
BF259	†0.54
BF262	0.73
BF263	0.88
BF270	0.47
BF271	0.42
BF272A	0.80
BF273	†0.33
BF274	†0.34
BF336	0.63
BF337	0.65
BF338	0.68
BF355	†0.72
BF362	†0.49
BF363	†0.48
BF367	†0.29
BF451	0.43
BF457	0.46
BF458	0.49
BF459	0.52
BF594	†0.16
BF596	†0.17
BF597	†0.27
BFR39	†0.30
BFR40	†0.29
BFR41	†0.30
BFR50	†0.29
BFR52	†0.33
BFR61	†0.29
BFR62	†0.28
BFR79	†0.30
BFR80	†0.29
BFR81	†0.30
BFR88	†0.42
BFT41	0.48
BFT43	0.55
BFW11	1.02
BFW30	2.58
BFW59	†0.19
BFW60	†0.20
BFW90	†0.65
BFX29	0.38
BFX84	0.42
BFY50	0.38
BFY51	0.37
BFY52	0.36
BFY53	0.36
BFY90	1.98
BPX25	1.62

Type	Price (£)
BPX29	1.62
BR101	0.53
BR103	0.64
BR303	1.06
BRC4443	1.76
BRY39	0.60
BRY56	†0.44
BSS27	0.92
BT106	1.50
BT109	1.99
BT116	1.45
BT119	5.18
BU102	2.85
BU105	†1.80
BU105/02	†1.95
BU108	†2.98
BU126	†2.91
BU204	†2.50
BU205	†2.78
BU206	†3.09
BU208	†4.88
BU407	†1.38
BUY77	2.50
C106D	0.80
C106F	0.43
C111E	†0.46
D40N1	0.64
E1222	0.47
E5024	†0.19
GET872	0.46
MC140	†0.36
ME0402	†0.18
MF0404/02	†0.18
ME6001	†0.18
ME6002	†0.18
MJ2955	1.30
MJ3000	1.58
MJE340	0.68
MJE341	0.72
MJE370	0.74
MJE371	0.79
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.95
MJE3055	1.22
MPF102	†0.40
MPS3702	†0.33
MPS3705	†0.30
MPS6521	†0.36
MPS6523	†0.36
MPS6566	†0.36
MPSA05	†0.30
MPSA06	†0.32
MPSA55	†0.43
MPSA56	†0.45
MPSA93	†0.56
MPSL01	†0.33
MPSU01	0.61

Type	Price (£)
MPSU05	0.66
MPSU06	0.76
MPSU55	1.26
MPSU56	1.32
MPSU60	0.82
MPU131	†0.59
OC26	1.90
OC28	1.49
OC29	1.60
OC35	1.25
OC36	1.25
OC42	0.90
OC44	0.68
OC45	0.63
OC71	0.65
OC72	0.73
OC81	0.83
OC81D	0.95
OC139	1.30
OC140	1.35
OC170	0.80
OC171	0.82
OC200	3.90
OC201	3.95
OC202	2.40
OC205	3.95
OCP71	1.98
ON236A	0.94
R2008B	†2.92
R2010B	†2.79
R2322	†0.75
R2323	†0.85
ST2110	0.49
ST6120	0.48
TIC44	†0.25
TIC46	†0.35
TIC47	†0.45
TIP29A	0.47
TIP30A	0.50
TIP31A	0.51
TIP31C	0.67
TIP32A	0.58
TIP32C	0.72
TIP33A	0.77
TIP34A	0.84
TIP41A	0.72
TIP42A	0.80
TIP2955	0.77
TIP3055	0.58
TIS43	†0.44
TIS73	†1.36
TIS90	†0.23
TIS91	†0.28
ZTX108	†0.14
ZTX109	†0.16
ZTX213	†0.23
ZTX300	†0.16
ZTX304	†0.26

Type	Price (£)
ZTX500	†0.18
ZTX502	†0.22
ZTX504	†0.28
2N404	1.30
2N696	0.46
2N697	0.46
2N706A	0.33
2N708	0.29
2N914	0.32
2N916	0.46
2N918	0.54
2N930	0.29
2N1164	8.29
2N1304	1.40
2N1305	1.29
2N1306	1.49
2N1307	1.32
2N1308	1.53
2N1711	0.47
2N1893	0.52
2N2102	0.71
2N2217	0.55
2N2218	0.38
2N2219	0.42
2N2221A	0.26
2N2222A	0.41
2N2369A	0.40
2N2401	0.80
2N2484	0.35
2N2570	0.74
2N2646	0.82
2N2784	1.15
2N2869	2.08
2N2894	0.45
2N2904*	0.40
2N2905*	0.39
2N2906*	0.36
2N2926G	†0.15
2N2926O	†0.14
2N2926Y	†0.14
2N2955	1.12
2N3053	0.48
2N3054	0.86
2N3055	0.72
2N3250	0.52
2N3254	0.58
2N3391A	0.38
2N3633	12.70
2N3703	†0.17
2N3704	†0.19
2N3705	†0.17
2N3706	†0.16
2N3707	†0.18
2N3708	†0.17
2N3715	1.70
2N3771	2.39
2N3772	2.58
2N3773	3.90
2N3794	†0.40

Type	Price (£)
2N3819	†0.47
2N3820	0.72
2N3866	1.08
2N3904	†0.20
2N3905	†0.20
2N3906	†0.20
2N4036	0.94
2N4123	†0.17
2N4124	†0.17
2N4126	†0.17
2N4236	2.20
2N4289	†0.32
2N4292	†0.32
2N4416	0.85
2N4444	1.90
2N4921	0.80
2N5042	1.65
2N5060	†0.28
2N5061	†0.30
2N5064	0.63
2N5086	†0.49
2N5087	†0.50
2N5208	†0.59
2N5294	0.68
2N5296	0.68
2N5298	0.71
2N5322	1.16
2N5449	†0.18
2N5457	†0.46
2N5458	†0.40
2N5459	†0.58
2N5494	0.85
2N5496	1.05
2N6027	0.55
2N6107	0.71
2N6122	0.60
2N6178	1.07
2N6180	1.39
2N6211	2.74
2SB337BP	4.28
2SC458C	0.78
2SC643A	2.25
2SC930D	1.50
2SC1061	1.45
2SC1172Y	3.55
2SD234	1.48
3N128	1.60
40250	0.98
40251	1.14
40327	0.67
40361	0.48
40362	0.50
40410	0.94
40429	0.88
40530	0.79
40595	1.39
40603	1.13
40636	1.25
40654	0.89

Alternative gain versions available on items marked*. For matched pairs add 20p per pair.

LINEAR IC's

Type	Price (£)
BRC1330	†0.93
CA810QM	2.44
CA3005	1.85
CA3012	1.45
CA3014	2.23
CA3018	0.71
CA3020	1.89
CA3028A	0.80
CA3028B	1.09
CA3045	3.75
CA3046	0.70
CA3065	1.74
CA3068	1.90
CA3130S	1.57
FCH161	†2.40
FCJ101	†3.32
LM309K	1.98
LM380N-14	1.65
LM1303N	3.08
MC1307P	†1.82
MC1310P*	†1.94
MC1312P	2.34
MC1327P*	†1.86
MC1330P	†0.93
MC1350P	†1.22
MC1351P	†1.42
MC1352P	†1.42
MC1357P	†2.92
MC1358P*	†2.30
MC1458G	1.43
MC1496L	1.15
MC3051P	0.58
MFC4008	0.85
MFC4060A	0.98
MFC6040	1.11
MIC1P	2.58
ML231	†3.57
ML232	†3.57
NE555	0.72
NE556	1.34
NE566	1.95
SAA1024	†5.70
SAA1025	†10.35
SAS560A	†2.01
SAS570	†2.01
SC9503P	†1.40
SC9504P	†1.38
SL414A	1.91
SL432A	2.52
SL450	5.10
SL901B	†4.20
SL917B	†5.60
SL918A	†5.95
SN72440N	†2.21
SN76001N	†1.67
SN76003N	2.22

Type	Price (£)
SN7600BKE	1.56
SN76013N	1.56
SN76013ND	1.40
SN76018KE	1.56
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.22
SN76110N	1.20
SN76115N	†1.62
SN76116N	1.78
SN76131N	†2.10
SN76226N	†2.60
SN70227N	†1.61
SN76228N	†1.80
SN76502N	†1.92
SN76530P	†0.97
SN76533N	†1.38
SN76544N	†1.85
SN76546N	†1.85
SN76570N	†1.81
SN76620AN	†0.99
SN76650N	†1.48
SN76660N	†0.64
SN76666N	†0.96
TA7073P	†3.51
TAA263	†2.20
TAA300	†3.85
TAA320	1.10
TAA350A	†2.48
TAA370A	3.18
TAA435	†1.70
TAA450	†3.39
TAA521	1.10
TAA522	2.09
TAA550	0.45
TAA560	1.93
TAA570	†2.30
TAA611A	1.67
TAA611B	1.89
TAA621AXI	2.33
TAA630Q	3.91
TAA630S	4.18
TAA661A	2.39
TAA661B	1.75
TAA700*	†2.80
TAA840	†3.38
TAA861A	0.95
TAA930A	1.43
TAA930B	1.43
TAA960	†2.25
TAA970	†2.48
TAD100	†2.66
TBA120A	†0.90
TBA120S*	†0.99
TBA120SA	†1.02
TBA231	1.12

Type	Price (£)
TBA240A	†3.98
TBA281	†2.07
TBA395*	†2.58
TBA396	†2.40
TBA400	†2.20
TBA480Q	†1.84
TBA500*	†2.21
TBA510*	†2.21
TBA520P*	†3.40
TBA530P	†2.24
TBA540*	†2.88
TBA550*	†3.13
TBA560C*	†3.18
TBA570*	†1.29
TBA611B	2.68
TBA641	2.55
TBA641A12	2.35
TBA641B11	2.61
TBA651	†2.12
TBA673	†2.19
TBA700*	†2.50
TBA720AQ	†2.38
TBA720Q	†2.38
TBA750*	†2.18
TBA800	1.65
TBA810AS	1.69
TBA920*	†3.60
TBA940	†3.52
TBA950	†2.78
TBA990*	†2.90
TCA270A*	†3.55
TCA280A	1.43
TCA290A	3.46
TCA420A	1.98
TCA440	1.67
TCA640	2.76
TCA650	2.76
TCA660	2.76
TCA730	3.54
TCA740	3.04
TCA750	2.53
TCA760	1.52
TCA820	3.29
TDA440	†4.16
TDA1003	1.52
TDA1004	2.73
TDA1005	3.04
TDA1022	6.89
TDA1024	0.97
TDA1034	1.98
TDA2610	2.86
TDA2640	2.86
ZN414	1.45

* Indicates Q version is also available.

DIODES

Type	Price (£)
AA113	0.17
AA119	0.21
AA129	0.28
AA143	0.18
AAY30	0.28
AAZ13	0.42
AAZ15	0.35
AAZ17	0.28
AY102	3.85
BA100	0.24
BA102	0.36
BA104	0.19
BA110	0.80
BA111	0.70
BA115	0.17
BA116	0.56
BA121	0.85
BA129	0.48
BA145	0.19
BA148	0.19
BA154	0.06
BA155	0.17
BA156	0.12
BA157	0.25
BA158	0.28
BA159	0.40
BA164	0.14
BA170	0.18
BA182	0.27
BA201	0.13
BA202	0.14
BA203	0.14
BA216	0.08
BA219	0.11
BA243	0.45
BA317	0.06
BA318	0.07
BAV10	0.10
BAV21	0.18
BAW62	0.06
BAX13	0.07
BAX16	0.10
BAX17	0.19
BAY72	0.16
BB104B	0.52
BB105B	0.33
BB105G	0.30
BR100	0.40
BY100	0.35
BY103	0.35

Type	Price (£)
BY114	0.60
BY118	1.10
BY126	0.20
BY127	0.21
BY133	0.35
BY140	1.40
BY164	0.75
BY176	2.80
BY179	0.83
BY182	1.14
BY184	0.44
BY189	5.30
BY190	4.90
BY206	0.26
BY238	0.25
BYX10	0.30
BYX38/600	0.70
BYX70/500	0.53
ITT44	0.08
ITT210	0.63
ITT827	0.80
MCR101	0.43
MR854	1.10
OA5	0.88
OA10	0.58
OA47	0.20
OA81	0.19
OA90	0.13
OA91	0.15
OA95	0.20
OA200	0.13
OA202	0.13
OA210	0.89
TIL209	0.14
TIL211	0.18
TV20	2.25
IN914	0.08
IN916	0.06
IN4001	0.06
IN4002	0.07
IN4003	0.08
IN4004	0.08
IN4005	0.09
IN4006	0.10
IN4007	0.12
IN5400	0.15
IN5401	0.17
IN5402	0.20
IS920	0.09
IS921	0.11

ZENER DIODES

400mW plastic	3.0-33V	14p each
1/1.3W plastic	3.3-180V	18p each
1.5W flange	4.7-75V	£1.26 each
2.5W plastic	7.5-75V	67p each
20W stud	7.5-75V	£1.31 each
75W stud	7.5-75V	£7.95 each

VDR's, etc. (†)

Type	Price (£)
E295ZZ	
/01	0.28
/02	0.28
E298CD	
/A258	0.25
E298ED	
/A258	0.22
/A260	0.22
/A262	0.22
/A265	0.22
/P268	0.22
E298ZZ	
/05	0.25
/06	0.22
E299DD/P116-P354	all 0.23
E299DH	
/P230	0.72
R53	1.75
VA1015	0.92
VA1026	0.79
VA1033/34/38/39/40/53	all 0.20
VA1055s/56s/66s/67s	all 0.23
VA1074	0.20
VA1077	0.31
VA1091	0.29
VA1096/97/98	all 0.20
VA1103	0.32
VA1104	0.46
VA1108/09/10/11/12	all 0.24
VA8650	1.20
2322 554 02221	0.59
2322 662 98003	0.88

VALVES (†)

Type	Price (£)
DY86/87	0.75
DY802	0.75
ECC81	0.78
ECC82	0.95
ECC83	0.78
ECH81	0.83
ECL80	0.82
EF80	0.60
EF183	0.75
EF184	0.75
EH90	0.94
EL34	3.08
EY51	1.20
EY86/87	0.67
PCC84	0.61
PCC85	0.79
PCC89	0.74
PCC189	0.94
PCF80	1.20
PCF86	0.87
PCF200	2.32
PCF801	0.74
PCF802	1.20
PCF806	3.37
PCF808	2.00
PCL82	0.93
PCL83	1.12
PCL84	0.65
PCL86	1.27
PCL805/85	1.00
PD500	3.75
PFL200	1.40
PL36	1.20
PL81	0.94
PL84	0.79
PL504	1.50
PL508	1.85
PL509	3.10
PL519	3.10
PL802	3.25
PY81/P810	0.60

BRIDGES

Rating	Price (£)	Rating	Price (£)
1½A 50V	0.27	2A 100V	0.36
100V	0.28	200V	0.40
200V	0.32	400V	0.47
400V	0.40	600V	0.53
600V	0.50	800V	0.60
800V	0.58	1000V	0.87
3A 100V	0.52	6A 100V	0.68
200V	0.55	200V	0.68
400V	0.61	400V	0.74
600V	0.67	600V	0.80
800V	0.80	800V	0.88
1000V	1.20	1000V	0.95

10A and 25A ranges also stocked.

RESISTORS

Carbon Film (5%) (†) — *Mixes of a minimum of 10pcs of any value:*

	Ea	10 of one value	50pc	100pc	500pc
¼W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.40	£5.40
⅓W 10Ω-10MΩ (E24)	3p	25p	95p	£1.40	£5.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.80	£6.40	£26.80

Wirewound (5%)

2½W 0.22Ω-270Ω	18p
4W 1.0Ω-10kΩ	22p
7W 0.68Ω-22kΩ	24p
11W 1.0Ω-22kΩ	28p
17W 1.0Ω-22kΩ	33p
Vertical mounting pillars	3p

Presets (†)

0.1W (Vertical and Horizontal) 100, 220, 470Ω, 1, 2.2, 4.7, 10, 22, 47, 100, 220, 470kΩ, 1, 2.5, 5MΩ all 14p each

0.2W (Vertical and Horizontal) Values as 0.1W all 14p each

FUSES (all packs of 10)

20mm Time Delay (BEAB)
40mA £3.68
50, 63mA £2.55
100mA £1.86
160, 200, 250mA £1.44
315, 500, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 5A all £1.19

20mm quick-blow (BEAB)
100mA 68p
200, 250, 315, 500, 630, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 5A all 56p
2A circuit breakers · metal £1.52, plastic £1.48

LABGEAR (Details of full range on request)
COLOURTEXT ADAPTOR 7026
Full facility Colourtext decoder to place between aerial and receiver. All you would expect of a quality ready-made unit. Leaflet on request. †£340.20

COLOUR BAR GENERATOR
CM6052/DB. VHF/UHF gives standard B band colour bars + variable tuning + front panel on/off switch + sync trigger output + blank raster + red raster + crosshatch + greyscale stepwedge + colour bar + centre cross + dot pattern + centre dot. £182.25

TELEVISION COLOUR RECEIVER MK II

SEMI CONDUCTOR PACK No. 1 (Power Supply)

All Parts as Published £6.45 (inclusive of 51p VAT and p & p)

P. & P. UK: £0.12 per order. Overseas: At cost.
Please add VAT at 8% and 12½% on items marked†.
It is only possible to show part of our range here. Our catalogue (30p refundable) shows Service Aids, 7400 series, CMOS, op amps, SCRs etc., hardware, capacitors, special TV items and many more transistors, diodes, i.c.'s and valves.
Giro A/c 23 532 400. *A/c facilities available*

CAPACITORS

Metallised Paper (†)

2n2F	1500V DC	60p	10nF	500V AC	60p
2n2F	600V AC	24p	15nF	300V AC	30p
3n6F	1700V DC	60p	22nF	300V AC	32p
4n7F	1500V DC	60p	100nF	1000V DC	20p
10nF	1000V DC	22p	470nF	1000V DC	60p

H.V. Disc Ceramic (†)

1kV	1.5nF	18p
3kV	1.5nF	20p
8kV	10, 22, 47, 82, 100, 120, 150, 180, 200, 220pF	30p
8kV	250, 270, 300pF	39p
10kV	1nF	67p
18kV	1nF	73p

CONVERGENCE POTENTIOMETERS
5, 7, 10, 15, 20, 50, 100, 200, 500Ω †38p each
Spindles for above 5p each

VHF to UHF CONVERTER CM6022/RA. "Televerta" for DX-ing or uhf receiver use on relay systems, Eire etc. †£24.40

EAST CORNWALL COMPONENTS

CALLINGTON – CORNWALL PL17 7DW

TEL: CALLINGTON (05793) 2637. TELEX: 35544 (OFFICE OPEN 9.30-5.00 MON-FRI)

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It Takes Two to Tango

Whatever's going on? All of a sudden there seems to be an almost continuous soft shoe shuffle between the UK and Japanese TV industries. A few days ago it was announced that a Radio Industry Council delegation, led by Lord Thorneycroft, had reached an understanding with the Japanese about the UK TV, audio and video markets following two days of talks with the Japanese Electronics Industries Association in Kyoto. The idea apparently is that the Japanese have agreed to maintain exports "at a reasonable level" in accordance with the UK market, co-operating in investigating any problems that arise. A further meeting will be held in London later this year. Both governments supported the talks, which it's claimed have resulted in a new spirit of co-operation. The RIC delegation comment that Japan's orderly marketing policy was much appreciated. One's initial reaction to that is who's kidding whom? Especially as there must be a certain amount of concern at present over the fact that some of the PAL patents expire next year. Nevertheless ... We have Toshiba co-operating in the West Country, Sony expressing satisfaction with their operation in South Wales, and that visit we mentioned last month by a Thorn delegation to Japanese colour TV plants. The Thorn group found their hosts "extremely co-operative", and comment that the Japanese were impressed with the UK industry's efforts to deal with the problem full on rather than simply sitting back and calling for duties and quotas.

The Thorn delegation, consisting of union and management representatives, certainly came back with much information on that fascinating subject – what makes Japanese industry tick. It's worth reporting on some of their findings, which naturally fall into two main categories, industrial relations and production techniques.

The dedication of Japanese workers to their companies is well known. Even so, there were one or two surprises. The Japanese do strike for example. On Sundays. Pointless? Well, you demonstrate you see, and the company loses face. That's very important to the Japanese, who aim to run their affairs in total "harmony". This harmony is further disrupted by wearing armbands and lapel badges during a dispute to indicate lack of harmony with the management. It seems to work, but clearly wouldn't here: as a union representative put it, we're up against a totally different culture in this respect. Absenteeism is it seems quite unknown. We're talking about the large corporations however, where the job for life tradition operates. Not all the work is done under these conditions. Much of the labour intensive work is subcontracted out to smaller concerns, and the working conditions and relations there are less easy to assess.

What of the technology? Thorn have invested substantially in recent times, and already have computerised component checking and automatic component insertion. In these respects, there is little to learn. It was pointed out however that Japanese plants are more modern and purpose built, so that all operations can be carried out with maximum efficiency. Japanese skill with engineering detail also plays a part. And of course the scale of operations is much larger. Several Japanese TV plants could by themselves supply the entire UK market, i.e. we're talking about plants producing 1·5 million or so sets a year. Thorn's largest plant is at present producing 250,000 sets a year. Quite a lot even so you might say. But the sets are not all the same, and when you break down the product mix to determine production of particular models you find yourself with comparatively small runs.

The Japanese subcontracting system, which came as something of a surprise to us, also helps. The point here is that the large plants are highly capital intensive, and if you combine this with subcontracting out as much as possible of the labour intensive operations you get the best of both worlds. About 70% of component insertion is automated. That leaves 30%. So the partly assembled PCBs are sent out to subcontractors who complete the boards and carry out the various wiring and soldering operations. Once the human handling operations are complete, the boards come back for assembly in the sets and testing. This is something that would probably raise a few union eyebrows if it was attempted in the UK.

Another intriguing aspect of Japanese operations is stock levels. Most components are produced in house, nearby, while distribution is highly efficient and reliable. This means that it's not necessary for plants to hold large stocks. Stock levels adequate for four-five days' work seem average, though in one extreme case the stock level was down to an hour's requirements! In the UK, where components come from all over, many being imported, stock levels of several weeks' requirements are usual, since it's necesary to take into consideration such contingencies as strikes at suppliers, shipping problems, the weather and so on. One can see immediately the economic significance of these different stock levels.

The Japanese TV industry has also been helped by the relative simplicity of Japanese TV sets – 14-18in. models, with a 90° tube and no remote control (not necessary in the average small Japanese living room, where you can lean forward to change channel!). Thorn pointed out that at present 70% of their production incorporates remote control.

In the circumstances, the UK industry has performed very creditably. Thorn say they are "determined to not only maintain but also to improve their market share in the UK and export markets!" One wishes them well.

JANUARY COVER

We regret that an acknowledgement to Tritel, who made available to us the sets shown on our front cover last month, was omitted in error. We are grateful to Tritel for their helpful co-operation.

Teletopics

HITACHI-GEC LINK

The long rumoured link up between GEC and Hitachi has now been officially announced. The two companies will have equal £5·5 millions shares in a new company producing television receivers and music centres. The move will secure the future of 2,000 GEC employees at their Hirwaun plant in South Wales and two smaller associated units. GEC will be providing factory capacity, while the new company will have access to Hitachi's research, development and production technology. The deal in fact sounds very similar to the Rank-Toshiba one announced a couple of months ago, though no government aid is involved at present. The new company plans to double the present 150,000 a year colour set production over the next five years, with between 30-40% of the sets being exported. The separate Hitachi and GEC sales networks in the UK are to be retained, with the Hirwaun plant supplying products for both ranges. The Department of Industry has given its blessing to the deal.

THE COLOUR CRT SCENE

One intriguing feature of the moves mentioned above is who will be supplying the tubes – both Rank and GEC have traditionally been Mullard customers. Toshiba and Hitachi are both major tube makers themselves however. Will they be prepared to use Mullard's new 90° 20in. colour tube when according to a recent commentator, Klaus Hüttman, general manager of ITT's West German TV centre at Esslingen, there's at present excess capacity of ten million colour tubes a year world wide – mainly in the Far East? Mullard say that their new tube is tailored to the known requirements of the West European market rather than being an international compromise. It will in particular have a pure red – Japanese tubes tend towards orange in this part of the light spectrum.

It's also interesting that before long Mullard will be producing three different colour tubes: 20AX, the new 90° 20in. tube, and . . . 30AX. Klaus Hüttman has criticised Mullard's preparations to launch the 30AX tube when "20AX still has a lot going for it". This looks like something of a "can't win" situation: you get criticised if you don't invest in technical innovation, and also if you do! Timing of course is the crux of this problem, but in a highly competitive field such as the international TV one, firms inevitably try to seize any possible initiative – one has only to look at VCRs. 30AX is being developed to offer the same advantages everyone seems to be after at present – lower power consumption in the yoke and a gun giving improved focusing.

Much of the work on obtaining greater light output from the current generation of colour tubes has been undertaken by ITT, who call their version the Heliochrom system. ITT are at present producing 5,000 Heliochrom tubes a day, in 26in. 20AX and 20in. PIL versions. The first move adopted by ITT was to increase the size of the slots in the shadowmask, allowing more of the beam current to reach the screen. By itself however this move would have reduced the beam landing reserve, creating purity problems. The solution to this has been to use a variable pitch mask, with increased slot size at the edges and corners, in conjunction with increased phosphor stripe width at the edges and corners. The mask's transmission factor has been increased from 16% to 19·5%, giving increased brightness for the same current – increasing the current would have adversely affected the focusing. This increased light output has made it possible to use higher light transmission glass without running into problems due to reflected light. The overall brightness improvement achieved in the Heliochrom and Hi-Bri tubes is 70%. ITT say that the system is at least as good as the black matrix system commonly used by the Japanese – developed by RCA in the early 70s.

CHANGES IN THE RENTAL SCENE

The Electronic Rentals Group (Visionhire) is to buy another well known high street rental organisation, British Relay Wireless, from the hire purchase and leasing group Lloyds and Scottish for £61 million. This will give Visionhire almost 500 more shops and take its present market share from 8% to 12%. Philips, who have a 31·9% interest in Electronic Rentals, will have a 34·08% interest in the new expanded group as a result of the complex way in which the deal is being financed. Visionhire say that they will now be the second largest TV rental group after Thorn (DER, Radio Rentals, Multibroadcast), and the move certainly seems a helpful one from Philips' point of view. Lloyds and Scottish took over BRW in 1974.

NORDMENDE

NordMende (UK) Ltd., the subsidiary recently established by the West German parent company, has moved to new premises. The new address is NordMende House, Rickfords Hill, Aylesbury, Bucks HP20 2RT, telephone Aylesbury (0296) 20501. The new premises include a service centre.

RATIONALISED TRIPLER

The rationalised e.h.t. tripler mentioned last month, available from Phab Electronics Ltd., can be used in the following sets/chassis: Autovox 2282; B&O 4000/5000; Decca 10, 30, 80 and 100 chassis; GEC hybrids and C2110 series; Grundig 3000, 3010, 5010, 5011, 5012, 6010, 6011, 6012, 2052, 2210, 2252R and 7200; ITT CVC5-CVC9 and CVC20-CVC30; Pye 691, 693 and 731; Rank A823, Z179 and T20; Saba 2705; Tandberg CTV2. It can be used to replace any tripler with 20mm fixing – most triplers of the Mullard type. The kit includes a tripler, bracket, screw kit, length of e.h.t. lead and a tag strip. The bracket is not required in many sets. Where a five-diode tripler is being replaced, the blue negative lead should be clipped 1in. from the tripler base. Instructions are included with the kit.

TANDBERG'S NORWEGIAN OPERATIONS TO STOP

The Norwegian government, which has given Tandberg considerable support in recent times, has recommended to the management of Tanbergs Radiofabrikk A/S that its main trading operations should be closed down. The Norwegian Minister of Industry has recommended that the government offer the company 50 million kroner to be spent on an orderly wind down of present operations and an investigation into the continued operations of the successful data products division, educational equipment division and certain consumer products such as tape recorders.

Tandberg (UK) Ltd., one of Tandberg's eleven overseas subsidiaries, is not affected. It's understood that most Tandberg colour sets have in recent times been produced in Scotland by Tandberg (Electronics) Ltd. This is an associate company of Tandberg UK and is also not affected by the parent company's difficulties.

LATEST BREMA FIGURES

The British Radio Equipment Manufacturers' Association's latest delivery figures cover the first nine months of 1978. Deliveries of colour receivers in the UK reached 1·2 million, of which 80% were UK made. On the monochrome side UK manufacturers supplied 57% of the 828,000 sets delivered.

RECONDITIONED CTV EXPORTS

Midland TV Trade Services of Kidderminster has received a £500,000 contract to supply 5,000 reconditioned colour sets to Nigeria over a two year period. The sets will be selected late models which will be completely overhauled, refurbished and converted to Nigerian TV standards in MTV's workshops.

This is an intriguing part of the current TV scene: MTV already supplies reconditioned sets to Holland, Denmark, India, the Far East, Australia and Israel, and is negotiating a contract for the supply of sets to Saudi Arabia. The Nigerian contract was obtained in the face of competition from multinational German and Japanese companies. You just don't know where that set sitting in the corner of your living room may end up . . .

TYPES OF RECTIFIER DIODE

Have you sometimes wondered about the difference between general-purpose, fast-recovery and soft fast-recovery rectifier diodes? When a forward biased semiconductor junction has been conducting long enough for a steady current flow to be established, it cannot cease to conduct immediately the applied voltage reverse biases it. This is because minority carriers in the junction region have to be cleared – by recombination and diffusion. As a result, some reverse current flows just after the diode has become reverse biased, as the characteristics in Fig. 1 show. One obvious disadvantage is the additional power dissipation. With a fast-recovery ("snap-off") diode the reverse current flow falls very rapidly, but the result can be conducted or radiated interference and the generation of high voltages

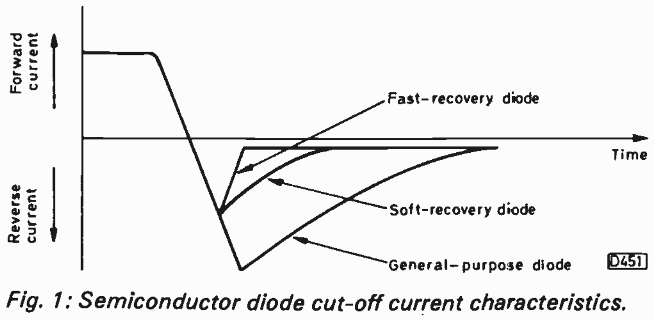


Fig. 1: Semiconductor diode cut-off current characteristics.

across any windings in series with the rectifier. The soft-recovery diode overcomes this problem, the reverse current falling rapidly but without the snap-off characteristic of a fast-recovery diode. Applications of soft-recovery diodes include line output stage rectifiers and switch-mode power supply circuits. Thanks to P. G. Noble for this information, writing on understanding rectifier diode data in the first issue of the new Philips/Mullard publication *Electronic Components and Applications.*

TV MEX

TV Mex, the first trade exhibition for the TV, microelectronics and microprocessing industry, was held at the Birmingham National Exhibition Centre from January 16-18th. Manufacturers and distributors of TV games, home computers and suppliers of teletext and viewdata systems were represented. The BBC and the Department of Industry were also present.

ITT's CVC45/1 CHASSIS

The success of the CVC40 16in. chassis has led ITT to introduce a new chassis, the CVC45/1, based on the same concept but modified for use with a 20in. tube. The main practical difference is the use of a separate e.h.t. tripler instead of a diode-split line output transformer. While using the same basic signals panel as the CVC20 series, the power supply and timebase circuitry are almost entirely different. It's interesting to compare the power consumption – approximately 150W at maximum beam current in the case of the CVC20 and 90W at maximum beam current in the case of the CVC45/1, which boasts a 65W consumption under normal operating conditions.

PRESTEL DEVELOPMENTS

The Post Office is planning a major drive to boost the overseas development of its Prestel viewdata system. The plan is to set up a world wide network of agents to promote and sell the service: the Post Office is at present holding discussions with a number of UK companies interested in becoming agents. The Prestel system is based on international standards and can be readily adopted to other languages. So far it's been demonstrated in 16 countries and 17 other European languages. The Post Office's Research Centre is at present working on producing viewdata in languages with their own alphabets – particularly Arabic, Greek, Hebrew and Katakana (phonetic Japanese). Demonstrations have also been held in Moscow using the cyrillic characters of the Russian alphabet.

The first Prestel set has been installed in a London hotel – the Portman. The set, a 26in. Baird model, has been installed by Radio Rentals Contracts Ltd. in a recently refurbished lobby where guests can make use of the service.

Selfridges claim to be the first department store to mount a display of the PO's Prestel system, using a GEC C2639H receiver. This set incorporates both teletext and Prestel facilities, controlled via a 30-channel ultrasonic remote control system. Access to the Prestel side is via a single button which gives fully automatic dialling of up to six selected computer numbers. After being switched to the TV mode, the set can still store the last Prestel page it displayed. The "key page" access facility allows up to 16 most frequently used page numbers (which can reach up to 16 digits) to be called up by pressing the page button followed by a one or two digit number. Selfridges plan to sell the set at around £1,400 initially.

Over the Counter

Robin D. Smith

NEVER a day goes by in this trade without something of interest turning up – either a technical problem or a matter of human interest. Let's start off with a technical one that caused us more than a little headscratching.

The Picture Got Darker

The set was a Decca hybrid colour one – the Bradford chassis – and the complaint that the picture got darker after the set had been on for a time, necessitating continual brightness control adjustments, the set getting rather hot at the same time. In fact the fault had been present for some time, and the set had been in the workshop on a couple of occasions, but without the fault showing up. It's owner likes to have the heat in his lounge well up however. Eventually I decided to take the set back to the workshop once again, and this time I actually saw what was being complained about. I also saw that the line output valve started to glow when the fault came on, hence the excessive heat.

New line output stage valves were tried as a start, but there was no change. Next check voltages around the PL509. The screen grid was about 60V low when the fault was present, while the cathode was about 1V on the high side. Clearly the line output valve was drawing excessive current – hence the heat. Now this can be due to incorrect drive, i.e. a fault in the line oscillator circuit, or excessive loading, i.e. a fault in the line output stage itself. So we got the scope out to examine the drive waveform at the control grid. This was roughly of the correct amplitude and shape so we directed our attention to the output stage. A lot of time was spent checking everything likely without success before we decided that an approximately correct drive waveform is maybe not good enough.

Back to the line oscillator stage therefore. The fault was still present with a new PCF802, and as the voltages were right, capacitor trouble was suspected. There's a polystyrene capacitor (C427) which couples the oscillator feedback to the control grid of the pentode section of the valve. A likely suspect. Value 470pF – but what's this, a 100pF capacitor fitted!

A replacement of the correct value restored correct waveform shape, cool line output valve operation, and stable brightness. The owner, a friend, subsequently looked through his bills for previous service work – and found one for "locating and replacing faulty capacitor in line oscillator circuit". From another engineer of course!

The Customer's Always Right

About a year ago we were called out to a Rank A823A set we'd sold. Fault sound but no raster. We noticed that there was plenty of line whistle, and could feel the e.h.t. on the screen, so the line timebase seemed to be in order. We then saw that the tube heaters were not alight, due to a dry-joint on the tube base panel fortunately. We set the picture up to give the sort of results we like, but the customer thought the picture too blue. The customer's always right of course, so we turned down the blue first anode control, leaving him with the colour he said he wanted.

Six months later we had to pay another visit, due to a short-circuit bridge rectifier on the power supply panel. On replacing this we noticed that there was now no blue at all. Fitting new transistors (two) in the blue channel brought it back, but the customer still wanted the blue turned down.

Last week we were back again because of another dry-joint in the tube heater circuit. On switching on it was clear that both the blue and red guns were completely flat. The tube was still under guarantee, so a replacement for a labour only charge was agreed. While doing this we supplied a loan set which had a very good tube in it – and was set up to our normal standards. "What nice colours" said the customer. We explained that for a year or so we'd been trying to persuade him to let us adjust his own set properly, but . . .

Or too Clever

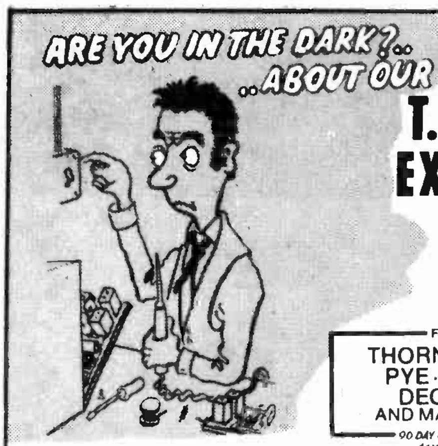
Another customer was too clever by half. We installed a new 22in. ITT colour set on Saturday afternoon. No problems. On Sunday at nine o'clock he was banging on my door at home, shouting that the set was dead and would I fix it immediately or else. On visiting him a little later I found that the mains plug fuse had failed. What's this I said, a 1A fuse. I knew I'd left a 5A one there, and a replacement 5A fuse restored normal operation. On enquiring about the 1A fuse the customer said he'd worked out by Ohm's Law that with 240V and a consumption of 155W the correct fuse would be one of about 1A. Rather annoyed, I pointed to the cabinet back which stated "fit plug with a 5A fuse". Ohm's Law doesn't allow for surges!

A Collection of Symptoms

The customer's complaint with a Decca MS2401 hybrid monochrome receiver was lack of height, but on examination neither the width nor the brightness were adequate either. This collection of symptoms suggested low h.t., and on checking both the HT1 and HT2 lines were about 40V lower than they should be. A replacement smoothing block (C93/4/5) restored correct h.t. voltages and on adjusting the preset width and height controls a full sized picture was obtained – brighter too, but marred by the fact that the tube was going soft.

Plenty of Portables

We've had plenty of portables in recently, as is to be expected at the time of writing. Our first check on an apparently dead Decca Gypsy revealed that the l.t. line was 4V instead of about 12V, while the series regulator transistor's 10Ω parallel resistor was getting very hot. Something somewhere was drawing a lot of current. Our golden rule with portables is to check with a 12V battery – this eliminates troubles in the mains section of the power supply. With the 12V battery connected across the 2,000μF reservoir capacitor, the set was drawing excessive current and I noticed that most of the components in the regulator circuit appeared to have been unsoldered at some time. My experience however is that the AU113 type of line output



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PYE 169 1000-1000/40	0.85
RRI 823 2500-2500/30	1.03
RRI 300-300/300	2.47
ITT/KB 200-200-75-25	2.86
TCE 950 100-300-100-16/275	1.83
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TCE 3000/3500 175-100-100	2.16
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TCE 8000/8500 700/800	0.93
TCE 8000/8500 400/350	0.93
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100-200-60/275	1.41
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200-200-100-32/350	1.41
125-300-100/350	1.41
300-200-100/300	1.41
2000-2000/40	0.70
300-300-100-32	1.41
300-300-100-50	1.41
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200-100-100-150/350	1.41

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Dropper TCE 1600	0.89
Dropper TCE 3000/3500	0.54
Dropper TCE 8000	0.80
Dropper TCE 8500	0.85
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Dropper Philips G8	0.25
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Dropper GEC 2000	0.71
Dropper PYE 11062	0.85
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DIODES & RECTIFIERS

AA116 Diode	0.11
AA117 Diode	0.11
AA119 Diode	0.11
OA47 Diode	0.08
OA79 Diode	0.08
OA81 Diode	0.08
OA85 Diode	0.08
OA90 Diode	0.08
OA91 Diode	0.08
OA95 Diode	0.08
OA202 Diode	0.12
BA100 Diode	0.12
BA102 Diode	0.07
BA130 Diode	0.10
BA145 Diode	0.20
BA148 Diode	0.20
BA154 Diode	0.06
BA155 Diode	0.09
BA164 Diode	0.09
BAX13 Diode	0.11
BAX16 Diode	0.07
BAY38 Diode	0.11
BY206 Diode	0.20
SK3F/04 Diode	0.20
IN4148 Diode	0.05
IS44 Diode	0.05
BY126 Rectifier	0.10
BY127 Rectifier	0.12
BY133 Rectifier	0.15
BY164 Rectifier	0.50
BY179 Bridge Rectifier	0.96
BY182 Bridge Rectifier	1.27
BY238 Rectifier	0.14
BYX10 Rectifier	0.16
BY187 High Voltage Rectifier	0.30
IN4001 Rectifier	0.08
IN4002 Rectifier	0.08
IN4003 Rectifier	0.09
IN4004 Rectifier	0.09
IN4005 Rectifier	0.10
IN4006 Rectifier	0.10
IN4007 Rectifier	0.11
BY142 Rectifier	0.10
BR100	0.30
BR101	0.35
BRY39	0.35
BT116	1.70
BT119	2.00
BT120	2.00
TV106	1.40
2N4443	1.00
BT100A/02	1.50
OT112	3.50
BYX55/350	0.60
BYX55/600	0.60
BYX71/600	0.60
2N4444 Thyristor	1.27
BT109 Thyristor	1.27

TRANSISTORS

AC107 Transistor	0.20
AC126 Transistor	0.20
AC127 Transistor	0.20
AC127/01 Transistor	0.30
AC128 Transistor	0.30
AC128/01 Transistor	0.30
AC141 Transistor	0.20
AC141K Transistor	0.30
AC142 Transistor	0.27
AC142K Transistor	0.45
AC153 Transistor	0.45
AC176 Transistor	0.30
AC176/01 Transistor	0.45
AC186 Transistor	0.30
AC187 Transistor	0.30
AC187K Transistor	0.45
AC188 Transistor	0.30
AC188K Transistor	0.45
AC193K Transistor	0.45
AC194K Transistor	0.45
AD140 Transistor	1.50
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AD143 Transistor	1.50
AD145 Transistor	1.50
AD149 Transistor	1.00
AD161 Transistor	0.50
AD162 Transistor	0.50
AD262 Transistor	1.20
AF114 Transistor	0.45
AF115 Transistor	0.45
AF116 Transistor	0.45
AF117 Transistor	0.45
AF118 Transistor	0.45
AF121 Transistor	0.45
AF124 Transistor	0.45
AF125 Transistor	0.45
AF126 Transistor	0.45
AF127 Transistor	0.45
AF139 Transistor	0.45
AF239 Transistor	0.60
AL102 Transistor	2.70
AU107 Transistor	2.70
AU110 Transistor	2.70
AU113 Transistor	2.70
BC107 Transistor	0.15
BC108 Transistor	0.15
BC109 Transistor	0.15
BC113 Transistor	0.12
BC114 Transistor	0.12
BC115 Transistor	0.15
BC116 Transistor	0.15
BC117 Transistor	0.15
BC118 Transistor	0.12
BC119 Transistor	0.33
BC125 Transistor	0.15
BC126 Transistor	0.14
BC136 Transistor	0.14
BC137 Transistor	0.14
BC138 Transistor	0.28
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BC170 Transistor	0.10
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BC172 Transistor	0.10
BC177 Transistor	0.17
BC178 Transistor	0.17
BC179 Transistor	0.17
BC182L Transistor	0.10
BC183 Transistor	0.10
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BC184L Transistor	0.10
BC184LC Transistor	0.12
BC186 Transistor	0.18
BC187 Transistor	0.18
BC203 Transistor	0.10
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BC206 Transistor	0.10
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BC208 Transistor	0.10
BC209 Transistor	0.10
BC212L Transistor	0.10
BC213L Transistor	0.10
BC214L Transistor	0.10
BC225 Transistor	0.30
BC237 Transistor	0.10
BC238 Transistor	0.10
BC251A Transistor	0.10
BC301 Transistor	0.30
BC303 Transistor	0.30
BC307 Transistor	0.10
BC308 Transistor	0.10
BC327 Transistor	0.11
BC328 Transistor	0.11
BC337 Transistor	0.11
BC338 Transistor	0.11
BC547 Transistor	0.11
BD115 Transistor	0.35
BD116 Transistor	0.80
BD124P Transistor	1.80
BD131 Transistor	0.45
BD132 Transistor	0.45
BD133 Transistor	0.54
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BD144 Transistor	2.50
BD155 Transistor	0.60
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BD163 Transistor	0.60
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BD183 Transistor	0.60
BD187 Transistor	0.60
BD210 Transistor	1.24
BD235 Transistor	0.54
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BD238 Transistor	0.54
BD239 Transistor	0.54
BD380 Transistor	0.54
BD437 Transistor	0.54
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BD441 Transistor	0.54
BD535 Transistor	0.54
BD536 Transistor	0.54
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BD538 Transistor	0.54
BDX73 Transistor	0.60
BDY201 Transistor	2.10
BF115 Transistor	0.45
BF118 Transistor	0.45
BF121 Transistor	0.60
BF152 Transistor	0.30
BF154 Transistor	0.15
BF157 Transistor	0.50
BF158 Transistor	0.30
BF160 Transistor	2.16
BF163 Transistor	0.45
BF167 Transistor	0.45
BF173 Transistor	0.45
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BF194 Transistor	0.10
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BF197 Transistor	0.10
BF198 Transistor	0.10
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BF200 Transistor	0.10
BF224 Transistor	0.10
BF240 Transistor	0.12
BF241 Transistor	0.12
BF256LC Transistor	0.36
BF257 Transistor	0.36
BF258 Transistor	0.37
BF271 Transistor	0.45
BF273 Transistor	0.15
BF274 Transistor	0.18
BF336 Transistor	0.37
BF337 Transistor	0.37
BF338 Transistor	0.39
BF355 Transistor	0.63
BF458 Transistor	0.75
BF459 Transistor	0.75
BFT43 Transistor	0.39
BFX29 Transistor	0.35
BFX84 Transistor	0.33
BFX85 Transistor	0.33
BFX88 Transistor	0.33
BFX89 Transistor	0.33
BFY50 Transistor	0.33
BFY51 Transistor	0.33
BFY52 Transistor	0.33
BFY90 Transistor	0.90
BDX32 Transistor	2.40
BU105 Transistor	1.50
BU105/01 Transistor	2.40
BU105/02 Transistor	2.40
BU105/04 Transistor	2.40
BU108 Transistor	2.40
BU204 Transistor	1.50
BU205 Transistor	1.50
BU206 Transistor	2.40
BU208 Transistor	2.40
BU208/02 Transistor	2.40
BU326S Transistor	1.98
BU406 Transistor	1.89
BU406D Transistor	2.66
BU407 Transistor	1.59
BU407D Transistor	2.10
2SC1172Y Transistor	2.40
R2008B Transistor	2.25
R2009 Transistor	2.25
R2010B Transistor	2.55
R2540 Transistor	3.00
ME0404 Transistor	0.15
ME0412 Transistor	0.15
ME4003 Transistor	0.10
ME6002 Transistor	0.15
ME8001 Transistor	0.12
MJE340 Transistor	0.75
MJE520 Transistor	0.60
MJE2955 Transistor	0.96
MJE3055 Transistor	0.87
MJ2955 Transistor	1.20
MJ3055 Transistor	1.20
MP8113 Transistor	0.75
MPSU05 Transistor	0.90
MPSU55 Transistor	0.90
TIP31A Transistor	0.48
TIP32A Transistor	0.48
TIP41A Transistor	0.75
TIP42A Transistor	0.75
TIP2995 Transistor	0.96
TIP3055 Transistor	0.96
TIS91M Transistor	0.21
2N2904 Transistor	0.33
2N2905A Transistor	0.36
2N2905 Transistor	0.36
2N3053 Transistor	0.36
2N3055 Transistor	0.88
2N3703 Transistor	0.12
2N3705 Transistor	0.12
2N3710 Transistor	0.12
2N5296 Transistor	0.57
2N5298 Transistor	0.57
2N5496 Transistor	0.63
2N6178 Transistor	0.90
2N6180 Transistor	0.90

INTEGRATED CIRCUITS

TAA550 Int Circuit	0.25
TAA570 Int Circuit	2.10
TAA611 B12 Int Circuit	2.00
TAA630S Int Circuit	2.50
TAA661B Int Circuit	1.60
TAA700 Int Circuit	3.50
TAD100 Int Circuit	1.75
TBA120AS Int Circuit	0.63
TBA231 Int Circuit	1.05
TBA325 Int Circuit	0.50
TBA480Q Int Circuit	1.94
TBA520Q Int Circuit	2.80
TBA530 Int Circuit	2.25
TBA530Q Int Circuit	2.40
TBA540 Int Circuit	2.60
TBA540Q Int Circuit	2.60
TBA550 Int Circuit	3.15
TBA550Q Int Circuit	3.15
TBA560C Int Circuit	3.15
TBA560CQ Int Circuit	3.48
TBA570 Int Circuit	1.62
TBA570Q Int Circuit	1.74
TBA641 BX1 Int Circuit	2.61
TBA641 B11 Int Circuit	3.18
TBA651 Int Circuit	1.75
TBA700Q Int Circuit	1.25
TBA720AQ Int Circuit	2.60
TBA730 Int Circuit	0.50
TBA750 Int Circuit	2.25
TBA750Q Int Circuit	2.40
TBA800 Int Circuit	1.30
TBA810S Int Circuit	1.50
TBA820 Int Circuit	1.05
TBA920 Int Circuit	3.66
TBA920Q Int Circuit	3.75
TBA990 Int Circuit	3.75
TBA990Q Int Circuit	3.66
TCA270Q Int Circuit	2.00
TCA900 Int Circuit	0.87
TCA940 Int Circuit	2.25
TDA1170 Int Circuit	2.60
TDA1200 Int Circuit	2.25
TDA1270 Int Circuit	2.60
TDA1412 Int Circuit	0.90
TDA2020 Int Circuit	3.80
MC1307P Int Circuit	1.60
MC1310P Int Circuit	1.80
MC1327P Int Circuit	2.10
MC1327PQ Int Circuit	2.10
MC1330P Int Circuit	1.35
MC1351P Int Circuit	1.74
MC1352P Int Circuit	1.30
MC1358PQ Int Circuit	1.40
SN76003N Int Circuit	3.10
SN76003ND Int Circuit	2.60
SN76013N Int Circuit	2.20
SN76013N07 Int Circuit	2.20
SN76013ND Int Circuit	2.00
SN76023N Int Circuit	2.20
SN76023ND Int Circuit	2.00
SN76033N Int Circuit	3.00
SN76110N Int Circuit	1.60
SN76131N Int Circuit	1.90
SN76226DN Int Circuit	1.30
SN76227N Int Circuit	1.00
SN76532N Int Circuit	1.50
SN76533N Int Circuit	1.50
SN76544N Int Circuit	1.70
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EABC80 Valve	1.50
EB91 Valve	1.10
EBC81 Valve	0.60
EBF80 Valve	0.65
EC86 Valve	1.10
EC88 Valve	1.10
ECC40 Valve	1.20
ECC81 Valve	1.20
ECC82 Valve	1.02
ECC83 Valve	1.02
ECC84 Valve	1.35
ECC85 Valve	1.75
ECC88 Valve	0.75
ECC189 Valve	1.20
ECF80	1.50
ECF82 Valve	0.65
ECF86 Valve	1.10
ECH81 Valve	1.80
ECH83 Valve	0.75
ECH84 Valve	2.10
ECL80 Valve	1.50
ECL82 Valve	1.32
ECL83 Valve	1.10
ECL84 Valve	0.90
ECL86 Valve	1.60
EF80 Valve	1.20
EF83 Valve	1.70
EF83 Valve	1.70
EF85 Valve	1.20
EF86 Valve	2.20
EF89 Valve	2.45
EF91 Valve	0.60
EF95 Valve	0.65
EF183 Valve	1.10
EF184 Valve	1.10
EH90 Valve	1.90
EL34 Valve	3.25
EL36 Valve	0.90
EL41 Valve	1.20
EL81 Valve	0.90
EL84 Valve	1.35
EL86 Valve	0.75
EL95 Valve	1.50
EM84 Valve	1.20
EM87 Valve	1.50
EY51 Valve	0.65
EY86/87 Valve	1.20
EY88 Valve	0.75
EZ80 Valve	1.00
EZ81 Valve	1.00
GY501 Valve	2.40
GZ34 Valve	2.25
PC86 Valve	2.00
PC88 Valve	2.00
PC97 Valve	1.60
PCC84 Valve	1.25
PCC85 Valve	1.50
PCC89 Valve	2.00
PCC189 Valve	2.00
PCC806 Valve	2.50
PC900 Valve	1.70
PCC88 Valve	1.70
PCF80 Valve	1.50
PCF82 Valve	1.90
PCF86 Valve	2.00
PCF200 Valve	1.20
PCF201 Valve	1.25
PCF801 Valve	2.10
PCF802 Valve	1.30
PCF806 Valve	2.10
PCH200 Valve	2.10
PCL82 Valve	1.50
PCL83 Valve	1.80
PCL84 Valve	1.50
PCL85/805 Valve	1.50
PCL86 Valve	1.50
PD500/510 Valve	4.80
PFL200 Valve	2.50
PL36 Valve	1.70
PL81 Valve	1.70
PL81A Valve	1.70
PL82 Valve	0.75
PL83 Valve	1.50
PL84 Valve	1.50
PL95 Valve	1.05
PL504 Valve	1.80
PL508 Valve	2.40
PL509 Valve	4.10
PL519 Valve	5.40
PL802 Valve	4.95
PY33 Valve	1.00
PY82 Valve	0.60
PY83 Valve	0.75
PY88 Valve	1.75
PY500A Valve	2.40
R19 Valve	0.75
U25 Valve	0.75
U26/KY80 Valve	2.20
U49 Valve	0.75
U191 Valve	0.75
UBF89 Valve	0.75
UCC85 Valve	0.75
UCH81 Valve	0.75
UCL82 Valve	1.50
UCL83 Valve	0.75
UF41 Valve	0.75
UL84 Valve	1.80
UY85 Valve	1.50
6BW7 Valve	2.10
6F23 Valve	2.40
6/30L2 Valve	2.40
30C15 Valve	2.40
30C17 Valve	2.40
30F5/6F23 Valve	2.40
30FL2/1 Valve	1.70
30FL12/PCE82 Valve	2.50
30L15/PCC805 Valve	2.50
30L17 Valve	2.50
30P12/PL801 Valve	2.50
30P19/PL36 Valve	1.70
30PL13 Valve	2.50
30PL15 Valve	2.50

EHT TRIPLERS

TCE950 Doubler	2.25
TCE950/1400 Tripler	3.50
TCE1400 (Pied system only)	4.00
TCE1500 Doubler	3.00
TCE500 Tripler	3.50
TCE1600 1/2 Wave	3.50
Decca CS1730/1830 Doubler	3.60
Decca CS1910/2213 Tripler	6.50
Decca 30 Series Tripler	6.50
Decca 80 Series Tripler	6.50
Decca 100 Series Tripler	6.50
GEC Hybrid 2028 Tripler	6.50
GEC2110 Tripler Pre Jan 77	7.00
GEC2110 Tripler Post Jan 77	6.50
ITT CVC5/8/9 Tripler	6.50
ITT VCV20/25/30 Tripler	6.50
Philips 520 Tripler	6.50
Philips 550 Tripler	6.50
Philips G9 Tripler	6.50
PYE 691/693/697 Tripler	6.00
PYE 731/725 Tripler	6.50
Philips 570 Doubler	6.50
PYE 713/CT2001 only/Doubler	6.50
RRI 823 Tripler	7.00
RRI Z179/823 Tripler	6.00
TCE3000/3500 Tripler	6.50
TCE4000 Tripler	8.00
TCE8000 Tripler	3.00
TCE8500 Tripler	6.00
TCE9000 Tripler	6.50
TVK52 Continental Sets	6.00
Korting 90% Tripler	6.50
Autovox Tripler	6.50

MISCELLANEOUS PRODUCTS

Sets of Avo Leads	9.50
ELC1043/05 Tuners	6.50
4.443 MHz Crystals	1.30
Cut Out TCE3500	1.20
Cut Out Grundig	1.50
Cut Out GEC	1.50
Cut Out TCE 8500	2.50
TV18 Rectifier Stick	0.50
TV20 Rectifier Stick	1.30
VA1104 Thermistor	0.35
Aerial Isolator	0.65
Solder 18SWG 60/400.5KGM	5.00
Plug 13A	0.36
Super Servisol	0.75
Foam Cleanser	0.75
Silicone Grease	0.75
Plastic Seal	0.75
Aeroklene	0.75
Freezit	0.75
Antistatic	0.75

transistor is the most likely cause of such trouble. On test it turned out to be short-circuit, while with it removed from circuit the current appeared to have returned to normal. The l.t. rail was in fact slightly over 12V, high due to the low loading, and as the 10Ω resistor was now cool I assumed that the regulator was working correctly.

So a new AU113 went in. These transistors are expensive however, so I always adopt the following procedure. Never switch on first with the mains applied. Always work from a variable, stabilised d.c. supply, building the voltage up gradually and noting the current drawn. At 12V the set was drawing the right current and displaying a perfect picture. Finally test with 240V mains.

Line Output Transistor Again

A portable fitted with the Thorn 1590 chassis was dead, with the 250mA mains fuse F1 open-circuit. Resistance checks on the mains rectifiers and their associated parallel protection capacitors revealed no shorts, so a new fuse was fitted and the set switched on, monitoring the l.t. rail. The voltage was low, suggesting excessive current, and after about twenty seconds the fuse blew again. I disabled the power supply and connected my variable d.c. supply across the 1,000μF l.t. smoothing capacitor, building the voltage up gradually and noting the current. At half the correct rail voltage, i.e. at about 6V, the set was drawing over 2A, suggesting line output transistor trouble again. It's sensible to suspect semiconductor devices first, because with a low rail voltage it's unlikely (though not impossible) that a resistor or capacitor will be faulty – unless it's associated with the higher voltage supplies derived from the line output transformer. Sure enough, the AU113 was once more short-circuit. Fit a replacement, fire up as described above, and back we were with a picture. Replace the fuse and finally test on mains.

Lack of Width: CVC25 Chassis

Lack of width was the fault on a solid-state ITT colour set fitted with the CVC25 chassis – the width was in by two inches at both sides of the screen. The height and scan linearity appeared to be correct, and the e.h.t. voltage was right at 25kV. Our attention was turned therefore to the EW modulator board, where the width control resides. ITT say that if the fault condition does not change when this panel is removed, the panel is probably all right. So we removed it, but the lack of width remained. The EW modulator driver transistor T13 is mounted on the mother board, but we could not fault it. Although the linearity seemed to be correct, we next decided to check the scan-correction capacitors C68 and C69. C68 is the usual series capacitor, C69 being coupled to the EW modulator circuit to provide the modulated scan-correction required at the start and finish of each line. C68 (1μF) was o.k., but C69 (0·15μF) turned out to be open-circuit. Note that the capacitance value must be correct: 0·1μF or 0·2μF will not do as the width will not be correct. Different values are used on the CVC20, CVC30 and CVC32 chassis.

CRT Trouble

The fault with a Thorn set fitted with the 1500 chassis was no results due to the heater chain being open-circuit. Unfortunately it was the c.r.t., but the customer decided to have a new one fitted. This produced results, but the picture was ballooning badly. Assuming that the trouble was in the line output stage, we made the usual checks – new valves, a new tripler, boost voltage, resistor values and, since nothing else was left, a new line output transformer. But the fault persisted. By now another Thorn 1500 had arrived in the workshop, so we decided to try cross-connecting the tubes by switching over the e.h.t. connectors, scan coils and bases. The fault now appeared on the other set, so obviously the new tube was faulty (probably a defect in the final anode arrangement). After heated words with the tube supplier a replacement was obtained and fitted, producing normal results. This sort of thing can be awkward, since you can't charge extra for the trouble not envisaged when the original quotation was made.

Width Control

After reconditioning an 18in. Decca hybrid colour receiver we'd taken in part exchange we still had excessive width – no castellations visible. Now width on Decca hybrid sets is usually adjusted by means of the preset set width/e.h.t. control VR451 and a tapping on the line output transformer. VR451 was already set at minimum however, so we moved on to the line output transformer – only to find no provision for width adjustment. The penny then dropped: this was the small-screen (17 and 18in.) version of the chassis. In these sets in addition to VR451 the a.c. blocking coil L402 in the horizontal shift circuit is made variable to form a width control – rather unusual. Anyway, adjusting L402 and resetting VR451 gave us correct width.

Rectifier Recommendation

For some time we've been experiencing premature failure of the bridge rectifier D402 in the GEC Junior Fineline Model 2114's power supply, the symptoms being a rolling hum bar with reduced width. We used to make up a bridge using four BY127s but these, rated at 1·5A, are not good enough for the job. We now use 1N5400 series diodes, which are rated at 3A. These seem to be the answer to the problem.

Educating an OAP

A reasonably well off old age pensioner brought in a Murphy radio for repair – the drive cord was faulty, the trouble being a broken plastic wheel. It took us us couple of hours' to fit the wheel, which we obtained direct from the RRI Ware service depot along with some other bits and pieces we required. I thought she'll never want to pay for the time and trouble it all took. So when she came in I told her what had been involved and asked her what she thought a fair charge would be. A pound she said, straight out. When I said I thought £4 was nearer the mark she said she thought that outrageous, pointing out that she was an OAP. I've known her for some time so I asked what she'd paid for her dentures and glasses. £100 and £70 respectively she said, and without complaint. On reflection she decided that £4 was fair after all!

Programmes in Welsh

Line collapse on a dual-standard monochrome set that came in the other day was traced to faulty scan coils. After replacing them and setting up I put the back on again and waited for the customer to collect the set. A couple of days later she phoned and asked whether the programmes on at the time were in Welsh. On asking her why she said the captions were not in English. It turned out that I'd reversed the line scan coil connections, something that's not always noticeable, especially as we work from a mirror in the workshop.

Commander-8 Remote Control System

Alan Willcox

THIS unit was designed to be operated in conjunction with a TV set fitted with a varicap tuner unit, replacing the existing potentiometer/switch bank. It was felt that most constructors would wish to avoid structural alterations to their TV sets, so the main PCB is designed to fit into an attractive, ready made case which occupies a position on the set top.

The integrated circuit used in the channel selection circuit is a widely available, low cost counter type i.c. rather than one of the range of i.c.s designed specifically for channel change applications. As well as a cost saving, greater reliability can be expected from this i.c. It also provides for eight channels rather than the usual six.

The transmitter PCB fits into a low cost, ready made case, and employs a single pair of touch contacts for sequential channel change.

Receiver/Channel Selector Circuit

The remote control receiver/channel selector circuit is shown in Fig. 1. The ultrasonic signal from the remote transmitter is picked up by transducer X1 and fed to the amplifier stages Tr10/Tr11. These drive the regenerative switch circuit consisting of Tr12/Tr13. This provides a rapid, positive-going pulse whenever an input signal is received, the pulse being coupled to the i.c. (IC1) via C6. The sensitivity of the ultrasonic link is set by VR9 which, in conjunction with R7 and C4, provides integration to improve the noise immunity of the circuit. Current for the switch Tr12/Tr13 is provided by C5, which charges during the intervals between command pulses via R9.

Only one output of the i.c. is positive at any time, providing forward bias to its associated switching transistor (Tr1-Tr8) via a LED (LED 1-8) which lights up to indicate the channel selected. This current is fixed by R11 in the supply line to the i.c. R11 also limits the i.c. supply to around 5V. The zener diode ZD1 is included to prevent the i.c. supply voltage (VDD) rising to 33V in the event of an open-circuit at one of its outputs. Channel one is automatically selected on switch on since the reset pin 15 is tied to VDD by C8 until it charges. D11 clips the level of the input pulse to VDD to conform with the input specifications of the i.c.

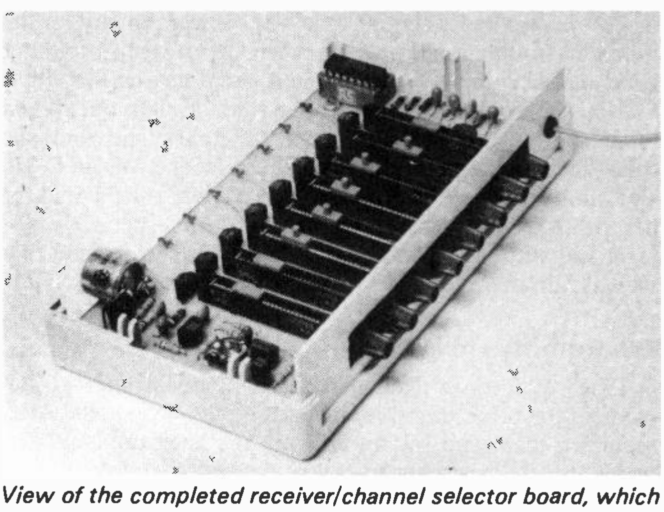
Transistors Tr1-Tr8 switch the tuning potentiometers VR1-VR8 into circuit. The output of the selected potentiometer is isolated from the others by the associated diodes. The polarity of the diodes is unusual, the cathode end being switched, leaving the cathodes of the unswitched diodes at 33V. R13 forward biases whichever of the isolating diodes is connected to the selected potentiometer. The emitter-follower Q9 provides temperature compensation for the isolating diodes, isolates the tuner circuit from the diode bias resistor R13, and provides a low output impedance.

Transmitter Circuit

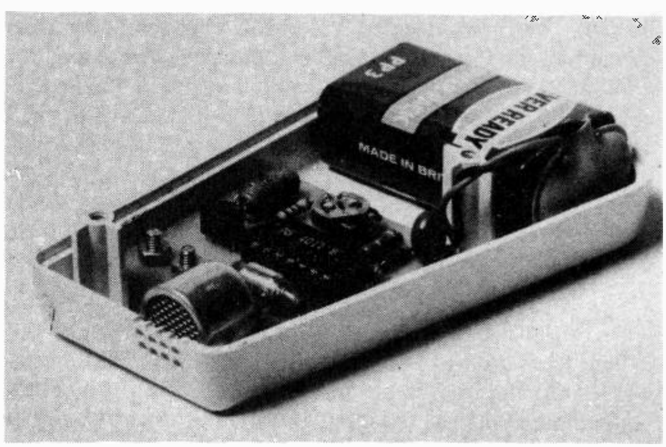
The circuit of the ultrasonic remote transmitter is shown in Fig. 2. A CMOS nand gate with buffered output is arranged to oscillate at 40kHz by virtue of positive feedback between gates a and b. Gates c and d give a push-pull drive to the transducer X2. The circuit transmits only when Tr14 conducts due to a small bias current through the touch contacts. An insignificant current is drawn from the battery when Tr14 is off, so an on/off switch is not required.

Construction

Construction of the receiver/channel selector unit is simple, all the components being fitted to the PCB as shown in Fig. 5. Light from the channel indicator LEDs shows through the red filter used for the front panel. As well as increasing the visibility of the LEDs in daylight, this



View of the completed receiver/channel selector board, which is mounted in the top half of the case. The stiffeners at the sides of the case's top and bottom should be cut back with a sharp knife where they meet the board. Use stout wires to mount the transducer on the board. The tuning controls protrude through a piece of black felt covering the cutout made at the rear of the case.



View of the transmitter board and battery, with the cover removed. Cut the pillars back as necessary to clear the board and battery. Don't forget to fit nuts under the board retaining screws as well as on top.

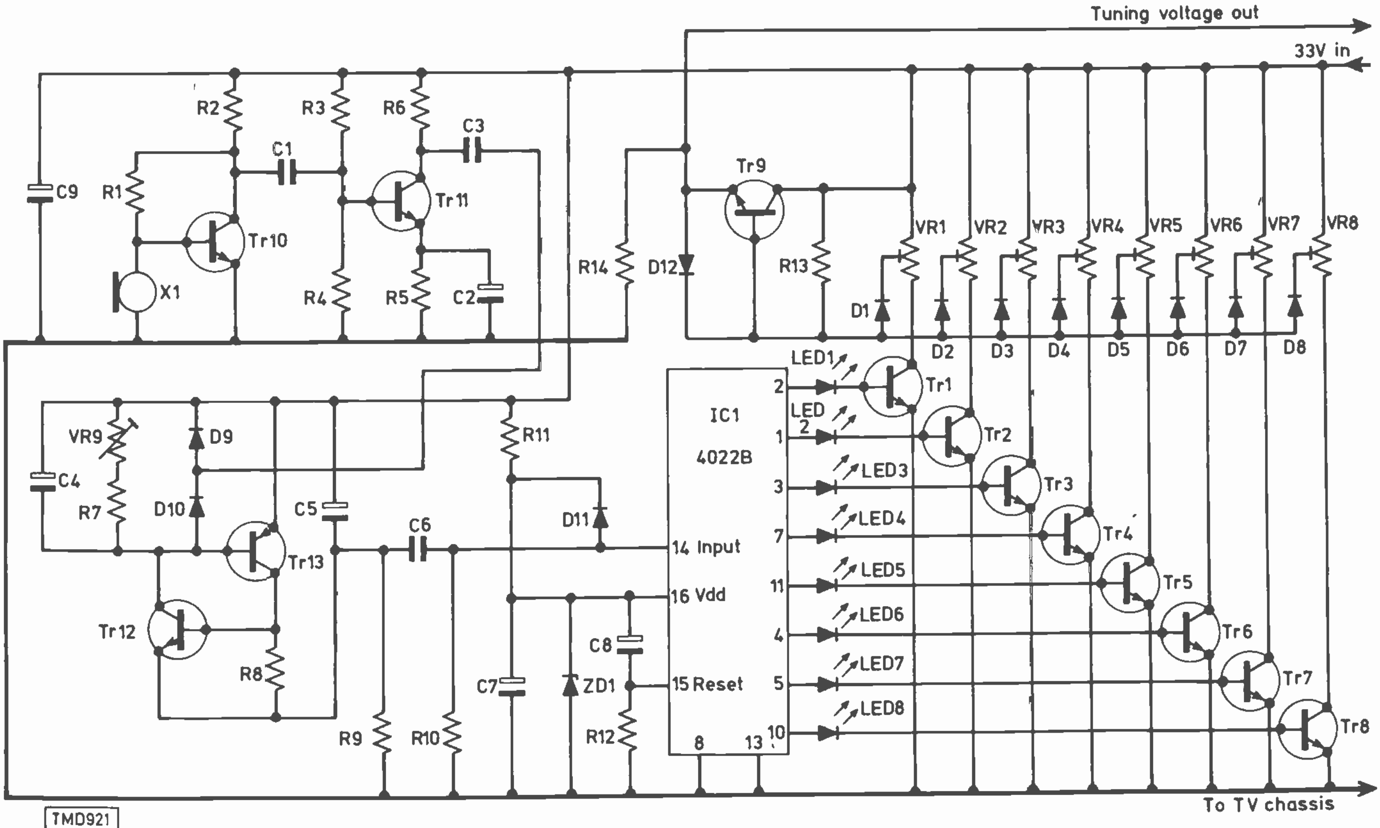


Fig. 1: Circuit diagram of the remote control receiver/channel selector unit. For component values see box overpage.

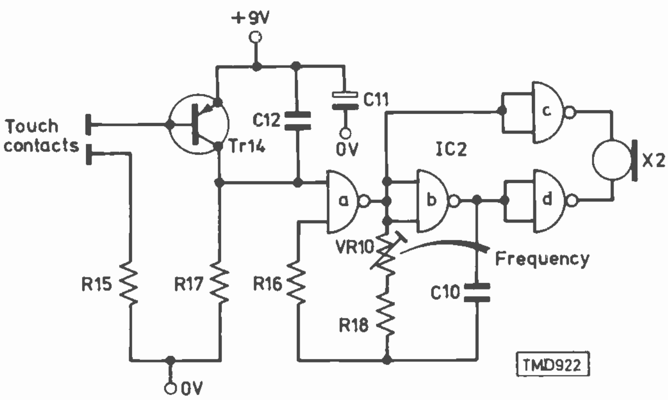


Fig. 2: Circuit of the transmitter unit.

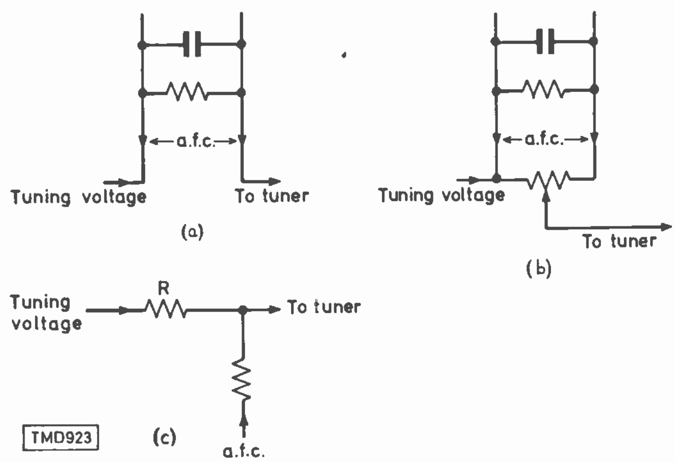


Fig. 3: A.F.C. connection arrangements. (a) Typical series arrangement. (b) Series circuit modified by the addition of a potentiometer to reduce the a.f.c. range. (c) Typical parallel arrangement. The value of resistor R may need to be reduced to limit the a.f.c. range.

arrangement avoids the need to drill any holes in the panel other than those required to allow the ultrasonic sound to reach the microphone X1. There should be at least 1/16in. clearance between the sides of the case and the PCB,

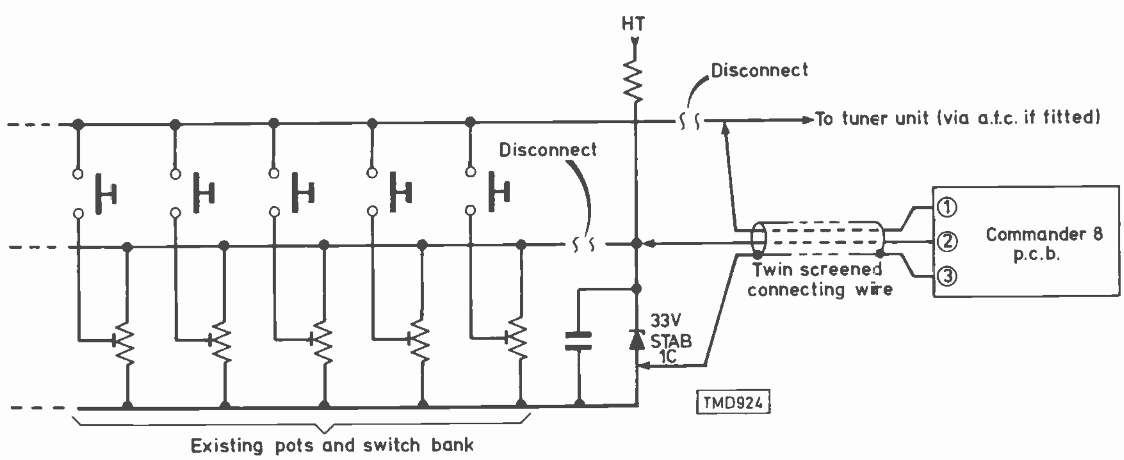


Fig. 4: Connections between the Commander-8 and a typical receiver. The tuner's 12V supply is often obtained from the stabilised 33V rail: if so, make sure that this supply is preserved.

otherwise the case halves, once closed, will be difficult to reopen. To achieve this, cut back with a sharp knife the case stiffeners on *both* halves where they meet the PCB. The case half holding the PCB becomes the top half of the unit when assembled. Drill a small hole in the other case half to allow a trimmer access to the ultrasonic gain control VR9.

A rectangular "window" can also be cut out of this case half to view the position of the tuning controls: the unit can then be turned upside down to assist initial tuning. This window should be sealed off with a slightly larger piece of clear plastic glued to the inside. If this window is made, the feet supplied with the case should not be used. Instead, a piece of felt glued to the case bottom will form a light trap between the case and the TV set. If light is kept out of the case the contrast of the LEDs is improved.

For the same reason, felt is used to surround the tuning controls where they protrude through the rear of the case. The front panel red filter is glued into position on one case half, preferably the one not holding the PCB.

The transmitter unit PCB is held in the case by two screws, the heads of which form the touch contacts. Use the holes in the PCB to form a guide to drill the case. Allow sufficient space between the PCB and the case front for the transducer X2. Don't forget to place two nuts on to the screws before the PCB is fitted, so that the copper print makes electrical contact with the screws.

Caution

Note that both the transmitter and receiver i.c.s are MOS types which can be damaged by static electricity when out of circuit. Discharge any body static by touching a cold water pipe or other true earth before handling, and ensure that the soldering iron is earthed. An i.c. socket is better, but some people experience difficulty in inserting the i.c.s without damaging the pins. It's best to close the pins in slightly before insertion.

Connection to the TV Set

The Commander 8 replaces the existing channel selector potentiometer/switch bank in the receiver, leaving the surrounding circuitry unchanged. Two points in the set have to be located, and a chassis connection made. First, the 33V feed to the potentiometers in the set must be disconnected and connected instead to the 33V input point of the Commander 8. Secondly, the tuning voltage lead from the selector unit to the tuner unit via the a.f.c. (if present) must be disconnected from the selector unit and reconnected instead to the Commander 8's tuning voltage output point. The chassis connection formed by the screen of the cable should be connected to a convenient point near the tuner or the channel selector unit.

If these modifications have been carried out correctly, the existing a.f.c. arrangement in the set will have been preserved, along with any facility to mute the a.f.c. to assist correct tuning. Under certain conditions in a receiver with a powerful a.f.c. circuit, the a.f.c. can lock on to the sound instead of the vision carrier when changing channels. This would fix the tuning at a point where there is sound but no vision. On most receivers the a.f.c. is kept weak to avoid this, or else an a.f.c. range preset is provided (Rank) which can reduce the hold-in range to the point where the effect disappears. Other manufacturers (notably Philips) get around the problem by building into the button unit a switch which briefly mutes the a.f.c. each time a station is selected. When such a receiver is converted to remote control this particular mechanism is out of action, so there's a possibility that this effect may occur. If this is the case, the a.f.c. holding range can be reduced, as shown in Fig. 3.

Setting Up

The preset control VR9 sets the sensitivity of the ultrasonic circuit, and should be set near to minimum (anticlockwise). When the TV is first switched on after connecting up, channel 1 (LED1) is automatically selected and VR1 is the tuning potentiometer in circuit. The oscillator frequency control VR10 in the transmitter must now be adjusted to match the transducers, or no signal will be received. Keeping a finger on the touch contacts, adjust VR10 until the channel changes. Slowly increase the distance between the transmitter and receiver, readjusting VR10 until maximum range is obtained. Adjust carefully, as the peak is quite sharp.

An alternative method of adjustment is to monitor the d.c. voltage across C4 and set VR10 for maximum. This should be done with the base of Tr13 disconnected, as the

★ Components List

Resistors:

R1	1M
R2	82k
R3	220k
R4	100k
R5	22k
R6	33k
R7	4k7
R8	15k
R9	1M
R10	1M
R11	15k
R12	1M
R13	1M
R14	1M
R15	100k
R16	470k
R17	1M
R18	5k6 5%

All ¼W or smaller

Presets:

VR1-8	100k 25 turn helical, AB 197 or similar
VR9	47k miniature horizontal
VR10	4k7 miniature horizontal

Capacitors:

C1	0·0047μF ceramic
C2	0·1μF 35V tantalum bead
C3	0·0047μF ceramic
C4	2·2μF 35V tantalum bead
C5	0·22μF 35V tantalum bead
C6	100pF ceramic
C7	1μF 35V tantalum bead
C8	0·22μF 35V tantalum bead
C9	4·7μF 63V electrolytic
C10	0·001μF 2½% or 5% polystyrene
C11	47μF 15V or higher tantalum bead
C12	0·047μF ceramic or miniature polyester

Semiconductors:

Tr1-Tr12	BC147
Tr13-Tr14	BC157
IC1	4022B*
IC2	4011B*
D1-D12	1N4148 or similar
ZD1	7·5V zener, BZY88
LED1-8	RS 586-447†

*Must be "B" specification not "UB".
†Other types will give insufficient brightness.

Miscellaneous:

X1	TDK SE05B-40R
X2	TDK SE05B-40T

Receiver case Vero 75-1237J
Red filter Sintel 29 × 142mm
Transmitter case Vero 75-1799E
Twin screened lead
PP3 battery and connector
6BA nuts and bolts

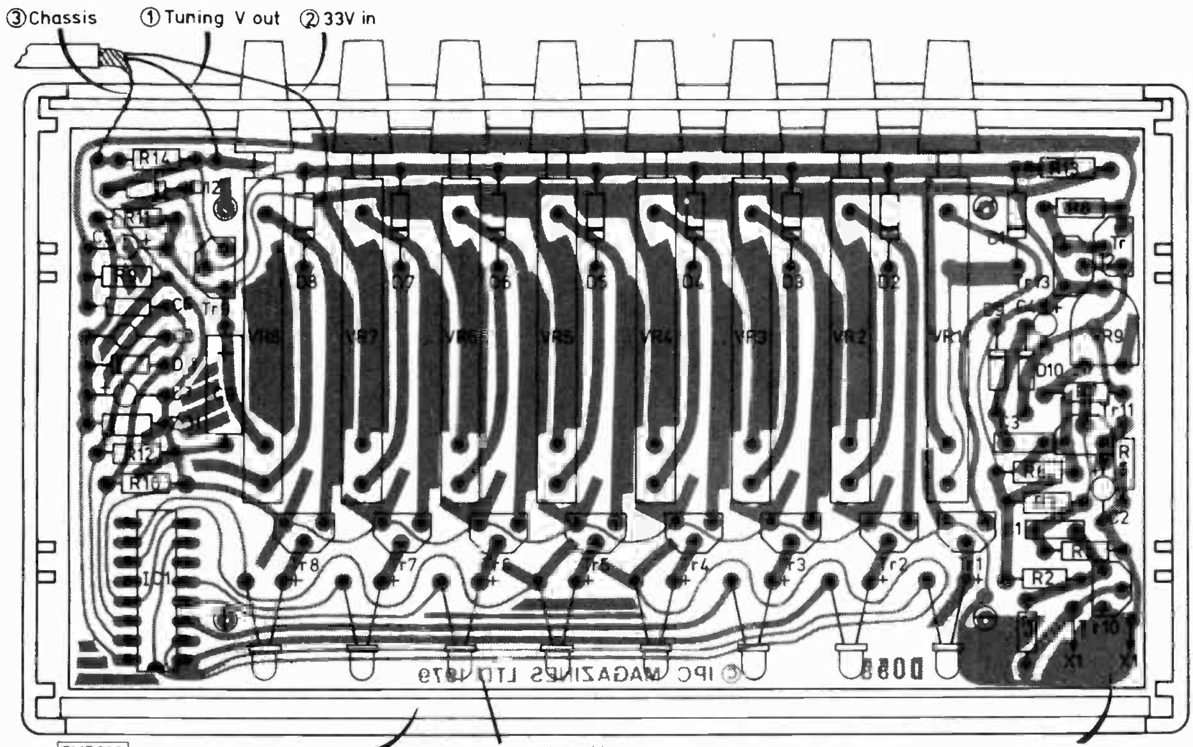
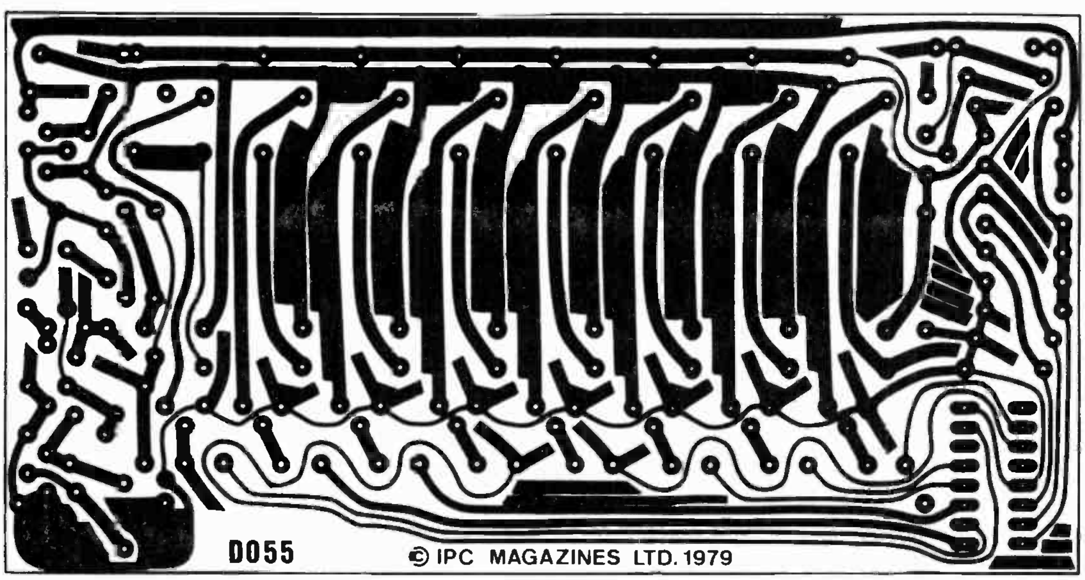


Fig. 5: Receiver/channel selector unit component layout.



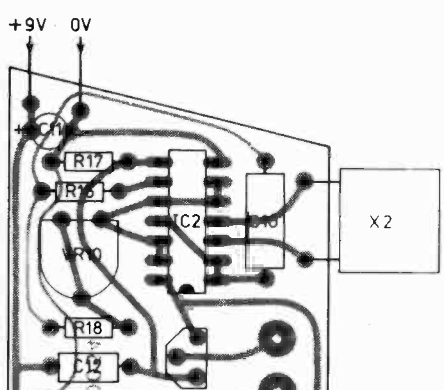
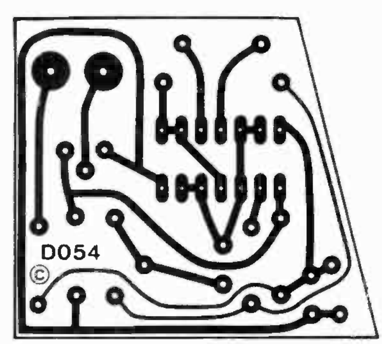


Fig. 6 (above): Receiver/channel selector unit PCB.

Fig. 7 (left): Transmitter unit component layout.

Fig. 8 (right): Transmitter unit PCB.



base-emitter junction limits this voltage to 0·5V.

Adjust the sensitivity control VR9 to give the required range. Avoid setting the sensitivity too high, otherwise the unit may be triggered by extraneous sounds, or pick up interference from the line timebase in the set. Line timebase interference will prevent channel changing, so it's best to site the Commander 8 on the side of the set opposite the timebase. If the transmitter has been carefully adjusted, a range of 20-30ft. should be obtained without the above mentioned effects, usually with the sensitivity control set between minimum and halfway. ■

JAWS 3

Les Lawry-Johns

WHEN you first come face to face with a shark or perhaps a crocodile, what is your first reaction? Fear? Flight? This would have been mine I must admit. Until last week, that is. Now it would be infinite compassion, sympathy and sorrow for the poor beast, cursed with so many teeth to give it trouble.

Nobody knows the agony I've suffered of late, and apparently nobody cares – except to fall about laughing when I tell them of my plight. I shall never know why it is that when others are in trouble I'm all ears, attentive and grave, listening to their tale of woe and making sympathetic clucking noises. Yet when I'm in the mire, I might just as well be alone in the middle of the desert for all the sympathy I get. Perhaps I get in the mire too often.

You'll listen though, won't you?

For some time I'd been aware of a nagging ache up on the top left side. I concluded that it was due to an infected gum, and therefore washed it regularly with brandy. The ache came and went without giving too much trouble, and although I toyed with the idea of phoning Mr. Pullit for an appointment I kept putting it off as I am a fully paid up member of the Cowards Union.

I was tackling a hybrid GEC colour set which had the complaint of no colour however. I must admit that the decoder panel on these sets is not one of my favourites, and I always end up in a muddle. I tried to be logical, but kept going round in circles because the gated burst amplifier transistor TR325 wasn't being turned on. This was apparently due to the gating diodes D303 and D304 (see Fig. 1) not being switched on by the line pulses which were there but not very strong. The question was, why? I kept going round and round from the line output transformer to the decoder, and the dull ache was rapidly becoming a nagging pain. Aspirin, aspirin, that's the stuff. Enter wife carrying aspirin and ice cold water. Exit wife carrying ice cold water.

"The pain will go as soon as you get that set right. If it doesn't, phone the dentist for an appointment and don't be a coward."

"I can't get the set right, there's no colour signal. I know why, but I don't know why."

"You mean that that's supposed to be a black and white picture?"

"The fact that the grey scale is a mile out isn't what is causing me the trouble. I can put that right in no time. Once I get the colour signals through I can turn them off and sort out the black and white. All right?"

She pondered this for a moment. "No it's not. You always tell other people to get it right in black and white first. Why don't you do it if it's such good advice?"

"Oh all right. Just to prove it to you. If the tube's O.K., I'll present you with a beautiful black and white picture inside ten minutes. But that's not going to help my colour problem."

It was a bit of a relief to get away from the decoder and the poor gating pulses, so the tube base voltages were examined. The first anodes were about equal, but the blue grid was a fair bit out. In went a replacement PCL84. On came a BBC-1 test card. In full colour . . . .

The gating pulses were now at full strength. Colour turned down produced fair black and white. Looking again at the circuit showed that tag 4 on the line output transformer also supplies pulses to the grids of the three PCL84 triode clamps in the colour-difference output stages. So a faulty triode can mangle the gating pulses to the decoder as well as mess up the grey scale.

Enter wife. "How's your face?"

"Red."

"You've got the set right in black and white then."

"Yes, and I've solved the colour problem as well."

"Who's a clever boy then?"

Just to prove it, I turned up the colour and there it was as good as new.

Which all goes to show how little women know about anything, because my jaw ache was now worse, not better. So with a fantastic display of courage I phoned the dentist, expecting to be booked in a few days later.

"Come round now."

"Er, you don't mean right now, do you?"

"Yes."

Sitting back in the chair with a bib under my chin I indicated to Mr. Pullit which tooth had the abscess over it.

"Ah yes, there's some infection over it." So saying, he did whatever dentists do with a needle and then left me there to mull over my fate. Would it break on the way out? Would there be complications with ambulances screaming all over the place, collecting blood to replace that which I would probably lose as Mr. Pullit fought to remove my mighty molar?

After a while Mr. Pullit returned from his ablutions, tilted my head back and inserted a pair of insulated pliers into my open mouth. My jaw cracked open and the world exploded.

"You can stop screaming now, and wash out your mouth. It's not a bad tooth really. Pity about the infection."

"Make another appointment on the way out and I'll clean up the rest."

Gorn Green

With grave doubts I arranged for another visit in ten days, then continued to a couple of service calls.

The first was to a Philips G8 which looked greener than I did. The c.r.t.'s green cathode voltage was low, directing attention to the relevant BF337 output transistor. Its base voltage was higher than that of the other two. Switch off and check the transistor. Reads right. Switch on again and note that the screen didn't go green for quite a few seconds. Grab the freezer and prepare to spray. Probably the preceding i.c. No. Next spray the BF337. Instant results, with normal screen illumination. Change BF337 after all. Nice lady thanks me for prompt attention and asks me if I am well. I tell her about my tooth. She tells me about all of hers (one by one), which takes longer than the repair of the set did.

Gert Knotted

Mrs. Knotted is a well known local character and there was little need for formality.

"Wotcha Gert!"

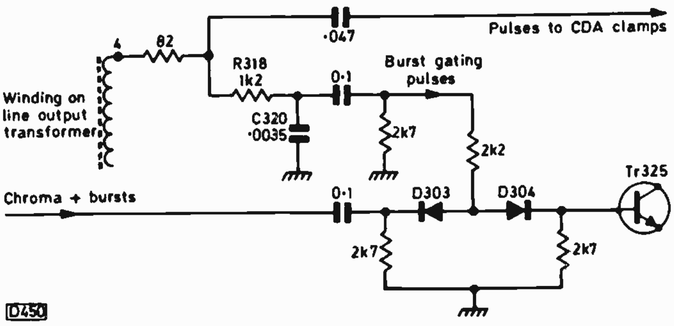


Fig. 1: Burst gating circuit used in the hybrid GEC colour chassis. Positive-going pulses from the line output transformer, delayed and shaped by R318/C320, forward bias the gating diodes D303/D304 to let the burst signal only through to TR325. With no burst getting through there's no colour of course, since the ident amplifier and colour-killer rectifier stages don't operate. Tag 4 of the line output transformer also feeds pulses to the triode clamp circuits in the colour-difference output stages. A defective clamp triode can reduce the amplitude of the burst gating pulses, thus removing the colour from the picture as well as upsetting the grey scale.

"Wotcha Lawry!"

"How do you like your new house, Gert?"

"The ******* house is all right Lawry. I don't feel so good though, it's that bum of a landlord along the road, selling gin that's been ****** about with. Makes me sick it does. He must be ******* barmy trying that one on me. I ask you, twenty five years up the high street and he thinks I don't know gin. I'll get the git I will. He'll be sorry."

I lapsed into sympathetic silence, and started work on the set. After all, how could anyone hope to get away with selling dud gin to Gert? I knew the chap in question. Into every shady deal you could think of. But I didn't think he was that daft.

However, the set was a Thorn 3500, with very queer symptoms indeed. There was some sound, but the screen illumination was dull and grey with occasional bursts of lines of colour in vertical bands – green, red and yellow – which came and went, leaving again the dull grey raster which undulated to betray heavy hum.

Switching off, we unplugged the power panel and persuaded it off its top clips. Turning the unit round showed the main smoothing block to be in a very sorry state. The negative tag was a good half inch away from the unit, leaving a gaping hole through which the connection still protruded.

"Picture valve gone has it Lawry?" asked Gert. "Stan said that's what it'll be."

"Must have done Gert", I muttered. "Can't find one anywhere."

So in went a new smoothing block, and back went the power unit. The only change was that the blank raster no longer undulated. I then found that the contrast at the back had been turned right down: turning it up produced a nice lot of lines across the screen. These couldn't be resolved with the line hold control. With a bit of luck, this turned out to be the first capacitor tested, namely the electrolytic (C511) in the reactance transistor's emitter circuit. The line hold was now good, and the colour could be tuned in. I was about to make some witty remark to Gert when there was a funny noise, the screen centre appeared to be occupied by an hour glass and I was aware that the side of my face was beginning to throb.

Now wait. Hang on. Don't panic. Could it be my rotten soldering on the main electrolytic? Could it be the 1,000μF reservoir capacitor in the supply to the 30V regulator? Slap another one across it. Bingo!

"You're O.K. now Gert, must get going."

"Thanks Lawry. Was it valve trouble?"

"Not really Gert. Your thingamy bobs had dried up."

"Don't you believe it love" said Gert.

The Second One

So off we went with the ache getting worse. Back at headquarters there were many things to do and by the time they were all sorted out it was too late to check with Mr. Pullit.

"Didn't you go to the dentist after all? Lost your nerve?" asked my ever considerate spouse.

"I did go and he took one out, but it's aching just as bad."

"Did you tell him which one?"

"Course I did."

"Then you told him to take out the wrong one, didn't you? Trust you to muck things up." Now you won't believe this, but she actually started to laugh. Laugh, I ask you. So did Harold when I later tried to kill the ache with brandy. Funny how landlords of pubs find other people's mistakes funny. Like wives I suppose. Under the sheer weight of spirit consumed, I had about four hours' sleep before cramming aspirin or something down my throat. Soon after nine o'clock I was back in the torture chamber.

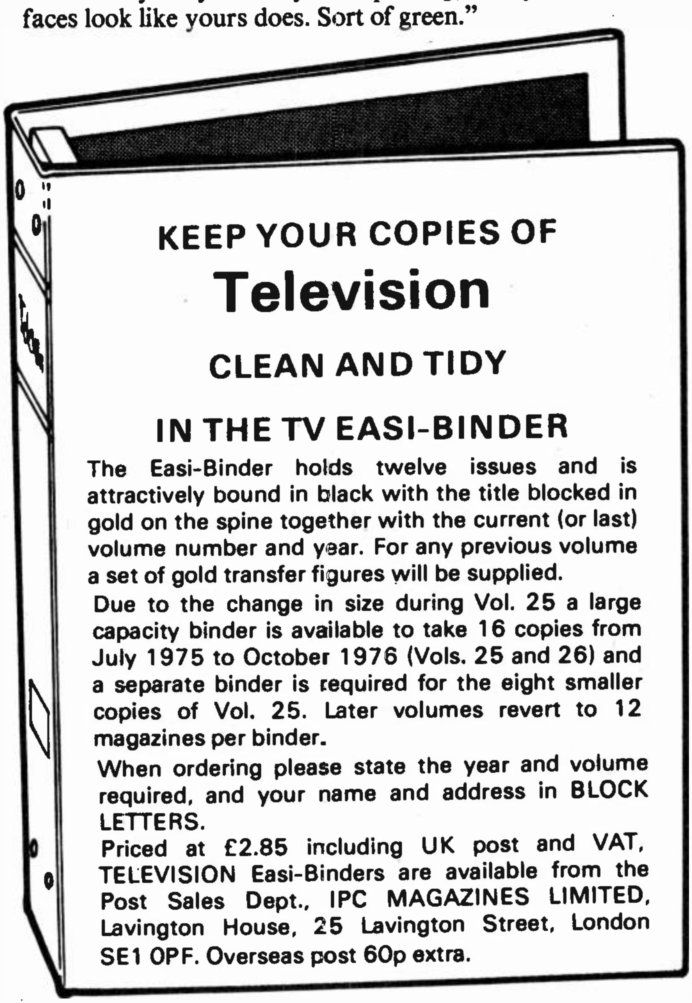
"You pulled out the wrong one."

"Oh no I didn't, that one had to come out. So will all the rest in time."

"The rest don't ache, only that one up there."

So out it came with a sickening crunch.

"Good tooth that. It's a pity you dallied so long with the other one and let the infection spread. Nip in and have a look at my telly when you're passing, will you? People's faces look like yours does. Sort of green."



Long-Distance Television

Roger Bunney

MORE reports of European TV signals arriving in Australia! An air mail letter from Anthony Mann near Perth in Western Australia reports reception of BBC-1 ch. B1 sound and vision signals on October 13th, between 0930-1020 GMT (1730-1820 local time). The signals were of fair to weak strength and were monitored on a communications receiver. Since that date BBC and French (ch. F2) sound have been monitored on a number of occasions, with signals sometimes being received from the lower power relays of both organisations – a BBC relay on 41·466MHz for example. Conditions in Australia have been very active, with Chinese signals at up to 57·75MHz, Russian and Japanese radio amateurs, Korea ch. A2 vision and the Hawaii 50·1MHz beacon all being received. Anthony comments that the ch. B1 vision signal would not have been resolvable due to the presence of strong signals from the Korean broadcasting service on 44·9 and 44·3MHz.

In a subsequent letter Anthony reports that November the 18th gave him his best F2 reception to date, with Korean, Chinese, Malayan, Russian and Japanese television, communications and paging signals. AFKN-TV ch. A2 was strong at times, but with terrific co-channel interference from three other stations! A Saturday morning kiddies' show was peaking at signal strength 9 (the top scale reading) at times – good going for a signal coming via a 9,100 mile, multiple-hop path. I feel that we must congratulate Anthony on this quite startling reception. As a postscript, he mentions that one of the BBC ch. B1 offset sound signals received came from either a 10W or 25W relay!

The aerial end of the Ferranti 11·45-11·8GHz satellite receiving system. Dish diameter 3 metres, gain 48·6dBi, with switchable dual linear polarisation.

Nearer home there has been yet more dramatic news from Ian Roberts (South Africa). The Statsionar T 714MHz USSR satellite is being received at good strengths there, with an elevation from horizontal of only 10° at Pretoria. Ian recently visited Andrew Rafferty (Pietermaritzburg) who has constructed a 6ft. dish with reflector and dipole linked via a 26dB gain u.h.f. preamplifier (4·4dB noise figure) to a standard TV receiver. Demodulation is by means of an NE561b phase-locked loop i.c. or a simple slope detector. The strength of the satellite's signals is such that a home-made 15-element u.h.f. Yagi array can be used. Programme times are 1100-1645 and 1800-2300 local time. The later time gives greater signal strength. It seems that the transmitted beamwidth must be wide, since the signal strength in SA is similar to that in the Siberian fringe areas.

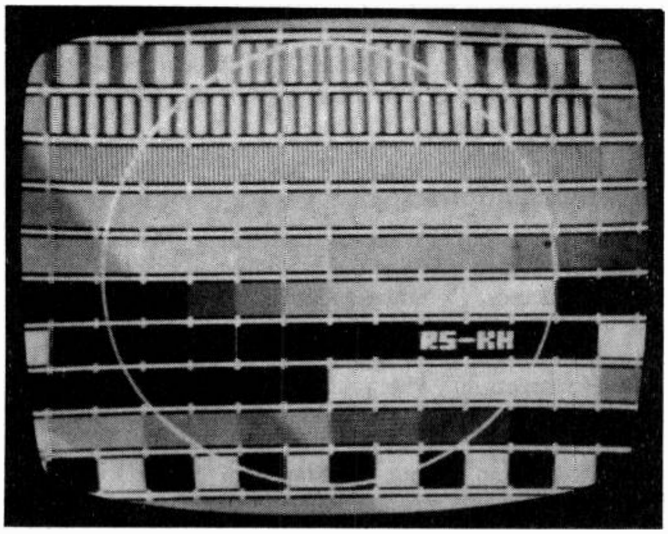
Ian has also had great success with terrestrial signals, reaching as high as ch. R2 vision. BBC, TDF (France), Spain and Italy are quite common, at times being of sufficient strength to watch! The first date on which BBC vision was received in SA was October 19th, the signal tending to retain its vertical polarisation. The m.u.f. reached 62MHz on several days.

Still closer to home Allan Latham reports from Abu Dhabi that reception of China and Russia via the F2 layer is "quite common", while Korean TV on ch. A2 has put in an appearance on several occasions. European signals are much in evidence to the north west, but to date only TVP (Poland) has been definitely confirmed – due to the characteristic dark background to its PM5544 test pattern. The spectrum on most channels is normally jammed with interference from many transmitters. A near neighbour of Allan's, Geoff Perrin at Al Ain, also reports reception of signals from many parts, including China, Russia and a ch. E4 cricket match commentary in English suspected of having come from India or Pakistan. The period November 7-14th was the most active.

UK Reception Report

Finally, back to the UK. Probably the main point of interest has been the excellent tropospheric conditions during the early part of November, from the 5th to the 10th. Clive Athowe (Norwich) reports good Swiss u.h.f. reception on the 6th, while the 7th proved exceptional with East Germany and Czechoslovakia ch. R31 with the EZO pattern and Plezn identification PLZ31. Brian Fitch (Scarborough) received a mass of West German and one East German u.h.f. transmitter. David Palmer (Lowestoft), using a JVC 3070 receiver with v.h.f. tuner and a Fuba XC391B array, also received many W. German u.h.f. stations and Czechoslovakia.

There was a second lift on the 10th, when Holland was exceptional. Most Dutch transmitters, including a ch. E51



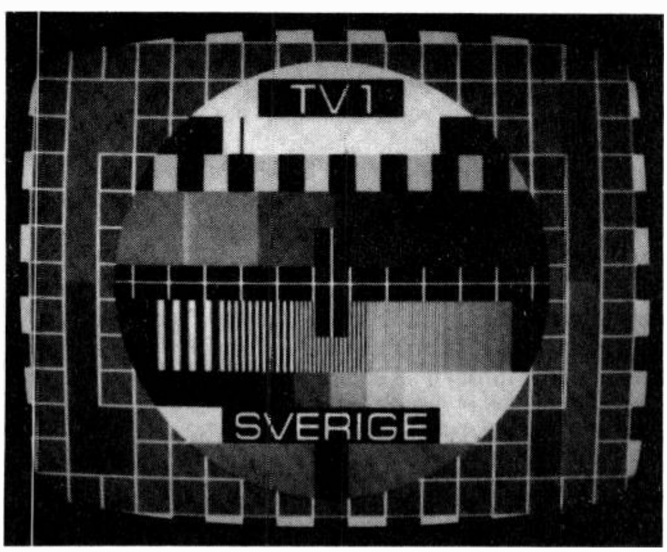
The EZO test pattern, photographed in Prague, Czechoslovakia by Chris Wilson.

1kW relay, were received here at Romsey. For the second time ever I received East Germany at u.h.f., and a new one on ch. E31. This was particularly gratifying since only a few days earlier I'd erected a modified Telerection backfire u.h.f. aerial.

Ray Davies (Norwich) also noted good tropospherics, but the most interesting point is his Sp.E reception on the night of October 30th. Finnish and Norwegian signals at good strength were arriving on chs. E2, 3 and 4 from 2030-2215. There was also a floater on ch. E3. NRK (Norway) switched off at 2145, and a signal was then noted between chs. E3 and E4. The picture was of a variety show, the image not filling the screen, and Ray is 90% certain that it was ch. A3. The picture was sharp however, suggesting single-hop Sp.E rather than F2 or Auroral reception. Ray is mystified. So was I some days later when a letter arrived from Kevin Jackson (Leeds) reporting – following a good F2 day – a weak Aurora on its first phase during the late afternoon on that date. Possibly a second phase occurred later that night. All very strange. Can anyone throw any light on this?

F2 Reception in the UK

There's also been F2 reception in the UK, with the "usual" signals from Africa. I noted African ch. E2 signals



The PM5544 test pattern as used by SR – Stockholm, Sweden.

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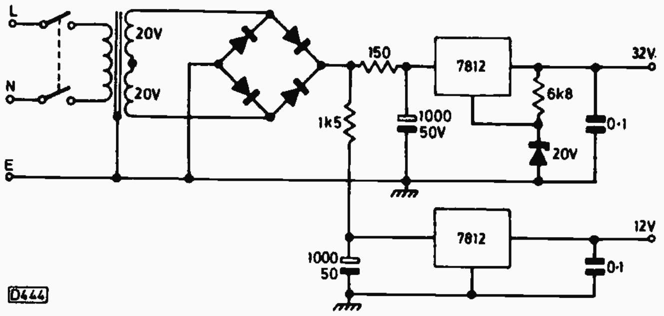

Fig. 1: the varicap tuner power supply used by Robin Crossley incorporates two 7812 i.c.s to provide stabilised 12V and 32V outputs.

on nine days – either Gwelo on programme or the relatively common frequency gratings/grey scale thought to come from either Kenya or Ghana. Similar reception has been reported from Honiton (Hugh Cocks) and Shaftesbury (David Martin), and such signals have now reached Derby (Garry Smith, on the 2nd) and Consett, Co. Durham (Dereck Waller, on the 12th) with a coloured announcer and Grand Prix racing. This latter signal was also received in Abu Dhabi. The frequency gratings on ch. E2 were also received by Garry Smith at 1254 on the 12th, but with a programme floater. This consisted of commercials, a discussion between two coloured gentlemen, and a non-synchronised French dialogue! Other manifestations of the current F2 conditions are the mass of US police cars etc. heard in the lower end of Band I, and Russian forward-scatter stations. Hugh reports that one commentator on a Russian network sounded rather drunk ... While visiting Hugh recently we heard at 1800 on 45MHz what seemed to be an army exercise in procedure tests for radio operating. The base station, manned by an abrupt Scottish RSM, was calling an aspiring recruit who didn't respond to the first "Delta Tango 2, come in". The RSM recalled Delta Tango 2, advising him to answer at once and not wait a second call. If replies continue to be delayed, the RSM would personally ".... you with your own left boot, over and out." It struck me later that these words could have arrived in Africa via TE skip (doubtlessly confusing the Rhodesian army which also uses 45MHz, with English) and in the US via F2 to confuse the highway patrol! The 45MHz tests were obviously in the Devon area.

All in all, an interesting month.

News Items

Satellites: Another first for Steve Birkill who received the OTS-2 satellite at 11·6GHz on November 2nd. We hope to publish more on this later.

Rhodesia: The transmitters in use are as follows: Bulawayo ch. E2 3kW; Gwelo ch. E2 17·6kW directional; Salisbury ch. E4 20kW; South/S.E. districts ch. E5 40kW directional; Umtali ch. E5 12kW directional. Our thanks to the RBC director of engineering for this information. Note that the *WRTV Handbook 1978* gives Bulawayo as ch. E3.

Sunspots: Swiss radio reports that a high of 170 was reached on October 14th. Predictions for the next six months are: November 116, December 122, January 127, February 132, March 136, April 139.

Japan: A new TV receiver that can switch to either of two transmitted sound channels is under development, presumably for use with the BSE 12GHz satellite. Tests have been carried out using foreign films, with either the original or dubbed sound. The ATS-6 satellite used two sound channels during the Indian SITE programme.

West Germany: Heischer Rundfunk transmitters are now carrying the following test card identifications: Biedenkopf ch. E2 "hr 1 B"; Hardberg ch. E5 "hr 1 H"; Hoher Meisner ch. E7 "hr 1 M"; Grosser Feldberg ch. E8 "hr 1 F". Our thanks to Bernard Kirk.

Commercial Corner

In discussions on aerial matters in recent months mention has been made of log-periodic and discone arrays. South Midlands Communications Ltd., of SMC House, Osborne Road, Totton, Southampton SO4 4DN, tell us that they stock a 14-element log-periodic aerial covering the 35-130MHz spectrum. The price is £125 plus VAT. At a somewhat lower price is the 13-element LT606 covering 50-500 MHz with a forward gain of 7-8dB, front-to-back ratio of 15dB and an output impedance of 50Ω into coaxial feeder. The longest element is 3·3m and the boom length 2·6m. The price is £75·95 plus VAT (at 12½%). The GDX1 discone aerial covers 80-480MHz and has a gain of 3·4dB (omnidirectional, compared with a quarter-wave ground plane aerial) and again matching 50Ω. The price of this is £37·50 plus VAT. I've not tested any of these, so enquiries to SMC please.

At long last some 50Ω coaxial cable is readily available. As regular readers will know, such cable is used for matching sections in aerial systems. Astra Aerials tell us that they can supply this by the metre: a two metre length of their B86 50Ω coaxial cable costs £0·65, inclusive of VAT and postage.

From Our Correspondents . . .

Hugh Cocks reports reception of various West European patterns – the Dutch PM5544 and certain West German ones from various networks (I noted the older circular pattern) – but they appear from a southerly direction at 47MHz. The signals are usually trop-like and weak. It's felt that they are coming from the Caen transmitter, as some form of wideband video information that "passes through" the transmitter from a microwave link source. Can anyone clear up this mystery?

Robin Crossley (St. Albans) is rebuilding his TV-DXing apparatus, with a Bush TV161 (good for gain, I'm told) and a varicap tuner. The tuner power supply circuit he's using is shown in Fig. 1. Robin has already successfully received several French stations.

William Maybury (Coatbridge) has been visiting West Germany and sent these observations. There are few Band I aerials now in use, transmissions apparently being received at Band III and u.h.f. where there's not already duplication of all three area programmes at u.h.f. The Freiburg transmitter (Sudwestfunk) transmits the test card plus SWF radio I with tone bursts until SWF-1 programmes start. There's only the test card plus tone on SWF-2 and -3. At close down, all three transmitters radiate the test card. Many people in the area watch French TV, but a 20in. Sony set capable of receiving the French u.h.f. transmissions costs £120 more than the standard West German receiver. Remote control is normal, with some sets able to search through all channels, random channel access, etc. Some receivers handle 16 channel selections. German teletext is called Videotext, and sets able to receive this are already available though regular transmissions have not started.

Finally, best wishes to Robert Copeman, Sydney, Australia, who regularly sends us news and information: he announced his engagement on return from a recent trip to New Zealand.

Letters

MULTIBURST GENERATOR

I read with interest Ian Pawson's article on a multiburst generator, and would like to raise a point on using a square wave output from such a generator. When the harmonics of a square wave are removed by filtering, the fundamental signal amplitude becomes $4/\pi$ times the original. On high frequency ranges therefore, in particular the 5MHz range, the filtering effect of a video amplifier (due to its restricted bandwidth) will result in signal enhancement by between 1 and $4/\pi$. If the generator output is used when trimming an amplifier for a flat response, the actual video response will fall, following some arbitrary shape, from 1 to $\pi/4$. Caution is required therefore when comparing the input and output on a dual-beam scope.

The answer is to generate sinewaves, as used on Test Card F etc., though I don't suggest that this is practical for a project of this kind. It's not my intention to criticise Ian Pawson's design however, only to make this small but very important point.

D. Halliday, BATC,
Wimborne, Dorset.

STANDARDS OF SERVICE

I've read with interest recent editorials and comments on the standards of servicing, and agree with most of what's been said. There's another point I'd like to bring up however, the service we get from the TV companies themselves, since this affects the service we can give our customers.

Trouble with one well-known firm has included invoices being sent back to us marked "pending", then never hearing anything else. One customer got so fed up waiting for a new speaker for a portable transistor radio that he wrote direct, enclosing an s.a.e., but he never received a reply. Other problems with the same firm have included wrong parts sent despite our quoting the correct part number, and notes sent to us saying that an ordered component cannot be identified even though we'd had the same part only a month or so previously when ordering in the same manner.

More regretable was the trouble we subsequently had with a firm we've always regarded as being one of the best in providing a back-up service. We had three of the latest mono cassette decks from this firm. There was no problem on battery operation, but on mains there was an annoying hum from the speaker with the volume control turned up. Nothing too bad you might think, but when a recording has been made the hum becomes worse because the condenser microphone picks up the hum and transfers it on to the tape. We returned one but heard nothing for six weeks. A customer then showed interest in one of the others, so we thought we'd take a look ourselves. Our apprentice set about one of them and discovered that the hum got worse if the panel was put nearer the mains transformer. We then took several other decks from the same manufacturer off the shelf, and discovered that in all cases the mains transformer was built into a metal box – obviously to provide screening. We reported this on more than one occasion, and the manufacturer eventually admitted that it was a design fault and that the transformer should have been screened. They have refused to take any action however on the grounds (a) that we're the only firm that's complained, and (b) that the unit's only a cheap one not worth bothering with. Surely they don't need confirmation from other firms who've had the same trouble? And are they all that cheap? The trade price of the deck is £28, so the cheapest we can sell it at is £42 including VAT. I don't call that cheap by any stretch of the imagination.

To sum up, it's not always possible to provide a good service when the manufacturers are not giving us the back-up we need. It makes one properly disillusioned.

M. L. Biddlescombe,
Freshwater, Isle of Wight.

NEW LEASE OF LIFE

My old Murphy Model V530 (circa 1961) recently produced the symptoms of its last gasp! A pity, since it's the most compact and trouble free set of its age I've ever come across. Bubbling noises from the oil-filled line output transformer and a blank screen showed that a new transformer was necessary, but it's impossible to get one these days. If Manor Supplies can't supply one, then no one can! They couldn't, and in fact seemed very surprised at the enquiry.

I wanted to keep this fine old set going however, and as I'd recently fitted a field output transformer from a Thorn 1500 chassis in an old Sobell 1000 series set with success and still had the cannibalised Thorn chassis I decided to try its line output transformer in the Murphy set to see what would happen. This I did, the original clamp on the Murphy line output transformer being adapted to the Thorn transformer without alteration. The only snags to start with were false line lock and a negative picture. These were cured by reversing the polarity of the pulse leads on the transformer, and for the time being the Murphy set's got a new lease of life I didn't really expect. As pensioners can't be choosers, I feel quite happy with the outcome.

N. H. Hodgson,
Hayes, Middx.

INTERMITTENT GREEN SCREEN

In the December *Your Problems Solved* you comment on an intermittent green screen on a set fitted with the ITT hybrid colour chassis. I had this problem for a long time. The green driver and output transistors were changed, also several of the associated resistors, each time curing the fault for a few days. Eventually however the fault was traced to a faulty earthing connection. Each colour amplifier has a separate earth connection made to the frame by means of a large soldered blob. In this set the green amplifier's copper earthing strip had cracked and parted at the boundary of the blob.

L. A. Winn,
Gravesend, Kent.

Editorial Note: The earlier CVC5 and later CVC8 etc. chassis differ in this area.

TV Servicing: Beginners Start Here . . .

Part 17

S. Simon

LAST month we chatted about regulated power supplies, in particular the thyristor power supply used in the Philips G8 colour chassis. We also touched upon the type of power supply used in most mains/battery portables – the series voltage regulator – specifically mentioning the Thorn 1590 series of 12in. and 14in. (1591) receivers which were very popular. We propose therefore to dwell for a moment on the practical aspects of dealing with some of the more common faults that tend to direct suspicion towards the regulated power supply used in this chassis, along with some notes on other parts of the circuitry.

So as not to leave anyone out, we'll start at the mains input and work through: if you find some of our remarks too basic or simple, at least you can derive some satisfaction from the fact that not all will. We say this because our mail bag suggests that some of the more fundamental points have perhaps not been fully digested – or perhaps we've failed to dwell long enough on the basic building bricks. One pertinent request has been for a block diagram of a complete receiver, so that the links between the various sections we've talked about can be fully appreciated. We'll take this up in a later instalment. Meanwhile, back to the 1590/1/3's power supply arrangements.

The power supply in a mains/battery portable must be capable of providing a steady supply line of say 11·5V from a source of 12V or over (a fully charged battery may have six 2·2V cells, the charge in each of which may fall to say 1·85V in use) or from a 240V a.c. mains socket. The battery input may be via a socket with a switch (to disconnect the mains derived l.t. when the battery plug is inserted) direct to the regulator which has the job, as explained last month, of keeping the supply line constant at 11·5V (or whatever) under varying input conditions and current demands within the set.

The LT Fuse

Included in the line to the regulator is a fuse (F2, see Fig. 1 last month) which is designed to fail if the current exceeds a certain figure. Note that this figure is not the figure at which the fuse is rated (2·5A). The rated figure is what the fuse will happily pass in normal use: at some figure above this, say 7A, the fuse will blow. This fuse is generally referred to as the l.t. fuse, l.t. denoting low tension of low volts as opposed to an h.t. (high tension) fuse which may be included in a line of say over 100V.

In most portables this fuse will fail if the battery connections are reversed. This is because a safety diode which will conduct when the battery connections are reversed is often included (W6 in the case of the 1590 series). It conducts in no uncertain fashion, immediately blowing the fuse. In doing this it could well damage itself, blowing itself completely open (no longer providing an easy path to chassis) or becoming totally shorted (providing too easy a path whichever way round the input may be). Thus a quick check on such a safety diode is an essential routine servicing operation.

Incidentally such diodes are included in some car radios for the same purpose (a radio set designed for negative earth operation being put into a positive earth older car without being reset for this polarity) and the same precautions apply, i.e. check the diode as it may be shorted, thus continuing to blow fuses, or be open-circuit, thus affording no further protection in the event of a wrong connection.

Some receivers do not have this protection, and the unfortunate result of crossed battery leads may then be four burnt up diodes (in a bridge rectifier circuit) plus a mess of melted leads from the battery input of the receiver to the bridge circuit and some damage to the printed panel just to add to the fun. Such receivers do not carry well known brand names.

Mains Operation

To return to our specimen however, we'll now consider mains operation. The mains section of the on/off switch supplies the primary winding of a transformer via a 250mA supply fuse (F1) which is situated in close proximity to the transformer. Note the rating, 250mA or 0·25A at 240V, compared to the l.t. fuse rating of 2·5A at say 12V.

The secondary of the transformer consists of two windings with a common connection going to the negative return rail (receiver frame and receiver "earthing" points, i.e. "chassis"). The two remote ends are connected to the anodes of two diodes (W7 and W8) which have their cathodes joined to provide the unregulated positive supply line of some 16V. This you will see is a full-wave rectifier circuit. Some receivers use a single secondary winding which is connected to a bridge rectifier formation using four diodes.

The output from the diodes is taken via the battery socket, where it becomes common to the battery positive supply, i.e. it's then routed through the 2·5A l.t. fuse.

So the only items concerned with the mains supply (other than the mains lead and supply plug of course) are the on/off switch, the 250mA fuse, the transformer, two diodes and their 0·01μF shunt capacitors. So what can go wrong with this simple system?

Faults

Before citing some practical examples, let's clear up the position and duty of the l.t. fuse. The first question is, where is it? Viewing the receiver from the rear, it's on the rear edge of the panel over to the left side, beneath the aerial socket. Access is not too easy, which is just as well perhaps because some adventurous souls have been known to attack a correctly acting fuse (i.e. one which fails due to an overload) and invite disaster by increasing its rating or even wrapping silver foil around it. So our l.t. fuse in the 1590 series hides away in its snug corner.

If it's found to be blown, there could be many different causes which we will discuss in a moment: for now we need know only where it is and whether it's intact.

If it is intact but the receiver is not functioning, the rather obvious question is whether or not it will work from a battery supply. From a practical viewpoint this question is not so easily answered since it calls for a 12V supply which may not be to hand. So we'll tackle the problem from a purely mains point of view. It's fairly simple to check the presence of a live mains supply with nothing more than a neon screwdriver, but this will not check the transformer or the diodes. It will check the on/off switch and the 250mA fuse however.

The brown supply lead (L) should be live and should light the neon on both sides of the fuse holder (slide off plastic cover). It should not light on the blue lead (N). If the neon lights on the blue as well as the brown lead this indicates that there is no return to the neutral side of the mains. This could be due to a faulty on/off switch, or possibly a fractured mains lead. Usually however it simply means that the connections in the supply plug are not good and that the blue lead is not connected to the neutral pin. The reverse could apply if the neon does not light up at all (check back to the supply plug live side and fuse).

It's when the 250mA fuse is found to be open-circuit (neon lights one side, not the other) that one begins to wonder. If there's a fault which causes excess current to be drawn in the receiver proper, the 2·5A l.t. fuse will normally fail. So our first move must be to check this, and to ensure it is 2·5A and not after all a tube of silver paper. If it is 2·5A and is intact, it can be removed to divorce the mains unit from the rest of the set.

Before doing so however check the back-to-front resistance of the rectifiers W7 and W8. They should read, as we all know by now, low one way, high the other. Low means about 30Ω when the ohmmeter is switched to the R1 or low ohms range. It's very likely that one will read much lower to indicate that this is the suspect item, though this should have blown the 2·5A fuse. Why? Because the raw (unrectified) a.c. passing through the diode also has to pass through the 2·5A fuse before it causes W6 to conduct heavily, also the main electrolytic C85 (electrolytic capacitors are polarised to charge in one direction only, and therefore cannot stand the sight of a.c. when there's no standing d.c. to polarise them). It could be however that the 250mA fuse is already a trifle fatigued and fails first.

If one diode is found shorted, check the other one carefully as this could be open-circuit, with a high reading both ways, and may thus be the reason for the other shorting as it would have been left to shoulder the whole burden. We'll come back to this (one diode working) in a moment, but we're still concerned with the failure of the a.c. supply fuse.

If both diodes are in order and the 2·5A l.t. fuse has been removed there should be no reason for a new 250mA fuse to blow, should there? Well in fact there is. The fly in the ointment is the transformer itself, which can suffer from shorted turns on the primary winding.

Whilst for convenience we're making references to the 1590 circuit, these remarks can apply to lots of other mains-battery portables which use a transformer.

So we now know that transformers can suffer from shorted turns. This is hardly surprising, since the wire is wound layer upon layer with only enamel coating as insulation.

You will find this complaint (shorted turns) being frequently referred to in the servicing world. It's a particular bugbear in line output stages, where high voltages are present. Sound output and field output transformers can suffer in the same way, but in these cases the results are not so drastic, being obvious (or maybe not) by say a drop in sound output efficiency or as compression of the vertical scan respectively.

It's quite on the cards that a new 250mA fuse will not fail, and that the set will work when the 2·5A fuse is refitted. This is because the original 250mA fuse had merely been suffering from fatigue. Fuses do you know, as they are all subjected to a certain amount of stress, particularly at switch on.

"Half Waving"

If there's an overload on the regulated line however it may be the turn of the 2·5A fuse to fail (still bearing in mind that one of the rectifiers could be shorted if these have not been checked). Before getting on to the causes of overloading, there's another factor which should be mentioned regarding the transformer and the rectifier diodes. Whilst a short somewhere in a circuit leaves little doubt as to its presence, the opposite condition, an open-circuit, may not make itself so obvious. If only one circuit path is involved an open-circuit will be obvious because the circuit will simply fail to work. In the full-wave rectifier circuit we are considering however, one half can fail, leading to a "half waving" condition. This will of course be the result if one diode becomes open-circuit. This leaves the smoothing impaired, with a consequent wave on the picture.

Less obviously, the same condition will occur if one of the secondary windings on the transformer becomes open-circuit. How can this happen you may ask, bearing in mind the heavy guage of the wire used? The answer is that the wire itself doesn't become open-circuited. What does happen is that the junction of the lead outs to the earthing lead is improperly joined owing to the enamel not being completely removed prior to soldering, leaving a classic dry-joint, one winding being left high and dry you might say. Not likely? Sorry, but it is likely and it does happen, so check this simple but easily overlooked point.

Overloads

Now let's get down to the awkward bit: what to do when faced with either a blown 2·5A l.t. fuse or a regulated output which is much lower than the correct 11V or so. To say the least, it's helpful to know what the approximate current should be when the thing is working normally.

If the fuse is rated at 2·5A, it's reasonable to assume that the normal current is in the region of 1·5A (give or take a little). If the fuse hasn't blown but the regulator's output voltage is low, we have to evaluate a few things to start with. Is there any sort of picture on the screen, or is there any vestige of sound? Remember that the tube heater in the 1590 chassis and many others is wired across the regulated supply line. So although some of the circuits may be working, the tube heater supply may be insufficient to coax the cathode into a healthy emission, raster creating condition.

If there's doubt, remove the 2·5A fuse and connect the multimeter, switched to a range higher than this (depends upon the meter), across the holder: an amperes range of course, to check on our current problem. If the meter shows a reading below 1A, we are not dealing with an overload at all, rather the regulator is not working at its full potential. So attention should be directed to the regulator transistor itself and its control circuitry.

If the meter records excessive current flow however, in the region of say 2A, it's time to indulge in a little finger warming to see if anything is obviously running warmer than normal. A good place to start is the large 4,700μF main smoother (or, more correctly, reservoir) capacitor C85, which is not far away from the fuse. If this is hot the search has ended before it really started, and a replacement should restore normal conditions provided one of the W7/W8 diodes has not been leaking a.c. into the capacitor. This capacitor is one of the weak links, and although it normally suffers from loss of capacitance with resulting hum on the sound and distortion of the picture (if any), it can also leak and in doing so will overheat.

Normally however the moving finger will have to move on, say over to the front centre to see how the sound output transistors are getting on. If these are cool headed (not finger-licking hot), move over to the right side around the line output section. The line output transistor itself is unlikely to be the cause of the trouble, since it doesn't as a rule act up: when it shorts it really shorts and the 2·5A fuse doesn't stand a chance. What is more likely is that there's an overload in the line output stage and that this is putting the heat on as it were.

The line output transformer feeds several rectifiers, and these need checking out. A finger on each little diode in turn can be most rewarding. If one is hot, check it and its associated reservoir capacitor, first by disconnecting one end from the panel and noting the effect on the meter. Diodes can short or be overloaded (for example by a leaky reservoir capacitor), the net effect being the same – excessive current demand. If there's any doubt, the best plan is to disconnect each feed from the line output transformer, including in this operation the e.h.t. pencil rectifier. The line output stage circuit used in the Thorn 1590/1591 chassis is shown in Fig. 1.

This unshedding procedure is a common one that applies to all types of receiver in which fuses are not included in the separate feeds from the line output transformer. Some more recent receivers employ thermal cutouts in the feed lines (wirewound resistors with a soldered connection which melts when the resistor overheats), and in this case an unsprung spring may give an immediate clue as to the circuit in which the short dwells (perhaps).

This gives a rough idea then of the sort of procedure required when there's an overload.

Blown LT Fuse

It's far more common to find that the 2·5A fuse has blown. There are many things that can cause this, but one learns by experience where the trouble is more likely to be rather than where it could be. Bridge rectifiers, electrolytic capacitors and hard working transistors are the principal suspects.

Since these items are normally soldered to a printed panel one has little option but to disconnect the suspects from the print until the meter (ohmmeter, on the low ohms range, connected from the supply line to the common return or chassis) moves from a full deflection indication – if indeed the short can be recorded (it's often intermittent, just to make things easy).

There's no substitute for experience, as we all know, but this experience doesn't always have to be your own. Many contributors to this magazine have vast experience of particular makes and models and have tabulated the habits of these receivers into easily digestible form for the benefit of those who may well have considerable experience with other receivers but not these. The beginner can also benefit from a reading of this sort of material, since it demonstrates how each model seems to have its own peculiarities or habits.

So, a blown 2·5A fuse on the 1590 series would direct a weather eye over to the line output transistor, at the same time checking the associated rectifier diodes etc.

To check the line output transistor, it's not necessary to remove it, merely the nut and bolt that are in direct contact with the print (the other one isn't). One can then apply the red lead prod to the body (collector) of the transistor and the black one to either the base or emitter (these are joined from the d.c. point of view through the driver transformer). There should be no reading on the ohmmeter at all. If the leads are reversed of course there will be a reading due to the base-collector junction. This implies that a pnp transistor (e.g. AU113) is employed. Some versions use a silicon npn line output transistor with revised print connections. In this case of course the black lead will be applied to the transistor body and the red one to the base or emitter, where there should be no reading.

Should no short be recorded, fit a new fuse and try the set again with the nut and bolt still off. If the fuse holds (although, despite the regulator action, the supply voltage will be high) a careful check on the line output stage diodes and capacitors must be made before the transistor is coupled up again. If the fuse then fails or there are signs of overheating in some quarter, such as the sound output or field output stage, attention must be directed to such other possible (if not obvious) causes, disconnecting suspects in order of probability.

High Rail Voltage

You may have noticed we just mentioned that a high supply line voltage will result if the line output stage is disconnected. Now it's also on the cards that the supply line voltage may rise even if the normal load on the supply is still present. This is not nice, and could well be the reason for the fuse blowing. Not that a rise in voltage by itself will blow a fuse. What happens is that a component or stage may not like working under conditions of say a 25% rise in supply line voltage (over 15V instead of 11V). We must be very careful therefore to ensure that the voltage is correct when all stages are working. A convenient place to measure this line is at the body of the regulator transistor itself (i.e. its collector). Remember that the regulated line also supplies the tube heater in many sets (including the 1590 series), so even if all the other stages will work with the increased supply voltage without breaking down, the tube heater will still be overrun and if this state of affairs is allowed to continue the tube emission will eventually suffer (pearly whites and poor focus). The breakdown of say a transistor may thus be a blessing in disguise, inasmuch as it draws attention to the high supply line voltage.

Why High?

There can be several causes of an increased supply line voltage. The obvious first suspect is the regulator transistor itself, which can develop leakage, from emitter to collector or base to collector. The check is to disconnect the base and

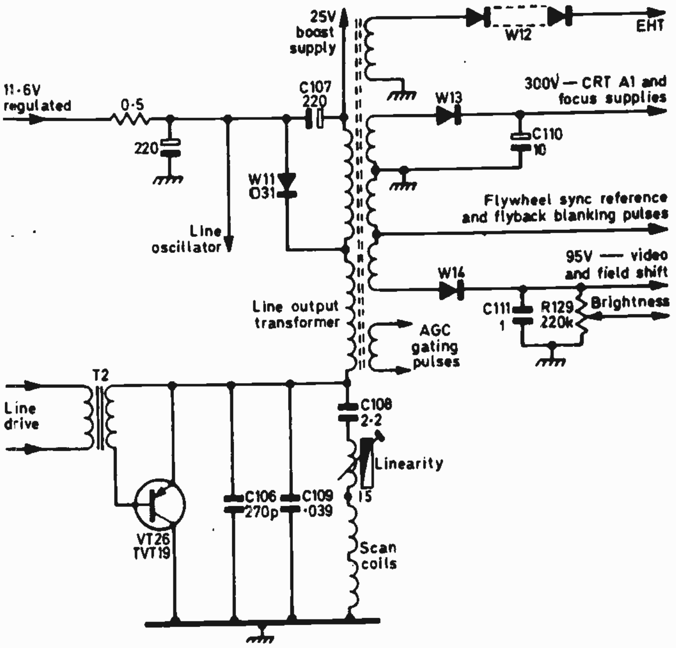

Fig. 1: Line output stage circuit (germanium output transistor version), Thorn 1590/1591 chassis. Defective rectifier diodes, W13 and W14 here, and their associated reservoir capacitors (C110, C111) can be responsible for overloading or a blown l.t. fuse. The e.h.t. rectifier W12 is another suspect in the event of overloading: in earlier versions of the 1590 it has a reservoir capacitor C115 which tends to go short-circuit. The line output transistor VT26 blows the l.t. fuse when it goes short-circuit. The line output stage circuits used in other mains/battery portables are usually very similar.

emitter leads and measure the forward and reverse readings to the collector.

If the regulator transistor is not at fault one is faced with the task of finding out what it is that's turning the regulator on harder than it should. The control transistor VT22, the zener diode W17, and various capacitors and resistors, including the preset control, may have to be checked. The first two (control transistor and zener diode) are the main suspects.

Low Rail Voltage

If the picture is small and possibly dark the supply line may be low. Whilst this could be due to excessive current being drawn, this is hardly likely if the sound and vision are present and are reasonable. We thus have to check, exactly as above, to find why in this case the regulator is not being turned on hard enough.

Once again the regulator transistor could be at fault, but this time with a high-resistance or open-circuit junction rather than a leaky one. The control transistor, zener diode etc. are again suspect and require careful checking or replacement if there is doubt.

Summary

We've discussed the power supply, and the faults affecting it, mainly with reference to battery-mains portables of the more common type. Readers wishing for a more detailed description of series voltage stabilisers are referred to page 69 of the December 1978 issue. There are also many varied designs of stabilised power supply of a more complex nature – switch-mode circuits for example – but these hardly belong in a series such as this for the present.

next month in

TELEVISION

● MODERN TUNING TECHNIQUES

Had you noticed how digital electronics are gradually taking over the front end of TV sets? It all started with the advent of the varicap tuner some years ago. Since this selects stations on the basis of a precise tuning voltage, it became possible to carry out channel selection by electronic rather than mechanical means. It also became possible to design ever more complex remote control systems providing digital control of channel selection and variables such as brightness, colour and volume. The ultimate step came with the appearance of LSI (large-scale integration, i.e. very sophisticated i.c.s) on the TV control scene. This made it possible to get rid of the tuning presets, by using either a memory to store digital signals to call up tuning voltages, or by frequency synthesis. These systems link up with teletext and viewdata of course. If you've not been keeping up with these developments, Harold Peter's feature starting next month will enable you to do so.

● RENOVATING VCRs

Now that extended play VCRs are on the market, many earlier Philips VCRs are becoming available secondhand at very reasonable prices. David Matthewson outlines the common faults that might require attention.

● KÖRTING 20in. COLOUR SETS

The Körting 20in. colour set was one of the first to be fitted with a PIL tube. John Coombes describes his fault experiences with this chassis.

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Colour Receiver Project

Part 5

Luke Theodossiou

THE timebase section of the receiver is probably the most complex, both from the point of view of the principles involved and the components employed. The PI tube with its integral yoke needs about the same deflection power as the Mullard 20AX – in fact it's somewhat less. The problem however is that the PI horizontal deflection coils are torroidal and have a low inductance and resistance. Therefore they require a low voltage but high current driving waveform. This situation is the opposite of the 20AX with the latter's saddle-wound yoke.

Line deflection options

Although the flyback voltage required for the PI yoke is only around 600V peak, the peak to peak current is about 12·5 Amps. This is quite outside the capability of the BU208 or similar devices. If we were to employ a transistor line output stage, there would be two alternatives. Firstly a new type of high current, low voltage transistor could be used: but we discarded this idea since the wound components would be hard to obtain, as would the transistor.

The other approach would be to use a BU208 and then employ the line output transformer as an autotransformer, thus stepping down the voltage by a ratio of 2:1 to give us the required scanning current. But here again the line output transformer would be a headache to obtain, and the remainder of the wound components very non-standard.

Solution adopted

The solution we've adopted therefore uses a thyristor timebase. This is ideal for the PI yoke, since it can handle high peak currents very reliably; in addition, this approach is commonly used in continental chassis, so the wound components should prove easier to obtain.

There is an additional and very important feature of the thyristor timebase circuit – but one which "clinched the deal" so far as we are concerned: it does not need a stabilised h.t. voltage in the conventional sense. Instead, a modified series circuit provides regulation against mains voltage fluctuations and beam current changes. It does this by feeding a specific amount of what is in effect "excess" energy from the line output stage back to the power supply. We shall deal with how this is achieved later.

Some of our readers may not be familiar with thyristor timebase circuitry, and therefore we shall be dealing with the principles of operation later in the article. First of all, the easy stuff!

Protection circuit

The rectified 220V from the power supply board comes in on pin 4 of connector D. Thyristor SCR1 is normally on, triggered by pulses supplied via D2 and R32 from the flyback thyristor. Of course, these pulses are not available until the timebase actually starts to work. R19 is therefore included to start the circuit. If a fault develops in the trace part of the circuit, it should not lead to catastrophic failure, but if the fault is in the flyback circuit (e.g. SCR3 itself going short-circuit) this will lead to a virtual short across the h.t. supply – with some nasty consequences.

This is where thyristor SCR1 comes in. If the gate fails to receive pulses, during the next trough in the input waveform (although the +220V input is rectified, it is not smoothed, remember) the cathode-anode voltage will fall to zero and the thyristor will switch off, thereby interrupting the supply. In this condition, a small current is supplied via R19, which ensures that the circuit starts if the fault is only a temporary one. This state will continue for a little while and if the fault does not clear R19, being a fusible component, will spring open as it becomes sufficiently hot. This totally cuts off the power. We chose this circuit in preference to the more usual crowbar type because it doesn't involve fuse changing if the fault is a temporary one. It's worth noting that under normal operating conditions the dissipation in the protection thyristor SCR1 is low (and zero of course when there's a fault). For enhanced safety however the device has been provided with a heatsink.

Smoothing

The supply is then smoothed by a combination of the double-section capacitor C16 and resistor R33. Resistor R34 is included to discharge the reservoir capacitor when the set is switched off.

Sync/line generator IC

The next section to consider is the sync separator/line oscillator circuit, which is designed around the ITT TDA9400 (IC1). We covered this i.c. in some deatil in the April issue, in fact, but for completeness it's well worth repeating here.

The i.c. comprises the sync separator (with internal noise suppression); a field sync pulse integrator; a line sync phase comparator with a switching stage for automatic time-constant changeover; the line oscillator; a second phase control circuit; a burst gate/line blanking (sandcastle) pulse generator; the output stage; and an undervoltage protection circuit. The functional block diagram of the device is shown in Fig. 1.

The composite video signal enters the i.c. at pin 6 via coupling/filtering components R1, C1 and C2. R2 provides bias for the integrated transistor whose base is connected to pin 6. The sync separator circuit then extracts the sync

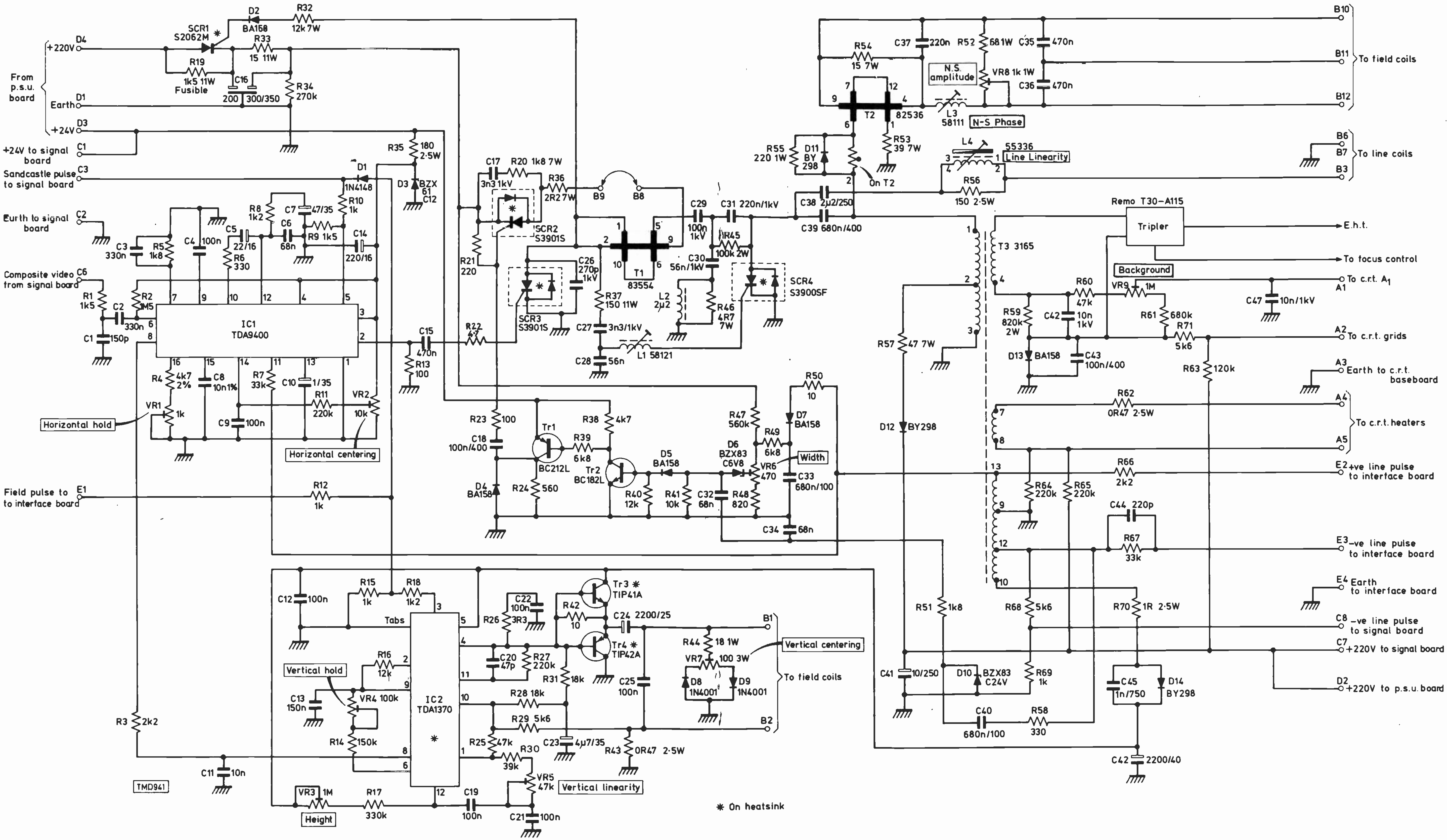


Fig. 2. Circuit diagram of the timebase board. The link shown on pins 8 and 9 of connector B provides protection by removing the power whenever this connector is unplugged, since this disconnects the line deflection coils from the circuit. Also note that peripheral components to the TDA9400 differ from those shown simply as a guide in Fig. 1.

stabilised by zener diode D3 to 12V and decoupled by C14. This method, although slightly wasteful (there is already a 12V stabilised rail on the signal board) does save a connection from one board to another, and also ensures that the timebase board can actually function even in the absence of the signal board or when there is a fault on the signal board.

Field timebase

The next section of the receiver to be considered is the field timebase, whose design centres around the SGS-ATES TDA1370 i.c. This device is a further development of the TDA1270, a variant of the TDA1170.

The PI yoke's low-impedance field coils do not require a high flyback voltage. The flyback voltage is clamped to the supply rail therefore, with only a very slight increase in power consumption. Due to the high scan current required by the yoke, the i.c. drives a complementary output stage consisting of two transistors which in turn drive the yoke.

Fig. 3 shows a block diagram of the TDA1370. The oscillator consists of a differential amplifier with positive feedback. Its frequency is determined by C13 and the value of the resistance made up by R14 and VR4 (the field hold control). This is fed from an internally stabilised supply which appears at pin 6. The stability of the oscillator against temperature and supply voltage variations and internal component tolerances is very high.

The field sync pulse from the TDA9400 is applied to the i.c. at pin 8, after filtering by R3 and C11. The sync circuit in the TDA1370 has a high degree of noise immunity, preventing false triggering.

A highly linear ramp is produced by the ramp generator and buffer stages of the i.c. Feedback via R30 and VR5 provides linearity correction. The output is then fed to the inverting input (pin 10) of the internal preamplifier. By connecting the height control from pin 12 to the supply rail instead of from pin 7 to chassis, height compensation against beam current changes is provided. The output current flows through R43, the voltage drop across which is compared at pin 10 with the voltage at pin 1 (ramp output) by means of R25 and R29: the ratio of the values of these sets the gain. The quiescent d.c. voltage at the output is set by R28, R31 and R29, R43 (R25 also has some effect).

Output stage

Since the output transistors provide only current amplification, the voltages (both a.c. and d.c.) at pin 4 of the i.c. and the emitters of the transistors are virtually the same. TR3 is switched on by a positive-going pulse with respect to the quiescent d.c. voltage at the output of the i.c., while TR4 is then switched off. The opposite occurs during a negative-going excursion of the output from the i.c. It's interesting to note that both transistors are switched off when the i.c. is in the quiescent state – this also occurs when the output is less than $\pm 0{\cdot}6$V (i.e. the voltage required to switch either transistor on). During this state, the i.c. itself provides the driving current to the yoke, via R42. If this resistor was not present, crossover distortion would become very visible on the screen – the symptom is line cramping at roughly the centre of the screen.

High frequency stability is ensured by R26, C20, C22, C25. The drive current to the yoke is fed via C24 which acts as a d.c. block. Vertical centering is achieved by the network consisting of R44, VR7, D8 and D9. A small portion of the signal is tapped off and rectified by either of these two diodes (depending on the setting of VR7 relative to its electrical centre). The positive or negative d.c. voltage thus obtained is applied to the yoke, as a result of which the raster moves either up or down.

Field flyback blanking

The TDA1370 differs from the TDA1270 in incorporating a field flyback blanking pulse generator. The duration of the pulse depends on R16. We've found that 12kΩ is the optimum value for this resistor – the teletext lines are blanked off, whilst the picture information remains intact. Though the PCB has no provision for it, a 4·7kΩ potentiometer in series with a 10kΩ resistor could be used to provide very accurate setting of the flyback blanking time – some constructors may wish to try this out. Alternatively, if necessary change the value of R16 in either direction to suit particular requirements. The flyback blanking pulse appears at pin 3, and is tapped down to the required amplitude by the divider formed by R18 and R15. It's then superimposed on to the sandcastle pulse via D1. It also goes to the remote control/teletext interface via R12.

Line output stage

Next to the line timebase. An excellent account of the operation of thyristor line output stages appeared in the June 1976 issue of *Television*. For fuller information readers are referred to this, since space limitations make it impossible to go over the whole story here. What we will do is to outline the scanning sequence. First though some component identification.

The line output stage is built around the two ITDs (integrated thyristor and diode) SCR3 and SCR4. The former is the flyback thyristor, the latter the scan thyristor (or retrace and trace respectively if you prefer that). The input and commutating coils are integrated as one component, T1, which although looking very like a transductor in fact isn't. The input coil is connected across terminals 2 and 9 of T1, while the commutating coil is in two halves and is taken out to terminals 1 and 5, with terminals 6 and 10 connecting the two halves in series. There's an additional winding which can be used to provide around 18V after rectification, but this is not used in our design. The whole assembly is usually referred to as a "combi" coil – an abbreviation for combination coil, would you believe!

Circuit action

The action of the line output stage is briefly as follows. About 3·3μsec before the start of the flyback, a short-duration pulse from IC1 (the TDA9400) is delivered to the gate of SCR3, switching it on. This connects terminal 1 of T1 (the commutating coil) to chassis, discharging the tuning capacitors C29, C30, C31. While SCR3 was off, and SCR4 on, these capacitors were charged from the h.t. rail via the input and commutating coils. The discharge current flows through SCR3, the commutating coil, the tuning capacitors and SCR4. The commutating coil forms a resonant circuit with the tuning capacitors, producing the commutating pulse. This current pulse flows through SCR4 in the opposite direction to the scan current. When the two opposing currents are equal, SCR4 switches off and the diode in parallel with it switches on, providing the path for the commutating pulse and the scan current, with the capacitor C38 discharging via the scan coils. When the commutating current falls below the scan current, D2

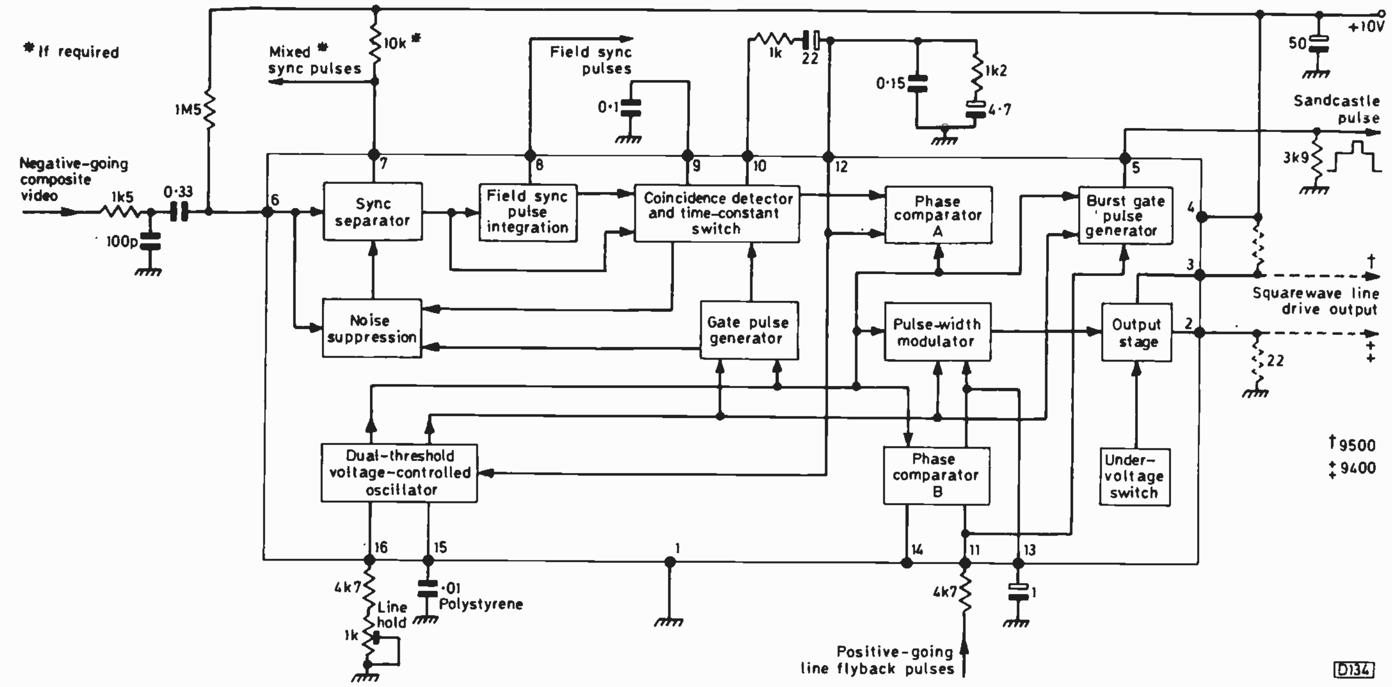


Fig. 1. Block diagram of the sync separator/line oscillator i.c. showing the difference in the output stage between the TDA9400 and the TDA9500 which is used for driving transistor line output stages. Typical values shown for external components.

pulses. To ensure noise spikes do not affect the operation of the sync separator, a noise gate circuit is included, which ensures disturbance-free operation under most conditions; this circuit does not need any external components. The field sync pulse is obtained by internal integration and limiting, appearing at pin 8. In earlier versions of the i.c., the composite sync pulses were available from pin 7. In the current version however, an additional RC network – R5 and C3 – improves the field sync pulse, thereby reducing jitter.

The line oscillator frequency is determined by the capacitor on pin 15 (C8). This is charged and discharged periodically by an internal current source and current sink respectively. The external combined resistance of R4 and VR1 on pin 16 defines the charging current and thus, in conjunction with C8, the line frequency.

Phase comparator A compares the sawtooth voltage produced by the oscillator with the timing of the line sync pulse. As a result an a.f.c. voltage which locks the oscillator frequency is produced. A frequency range limiter restricts the frequency holding range, which if allowed to deviate too far will result in the line output stage being overloaded.

The oscillator sawtooth voltage, which is in a fixed ratio to the line sync pulses, is also compared with the line flyback pulses fed in at pin 11. This is done by phase comparator B. This action compensates for time delays in the line output stage. Phase displacement, which shows as a horizontal picture shift, is determined by the current fed to pin 14. In our case this is achieved by VR2 and R11 – with C9 filtering any residual hum and noise. Adjustment of VR2 centres the raster in the horizontal direction.

The sandcastle pulse is derived from the oscillator sawtooth voltage, the line sync pulse and the line flyback pulse. It appears at the emitter of a transistor on pin 5 whose load is R9. Resistor R10 is included to provide protection from flashover.

VCR Operation

The time constant switch adjusts for the different conditions under off-air and VCR operation. When the signals from the sync separator and phase comparator A are in sync, pin 10 is short-circuited to earth internally. The time constant of the filter network at pin 12 increases therefore, reducing the pull-in range of the phase comparator to ensure disturbance-free operation. For VCR operation the automatic switch-over is blocked by applying a positive voltage to pin 9. This reduces the time constant at pin 12 and increases the phase comparator's control current. In consequence there is a faster reaction to the frequency changes due to the inherent shortcomings of the mechanical aspects of both VCRs and tapes – i.e. whenever flutter occurs the i.c. can track the rapid changes in frequency and thereby compensate for them. Without this compensation there is a tendency to line pulling, resembling weak line sync. Although no provision has actually been made for VCR operation in our design, it is very simple to incorporate for those who wish it. A 2k2 resistor is connected from pin 9 to pin 4 (+12V) via a switch which can be mounted anywhere that's convenient on the cabinet. Some tuning potentiometer units actually have this switch incorporated and coupled to one of the selector buttons. For those who wish to include the teletext/remote control option, there will be further information about this when we come to deal with the options.

IC output stage

The output stage of the i.c. consists of a Darlington emitter follower which is capable of delivering up to 600mA. Short-circuit protection ensures safety. The emitter resistor is external (R13). If the supply voltage to the i.c. falls, for example when the set is switched off, a built-in protection circuit ensures that clearly defined line-frequency output pulses are produced until the voltage on pin 4 falls to 4V. Thereafter the i.c. shuts down. This protection prevents the line output stage from being damaged by undefined drive pulses, particularly if the frequency is too low.

IC power supply

The power supply is derived from the 24V rail via R35,

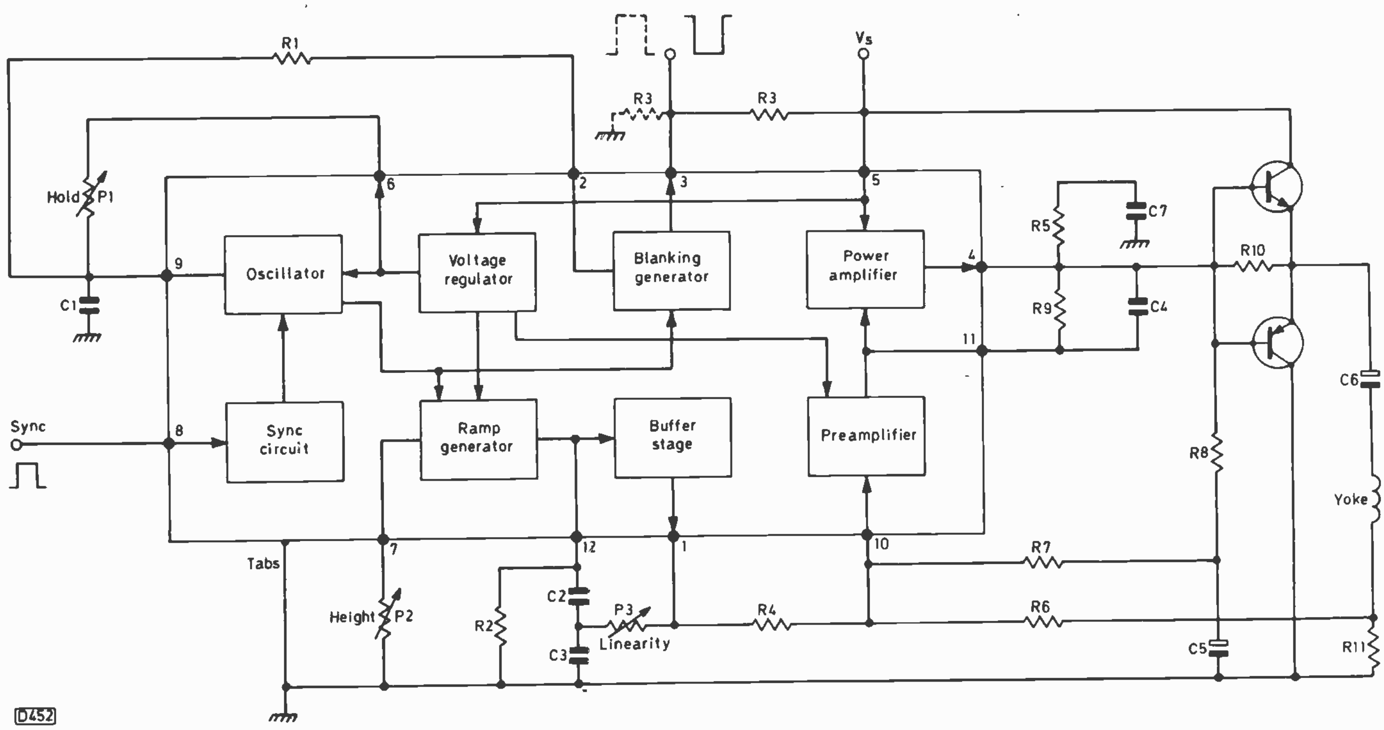


Fig. 3. Functional block diagram of the TDA1370 field timebase i.c.

switches off and the field around the scan coils begins to collapse, producing a current flow through the tuning capacitors, commutating coil and SCR3. When this current falls to zero, the tuning capacitors are charged in the opposite direction, cutting off SCR3 and switching on the associated parallel diode. This gives the second half of the flyback. The process continues until the tuning capacitors are discharged, when SCR3's parallel diode switches off. When the voltage tries to go negative, SCR4's diode switches on, providing efficiency diode action to give the first half of the forward scan. SCR4 is switched on at the centre of the screen by a pulse which is obtained from the input coil via the network R37, C27 and C28 (these components also providing transient suppression) and shaped by L1. Transient suppression and pulse shaping is also provided by C26, L2 and R46, while R45 provides a safety discharge path for the tuning capacitors. It will have been noted that the purpose of the commutating action is to switch off the scan thyristor towards the end of the scan, so that the flyback action can take place.

The line output stage operates at high peak currents, but it can do this reliably *only if the correct components are used*. It's essential for instance that C29, C30 and C31 are high quality polypropylene capacitors, otherwise fireworks may result. More about components when we deal with the construction of the board.

C38 also provides scan correction, while L4, damped by R56, gives line linearity correction.

EHT/width regulation

Back to the h.t. supply. On switch-on, current flows through R19, R33, the diode integral with SCR2, R36 and via the input and commutating coils charges up the tuning capacitors during the second half of the scan (i.e. when SCR4 is on). Once the capacitors have been charged and normal scanning action starts, SCR2's diode is switched off by a pulse produced by the input coil, and SCR2 is switched on to provide a path for this energy back to the reservoir capacitor. The timing of the pulse which switches on SCR2 determines the charge on the tuning capacitors, and therefore the picture width.

To generate the trigger pulse, 65V negative-going line flyback pulses from terminal 12 of the line output transformer, via R58 and C40, are limited by D10 to 24V peak. They are then integrated by R51 and C34, producing a sawtooth voltage whose amplitude is independent of the amplitude of the line flyback pulse – due to the action of zener D10. This is fed to the base of Tr2 via C32. A d.c. voltage is also fed to the base of this transistor. It is derived from two sources: positive-going line flyback pulses from terminal 13 of the line output transformer (around 65V peak) via R50 are rectified by D7, smoothed by C33, and injected to the top of VR6 via R49; and this point is also fed from the h.t. rail via R47. Thus the voltage here is the sum of the rectified flyback pulses and the h.t. line sample. This composite voltage will vary of course according to the h.t. voltage, which depends on the mains voltage, and to the peak value of the flyback pulses. The latter will vary in sympathy with the beam current: the greater the beam current demand, the lower the flyback pulse amplitude.

Potentiometer VR6 determines the value of the d.c. voltage at the base of Tr2, with D6 used simply for level shifting. The sawtooth voltage derived from the negative-going line flyback pulse sits on this d.c. voltage and is used to switch on Tr2. Therefore the d.c. voltage at this point determines the moment during the sawtooth excursion when the transistor turns on.

The pulses on the collector of Tr2 are fed to the base of Tr1 via R39. This transistor provides current enhancement. The inverted pulses developed across R24 and D4 are fed via C18 and R23 to the gate of SCR2. R21 ensures freedom from false triggering. The picture width is determined by the value of the flyback voltage, so when we adjust VR6 we are varying both the width and the e.h.t. value. That's to say, VR6 is not a scan amplitude control as such. Our component values have been purposely chosen so that when the picture width is correct, the e.h.t. is at the optimum value.

Next month

Next month we conclude our description of the timebase board circuit, and deal with its construction.

Combi Colour Receivers

Peter Murchison

THE year 1973 is still nostalgically remembered by many dealers as the great colour boom year, when fortunes were made out of record colour television sales. Manufacturers were working flat out to keep pace with demand, and most dealers were having a real hard time of it trying to get stock to sell – a most frustrating state of affairs! If you could get the sets you could sell each one two or three times over, and there were even waiting lists of prospective buyers hoping for a set by Christmas.

This of course proved to be an ideal state of affairs for the back street and garden shed importers, many of whom were busy gathering sets from all corners of Europe in order to make a quick profit before fading into oblivion, and giving little or no thought to spares or after sales service. The market was quickly flooded with a wide range of sets with strange sounding names like Loewe Opta, Graetz and Combi colour, all of which were eagerly snapped up by the set-hungry retailers.

We are going to take a brief look at the Combi, a particularly nasty beast which once imported was sold via various wholesale outlets to retail shops. By the time the customer got the set he was paying around £330 for a not too good product: a lot of money by the standards of the day. A vast number of these sets were sold in our area, and because of this our throughput of Combis for service in the course of a year is very high. We are only too aware of their habits and shortcomings, and consequently feel that it might be of help to pass on a little bit of gen to fellow technicians who might unexpectedly meet a Combi in their workshops.

The Combi colour sets that were imported are something over five years old now, and believe you me are starting to show their age in many ways. Because of this we were horrified to be confronted with a 26in. version sitting calmly on the workbench one Monday morning last month. The job ticket revealed that we were now its proud owners, as it had come in part exchange for a Japanese 18in. colour set and was hopefully to be reconditioned for resale. So we decided to switch on and see exactly what the nature of this particular beast was. We soon found out!

After a couple of minutes there was a familiar crackle as the e.h.t. came up, followed by a series of almighty cracks from the region of the e.h.t. cage at the left-hand end of the set. We hastily switched off and removed the back of the set to investigate. It's quite a struggle to get the back off, because it's held in by two spring clips at the bottom ends of the back cover. These clips have to be depressed with a screwdriver whilst the back cover is at the same time pulled towards you. If you're successful the whole back falls free and you find yourself surging backwards at the same time, groping for a convenient hand hold – usually a hot soldering iron in its stand!

The Line Output Transformer

Having dropped the chassis, which hinges downwards in much the same way as the ITT single-standard CVC series of hybrid colour sets, we noticed the marked similarity between this set and the ITT one – both in layout and in much of the circuit design. The only major difference is in the line output stage, where the Combi uses a GY501 e.h.t. rectifier coupled to a line output transformer with a 25kV overwinding (no shunt stabiliser). It was here that our trouble lay: yet another line output transformer with its overwinding smoldering from a breakdown of the insulation between winding and transformer core. I say "yet another" because these transformers were poorly made and, coupled with the high overwinding voltage, this leads to inevitable arcing and insulation breakdown. The line output transformers come at anything up to £50 each on the "black market", as a glance in the small ads column of various magazines will show. Usually the PL509 line output valve and PY500A boost diode will have suffered as well, so the whole job can turn out to be extremely costly for the poor unsuspecting customer who has already paid over the odds for the set itself. Sadly, in the case of the set upon our bench, we would have to stand the cost this time.

"Adrian" I shouted to our trainee lad, "a nice job for you here." Well Adrian is a bit of a whiz kid with the soldering iron, and he soon had the new line output transformer fitted and the set switched on. The e.h.t. came up with a healthy crackle, and with the brilliance turned down to give zero beam current the e.h.t. was set at 25kV with the horizontal amplitude preset control R517. We then turned up the brilliance and looked for the picture, which proved to be dark and greenish, with a general lack of highlights.

Faulty CRT

I had seen it all before! Switching off the first anode voltages one by one revealed poor-emission blue and green guns, whilst the red gun lacked emission entirely. For some reason the German tubes used in these sets seem to lose emission rather too quickly, the red gun usually being the first one to suffer. Other tubes of this type flash intermittently red, green or blue, a fault which can seldom be cured except by changing the tube. Some of these tubes seem to develop a peculiar fault, with the guns tracking so that the grey scale uncannily shifts from purple to green when the brilliance is reset. Some compensation can be achieved by altering the drive controls in the RGB output stages, but the only real cure is a tube change. Yes, the Combi can be a really expensive beast to service if you have these troubles to contend with.

"Adrian" I shouted again, "another of your favourite jobs here – just slip a new tube into this Combi!" The job was soon done and we were once again ready for testing, hoping for better luck this time.

Heater Chain

Well the picture looked good and the sound was reasonable, but I wasn't happy because the valves had all lit up like a string of fairy lights, whilst I was sure the PL509 anode was glowing slightly. I was sure that the set was being overrun in a similar manner to Les Lawry-John's cinema monitor a while back, so we decided to investigate the heater chain voltage. We had had experience of imported sets set up for 220V being distributed in this country – these back street importers had no clue when it came to things like that!

The heater chain (see Fig. 1) is fed from the live side of the mains, via the half-wave rectifier D704 and the 100Ω resistor R731 which in turn feeds the five valve heaters – the usual PL509, PY500A, PCF802, PCL86 and PCL805

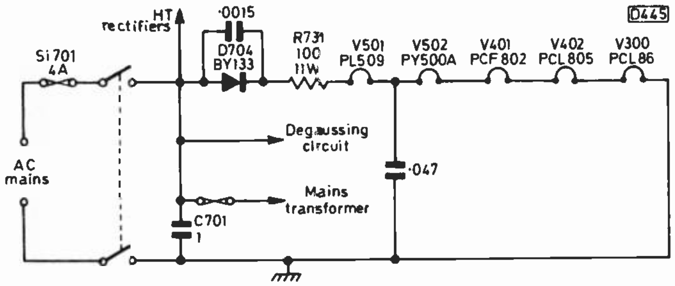


Fig. 1: The mains input circuit and heater chain. The mains filter capacitor C701 tends to go short-circuit rather violently, with the emission of much smoke. Replace it with the more usual 0·1µF 1kV working type. R731 should be 180Ω (see text).

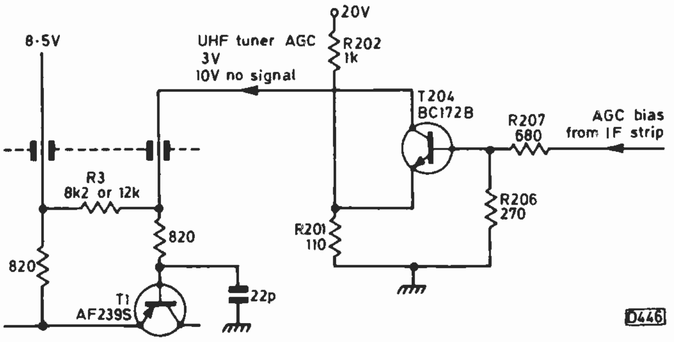


Fig. 2: The tuner a.g.c. system. The control stage T204 seems prone to trouble, sometimes dry-joints and at other times the transistor failing to function correctly.

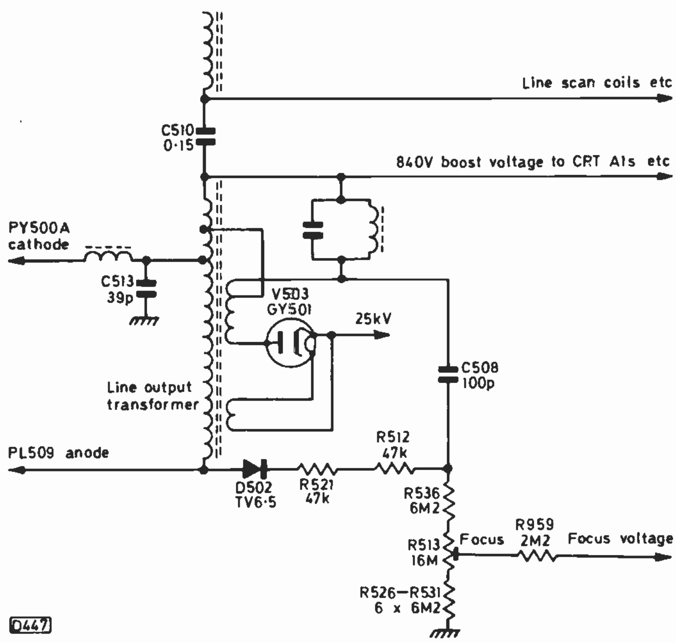


Fig. 3: The e.h.t. rectifier and focus rectifier circuits. The resistors in the focus chain tend to go open-circuit, the usual offenders being R526-R531.

valves. The total voltage required is 122·3V. Taking the nominal mains supply voltage as 250V a.c. and multiplying by 0·707 to allow for the heater chain diode we found that we needed to lose 177—122V. Dividing this 55 by 0·3 to get the value of the mains dropping resistor required showed us that something of about 180Ω was needed for things to run normally. So we removed the 100Ω resistor and put in a 180Ω 0·3A dropper section (RS) and switched on. Things ran much cooler after this, and a quick check with an Avo meter revealed that all was now well.

In fact we make a point of checking all incoming Combis, only to find that most of them are being overrun. A few later receivers were fitted with a 150Ω dropper, this value being about right for a 240V mains supply, but we still prefer to fit 180Ω. Some sets we have serviced are fitted with a 5·2µF dropper capacitor in place of the diode/resistor combination: again we remove the capacitor and fit a diode with a 180Ω series resistor in its place.

Raster Correction

Having fitted the new tube and solved the heater problem, we decided to put the crosshatch pattern on the screen and set the picture up for optimum results before sending it to the shop dowstairs for resale. All was not quite right however, because the horizontal lines at the top of the picture were curving downwards, indicating that something in the pincushion raster correction circuit had failed. We knew where to look, having seen this before: checking the resistance of R622 (47Ω) which is connected to the transductor Tr601 quickly proved that it was open-circuit.

This component is of the 2W carbon variety and seems to be underrated – a similar replacement will cook up in no time at all. So we fit a nice 50Ω 5W component which lasts rather longer than the 2W type fitted by the manufacturer. On switching on again a normal linear picture was obtained with truly straight horizontal lines at the top of the display. There was also a healthy "buzz" from the transductor, indicating that all was well.

AGC Faults

So I left Adrian busy with the crosshatch and convergence magnets whilst I cast my eye on a second Combi idling its life away in an odd corner of the workshop. This one belonged to a customer from a town some 30 miles away. He'd brought it back to us in desperation, having had little success with his local repair shop. The ticket on the back cover explained "very snowy picture, tuner low gain," and "no spares obtainable."

Well, our total stock of these tuners amounted to one secondhand one of dubious merit taken from a cannibalised set, so I was keeping my fingers crossed as to the exact nature of this fault. By this time Adrian had finished his convergence, so we started work straight away on this second set.

Sure enough on switching on with an aerial plugged in we were confronted with a very weak grainy picture. It could possibly be the r.f. amplifier in the tuner we thought, and had a look at the circuit to try and locate the source of the trouble. We noticed that a.g.c. is applied to the base of the r.f. transistor T1 from the tuner control stage in the i.f. strip (see Fig. 2). Now the a.g.c. voltage should increase as the signal gets weaker (forward a.g.c.), thus reducing the r.f. transistor's collector current to increase its gain – until a maximum of 10V is reached with no signal at all. Under normal signal conditions there should be around 3V on the tuner a.g.c. line.

We made a quick voltage check and found that the a.g.c. voltage was non-existent, concluding that the trouble lay here. To check the tuner we temporarily connected the 8·5V supply line to the a.g.c. line via a 470Ω resistor, biasing on T1 and proving that the tuner was in first class order – a good picture was obtained. The next step was to check back to T204 which is in a very inaccessible position on the i.f. strip. We managed to take voltage measurements however, and found that its emitter was high at around 18V. Checking the potential divider which feeds its emitter revealed that R201 (110Ω) was dry-jointed in the printed board at the earthy end. A touch of the soldering iron soon put that right and all reverted to normal.

We have in fact experienced a number of faults in the a.g.c. circuit; in one or two cases T204 itself has broken down or gone open-circuit, giving a similar effect to that described above.

Focus Trouble

Anyway, we stood back to admire the picture on our second Combi, feeling pleased at having run the snag to earth, and Adrian had just put the kettle on to brew a much needed cup of tea. Then a second fault occurred. The picture flickered slightly and instantly went out of focus. We groaned and tried adjusting the focus control R513 without success. Now the c.r.t.'s focus electrode is fed from a potential divider network consisting of nine high-value resistors and the focus control itself. One end of the network is connected to chassis, whilst the other end is fed by the focus rectifier diode D502 (see Fig. 3).

There was obviously excessive focus voltage at the c.r.t. because the spark gap was cracking over. From this we concluded that one of the resistors in the chain had gone open-circuit, so we switched the set off and checked each resistor with a multimeter. Sure enough, the third resistor in the chain (R528) had gone completely open-circuit, rendering the potential divider inoperative. We fitted a replacement and switched on, to be once again greeted with a good, sharp picture. All this had been timed to coincide with the workshop kettle blowing its top, so we were able to sit down for that life giving cup of tea!

The resistors in the focus chain in fact give a lot of trouble, and we've experienced many cases of intermittent focus. The only sure cure is to change all the resistors in one go, saving many repeated service calls and at the same time keeping the customers happy: after all, that's what it's all about! ■

Phase Confusion

S. W. Amos, B.Sc., C.Eng., M.I.E.E.

A LONG time ago – years before Shockley startled the world by inventing the junction transistor – a large electronics organisation (which had better be nameless) designed a piece of equipment which relied for its action on the 180° phase shift between the signals at the grid and anode of a valve. It didn't work, and at the ensuing post mortem it was discovered that the relationship between the grid and anode signals was not one of 180° phase shift but of inversion.

The gaffe was understandable. If a symmetrical wave such as a sine wave – so often used for test purposes – is phased shifted by 180° the result is the same as inverting the wave. This is shown in Fig. 1. Indeed the phase-shift oscillator makes use of this identity. But it does not follow from this that inversion is in general equivalent to a 180° phase shift. If it was possible to identity the output corresponding to a particular half-cycle of input, it would be found that an inverted output is coincident in time with the input whereas a phase-shifted output is non-inverted but is delayed in time by half the period of the wave. Corresponding half-cycles in Fig. 1 are labelled ABC to make this clear. The distinction between the two processes is most clearly shown by the fact that phase shift is always accompanied by delay, but inversion is not.

The non-equivalence of inversion and 180° phase shift becomes immediately obvious when an asymmetrical wave is subjected to the two processes. Fig. 2 shows the effects for a wave consisting of a fundamental with some second-harmonic distortion. Diagram (b) shows the inverted wave (undelayed) and diagram (c) the non-inverted but delayed wave caused by phase shifting.

To produce the result shown in Fig. 2(c), in which the wave is delayed by half the fundamental period without a change in the wave's shape, a network that introduces a 180° phase shift at the fundamental frequency, a 360° phase shift at the second-harmonic frequency, a 540° phase shift at the third harmonic and so on is needed. This is easily seen. Phase shift is always accompanied by signal delay, and the delay is given by the phase shift divided by the frequency (strictly, delay is given by $\phi/360f$ where ϕ is in degress and f in Hz).

For distortionless transmission through a network, clearly all the components of a complex wave must take the same time to travel through it: in other words, any delay must be constant and independent of frequency. This requires phase shift to be directly proportional to frequency. Thus if phase shift is plotted against frequency for an ideal network, the result is a straight line passing through the origin as shown in Fig. 3, the slope of the line being equal to the delay. A real network might have a phase-frequency characteristic similar to that shown by the broken line.

In spite of what has just been said, the idea that a 180° phase shift and signal inversion are equivalent is deeply rooted. This was demonstrated to me very graphically by a telephone conversation I had with a celebrated electronics engineer who had, in the past, been most helpful to me in unravelling technical knots and for whom I have a great respect.

"Hullo," I said. "Can you spare a moment to discuss signal transmission through valves?"

"Certainly" replied CEE affably.

"Good," I said. "Well, I've been thinking about the 180° phase shift introduced by valves."

"Yes" said CEE encouragingly, "what of it?"

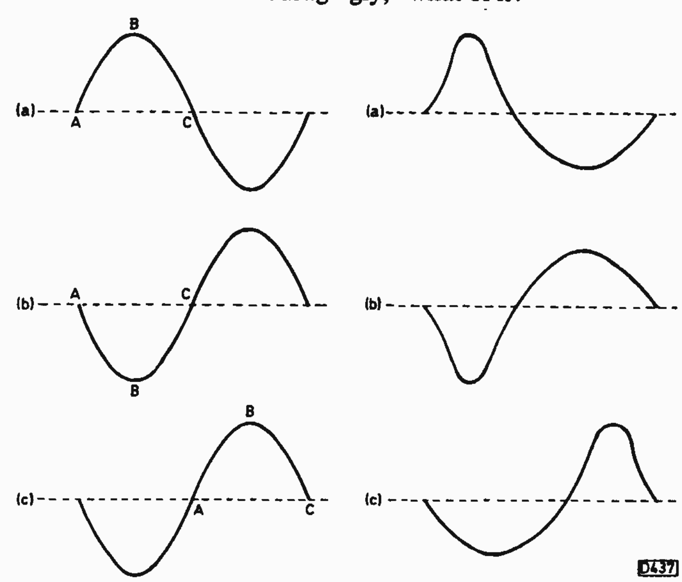
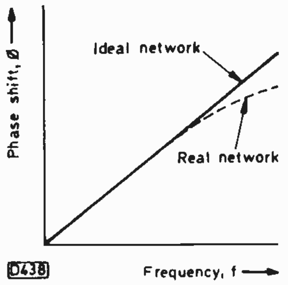


Fig. 1 (left): Symmetrical waveform (a), effect of inverting it (b) and of phase shifting it by 180° (c).

Fig. 2 (right): Asymmetrical waveform (a), effect of inverting it (b) and of phase shifting it by 180° (c).



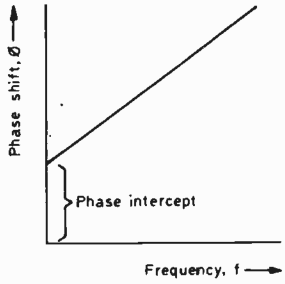


Fig. 3 (left): Phase/frequency characteristic of an ideal and a real network.
Fig. 4 (right): Phase intercept for a phase/frequency characteristic.

So he believed in it! My world began to crumble.

"If it's true" I went on cautiously, "then it would appear that valves don't obey the normal rules of signal transmission."

"What do you mean?" The expert sounded puzzled.

"Well," I said "surely phase shift must be directly proportional to frequency to minimise distortion?"

"Of course" said CEE.

"If," I said "the valve introduces a constant 180° phase shift independent of frequency, then the associated delay must be inversely proportional to frequency and this would cause ghastly distortion."

There followed what novelists describe as a pregnant silence.

"H'm," said CEE in the tone of a man deeply in thought. "That's a tricky one. Can I ring you back?"

"Of course" said I.

That conversation took place many years ago, and I'm still awaiting CEE's call! I found it incredible that he should apparently believe that a valve could introduce a genuine 180° phase shift. He must have known that phase shift can be caused only by combinations of resistance and reactance or by transit-time effects. An ideal valve or transistor is free of these, and a real active device doesn't suffer from them at low frequencies. Yet they can invert.

Phase Intercept

The 180° phase shift story still survives in textbooks, but in a disguised form. On the conditions for distortionless transmission of signals, they say that not only must the phase shift be linearly related to frequency over the passband occupied by the signal, but that the phase intercept must be an exact multiple of 180°. Phase intercept is the intercept made on the vertical axis by the phase characteristic at zero frequency, as indicated in Fig. 4, and the implication is that it's possible to add 180° to the phase shift at all frequencies without introducing distortion. This 180° is, of course, our old friend signal inversion again. Similarly, the textbooks maintain that 360° may be added to the ordinates to indicate the effect of the double inversion produced by two cascaded stages which, of course, yield an upright or non-inverted signal. In fact, as we have already shown, signal inversion is not in general equivalent to a 180° phase shift. Moreover, by adding 180° or any multiple of it to a curve representing direct proportionality between phase shift and frequency, the proportionality is destroyed, making the delay dependent on frequency.

No doubt some will defend the idea of phase intercept by pointing out that if you are testing with sine waves you can't tell the difference between a 180° phase shift and signal inversion. True. It's also true that absolute delay, as measured by phase shift divided by frequency (see previous qualification of this), is not so important as variations in delay over the signal passband. It's changes in the slope of the phase-shift/frequency characteristic that cause distortion, and these of course are unaffected by adding multiples of 180° to the ordinates.

But it must be very confusing to the student to be told that there are two kinds of phase shift: one (genuine), introduced by circuits of resistance and reactance or by transit-time effects, causes signal delay and must be directly proportional to frequency to minimise distortion; the other (fictitious), introduced by active devices and transformers, is independent of frequency and does not produce delay or distortion. And that in an amplifier the two types of phase shift can be added arithmetically to give the total phase shift! So, if the total phase shift is 210° for example, this could be caused by three *RC* circuits, in which case there would be considerable signal delay, or it could be due to signal inversion plus one *RC* circuit, in which case the delay is much less.

Terminology

Clearly there's a great temptation to regard signal inversion as 180° of genuine phase shift, and to attribute delay to it as my expert did. How much simpler it would be to say that for distortionless transmission phase shift must be directly proportional to frequency over the passband occupied by the signal, and that signal inversion does not count as phase shift.

It's undoubtedly misuse of the word "phase" that causes the confusion. It's so often used where the concept of phase in the true sense has little relevance. Another example occurs with the word "phase-splitter" – the circuit used to drive a push-pull amplifier. This has nothing to do with phase, such a stage producing one inverted and one non-inverted output signal (not, please, in-phase and out-of-phase or antiphase signals!).

Using this terminology, one could say that a common-base amplifier and an emitter-follower are non-inverting stages and that a common-emitter stage is inverting. Even here however there are traps, as I showed in a recent article (see Figs. 3 and 5 of *"Transistors in TV Circuits – Part 2"* in the June, 1978 issue, and the correspondence on page 578 of the September issue). When a common-emitter stage is described as inverting, there's an implied assumption that the potential of the common point (the emitter) is taken as the reference, i.e. is earthed or connected to the chassis. This is usually true. The circuit may be so arranged however that the natural reference potential is that of some other point in the circuit. For example, in the common-emitter circuit shown in highly simplified form in Fig. 5, the collector is earthed from the signal point of view and the non-earthy output terminal is the emitter. A positive-going signal applied to the base now gives a positive-going signal at the output. So here we have a non-inverting common-emitter amplifier. Readers may like to amuse themselves by working out, by analogy, the circuit diagram of an inverting common-base stage and emitter-follower (a misnomer, of course, so call it a common-collector stage). ■

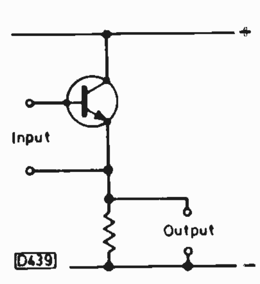


Fig. 5: Essential features of a non-inverting common-emitter transistor amplifier stage.

Service Notebook

George Wilding

No Raster, Ample EHT

No raster with ample e.h.t. indicates – assuming that the c.r.t. heater is energised – either zero or inadequate c.r.t. first anode voltage, excessive c.r.t. cathode voltage, or reduced c.r.t. grid voltage. The first two are the more common, but the third possibility can occur in colour sets using colour-difference drive with the mean c.r.t. grid voltages set by clamp circuits. We've had four cases of no raster but ample e.h.t. recently, all due to different causes.

The first set was a modern Decca one fitted with the 80 chassis. This uses a Toshiba SSI in-line gun c.r.t. The first anode and grid voltages were normal, but the cathode voltages were at almost the h.t. line voltage. Clearly the RGB output stages weren't conducting. Cascode RGB output stages are used in this chassis, and as the fault was common to all stages it was necessary to check only one. The emitters of the lower transistors are biased by a 7·5V zener diode (D207), but the voltage at this point was found to be almost 12V. Since the transistors are npn types they were being biased off. Clearly the diode was defective, a replacement restoring the raster.

The second case involved a Philips colour set fitted with the G8 chassis. Again the RGB output stages were found to be biased off, but the cause this time was a fault in the beam limiter circuit. Zener diode trouble again (D5582), as a result of which Tr5581's emitter voltage was at about 20V instead of 14·6V.

The third example was provided by a German made Philips colour set with electronic static convergence. This used colour-difference drive – the usual PL802 luminance output pentode to drive the cathodes, with PCF200 triode-pentodes driving the grids. The PL802 was naturally number one suspect – but we didn't have one with us and, being eight miles from base, had to be quite sure about our diagnosis. It was impossible unfortunately to check voltages from the top of the valveholder, and we didn't have the manual for this rare set with us. It was also practically impossible to check the voltages on the underside of the valveholder, as it was so close to the hinged left-hand side of the chassis.

The presence of screen grid and cathode voltages, and an anode voltage that varied with adjustment of the brightness and contrast controls, would have indicated that the valve was operating. We checked that the cathode resistor was intact, and that on switching on with the valve removed there was ample h.t. at the screen grid and anode pins. We then replaced the valve and identified the anode load resistor. There was no voltage drop across this, so it seemed likely that the valve had an internal disconnection or, just possibly, that a fault was biasing the control grid negatively. To clear the latter possibility we shorted the control grid (pin 2) and cathode (pin 1), but as expected there was neither screen illumination nor a change in the anode voltage, proving that the valve itself was responsible for the fault.

The final set was one fitted with the Pye group hybrid chassis which again uses colour-difference drive. There was ample c.r.t. first anode voltage and the PL802 was running at the normal temperature. A new PL802 had to be tried however since these valves give a fair amount of trouble. The fault persisted, and since the c.r.t. cathode voltages were about normal and varied with adjustment of the brightness control attention was turned to the c.r.t. grid circuits. The voltages here were much below the normal 62V, and it was then found that the cathode voltages of the triode clamp sections of the PCL84 valves were also very low. The cathodes are fed by a potential divider, R393/R397, and the former was found to be open-circuit.

It all depends on the particular circuitry therefore, and the first thing is to find out what sort of chassis is involved.

Incorrect Line Frequency

The owner of a Decca colour set fitted with the well known hybrid chassis said that the picture had suddenly "gone into lines" while he was watching. As expected, this turned out to be due to a sudden large change in the line frequency, and as also expected a replacement PCF802 line oscillator valve made no difference. So we started going through the usual suspects for loss of line sync on this chassis – the flywheel sync discriminator diodes, the three electrolytics in the line oscillator circuit, and the feedback capacitor. All proved to be in order, and there were no discoloured resistors. The slug in the line oscillator coil was found to be well down in the former however, while just holding a small screwdriver blade in the top part restored correct operating frequency, though without any real degree of lock. A short-circuit capacitor would probably have prevented oscillation, so it appeared that there was either a partially or completely open-circuit capacitor in the circuit or a changed value resistor. Capacitor substitution is a time consuming business, so we first started to check resistor values. It was soon discovered that the pentode section's 220Ω cathode bias resistor R445 had increased in value to about 2kΩ – due to a nearly complete break in the composition close to one of the end caps. Slight pressure on the resistor broke it in two, a replacement restoring normal operation.

Intermittent Contrast Variations

The complaint on a solid-state ITT colour receiver fitted with the CVC20 chassis was that the contrast would vary intermittently, both when it was and when it wasn't switched to "ideal colour" (S1001). In either case the contrast is controlled by setting the voltage on pin 2 of the TBA560C luminance/chrominance signal processing i.c., beam limiting also being carried out at this point. Tests showed that the voltage at this pin varied with the contrast variations, and as this happened both on "normal" and "ideal" operation suspicion fell on the beam limiter circuit.

This is shown in Fig. 1. Under normal conditions, both transistors are cut off. The operation of the circuit depends on the current flowing through R20 and thus the bias at the emitter of T1. The resistor returns the e.h.t. current to chassis, while at the same time carrying a bleed current which flows via R23. If the e.h.t. current is excessive the voltage at the junction of R19/R20/R23 falls. Once it falls to 0·7V below T1's base voltage T1 and T2 start to conduct and the beam limiting action takes place. Voltage tests revealed that T1's emitter voltage was varying, suggesting that either C7 was leaky or D3 defective. The diode turned

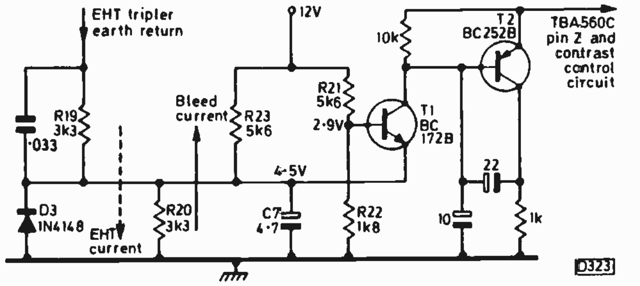


Fig. 1: Beam limiter circuit used in the ITT CVC20 chassis. D3, which is included to prevent the voltage at the junction R19/R20 falling below – 0·6V, was found to be responsible for intermittent contrast variations.

out to be the culprit, a replacement restoring normal, constant contrast.

Weak Field Hold

The trouble with a solid-state Pye colour receiver (725 90° chassis) was weak field hold but normal line locking, the fault tending to get worse after the set had been on for an hour or so. A TBA920 i.c. is used in this chassis as sync separator and line oscillator, with the composite sync output appearing at pin 7. This is fed via an integrating circuit to the base of a BC148 transistor. Weak field sync on these Pye group solid-state chassis is sometimes due to a defective electrolytic in the a.g.c. circuit, but before getting involved in this part of the circuit we decided to check the voltages around the BC148 transistor. There should be 12·5V at its collector, 1·5V at its base and 2·1V at its emitter, the latter being developed across a 4·7μF electrolytic (C941). All the voltages were low, so it seemed likely that C941 was defective since the bias developed across it is used to hold the transistor cut off in the absence of a field sync pulse at its base. On test C941 was found to have a pronounced leak.

Blown Mains Fuse

The mains input fuse in a Saba Model TS6716 (chassis H) had blown immediately after the set had been switched on. There are two fuses in series with the feed to the primary of the mains transformer in this chassis, the second fuse being a thermal one. The primary winding acts as an autotransformer to feed the h.t. circuit and degaussing circuit from a tap, and there are two secondaries, both fused. These two fuses were both intact, so we removed them to disconnect the secondary loads and checked for a short-circuit in the h.t. or degaussing circuits. There was nothing doing here, so the mains transformer was clearly suspect. We tried a new fuse just in case, but this too went open-circuit on switching on. Comparison between the resistance of a replacement transformer's primary winding and the original showed that the original had shorted turns. The power supply circuit was shown on page 208 of the February 1978 issue of *Television* incidentally.

No Raster

The owner of a Teleton 14in. mains/battery portable (Model TH14) said that the picture had disappeared immediately following a loud bang, leaving the sound unaffected. This naturally suggested a flashover or breakdown in the e.h.t. rectifier, or at least somewhere in the line output stage. On removing the one piece cabinet both fuses were found to be intact but on then removing the line output transformer screening can we were surprised to find a valve e.h.t. rectifier. There were no signs of an e.h.t. sparkover, nor was there any measurable short-circuit, so the only thing to do was to switch on and watch developments. Normal sound appeared, but the only screen illumination was in the form of a brilliant, thin vertical line.

The line scan coils are connected in parallel, so this unusual fault could be due only to an open-circuit connection to them or an open-circuit d.c. blocking/scan-correction capacitor. We then noticed that just behind the chassis there was a fair sized rectangular capacitor with a deep pinhole on one of its flat sides. This turned out to be the scan-coil feed capacitor C416, a lacquer 5·2μF type. We'd nothing approaching this value except in electrolytic form, which wasn't usable of course, but as a test we connected a 1μF paper capacitor across the connections going to C416. You might imagine that this would result in a picture of reduced width, but instead an over-wide picture with poor brightness appeared. The latter symptom gave us the clue – low e.h.t. Clearly the use of a lower than normal value capacitor was affecting the tuning of the line output stage, and on adding another 1μF capacitor in parallel with the first the picture width decreased and the brightness increased, confirming our diagnosis. Subsequently making up the full value with three large capacitors in parallel produced normal results.

Another interesting point is that the pinhole was on the opposite side of the capacitor to the leadout wires.

Receiver Adjustments

In a recent issue of *Scope*, Thorn's technical bulletin for service engineers, it was suggested that many complaints of tuner drift are due simply to the channel selectors not being tuned in correctly *without a.f.c.* This conclusion was arrived at after laboratory checks on returned tuners and associated circuits seldom revealed any significant faults. I'm sure that this applies to all makes, and that similar conclusions could well be arrived at in many cases of occasional colour loss. Even when the channels are tuned in correctly, this latter trouble is often due to the reference oscillator preset control being incorrectly set.

Some ITT and RRI models are particularly vulnerable to this, though they are just as stable and reliable when correctly adjusted. As one example, the owner of an ITT colour set fitted with the CVC5 chassis complained that there was a monochrome picture every time he switched on, colour appearing only after each channel had been tuned out and then in again. This was confirmed, and was found to be the case even when the selectors were spot-on with the a.f.c. switched off. The cure was simply to readjust R311 in the decoder's reference oscillator circuit. In the case of an ITT CVC20 chassis, the complaint of colour drop out was found to be due to the set oscillator trimmer C534 associated with the TBA540 i.c. being incorrectly set.

When investigating cases of colour drop out therefore it's vital first to check the channel tuning and the adjustment of any preset controls associated with the reference oscillator.

While on the subject of adjustments, a Thorn technical liaison officer found that many cases of e.h.t. tripler and/or line output transformer failure are due to excessive h.t. voltage as a result of mis-set controls.

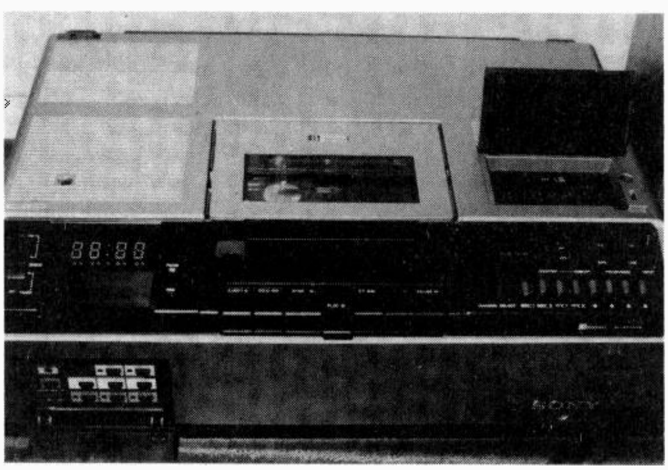
Apart from excessive h.t. voltage, another cause of strain on line output stage components in solid-state chassis is excessive flyback pulse amplitude due to the use of flyback tuning capacitors of not exactly the original value. It's vital to use exact value replacements.

The Sony Betamax VCR System

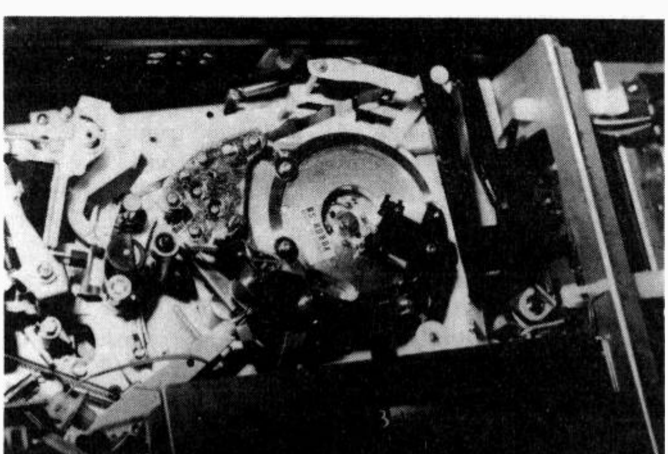
David Matthewson, B.Sc., Ph.D.

AMONGST the latest of the videocassette systems to be launched in the UK is the Sony Betamax system. The basic specification and format are derived from the original Betamax system I, which Sony launched in the USA some two and a half years ago. Although superficially similar to the JVC VHS system (see *Television,* August 1978) and offering similar facilities, the Betamax machine is incompatible with the VHS format VCRs.

The Betamax system offers a maximum recording time of 3 hours 15 minutes. The VCR itself has a built in u.h.f. tuner and modulator, the latter to provide a signal for feeding to the aerial socket of a TV set, a digital clock giving timed switch-on up to three days in advance, video input/output and audio input/output sockets, and most of the features found on rival European and Japanese VCRs. Unique features include a special u.h.f. tuning facility: the VCR provides a test pattern which simplifies the tuning of the colour receiver to the same frequency as the VCR modulator. A remote pause control is also supplied as standard. This enables brief commercials etc. to be deleted. The digital counter also has a memory facility which, if selected, will stop the VCR when it reaches "0000". An automatic circuit is incorporated to cope with both monochrome and colour signals, either off-air or from a video camera.



General view of the Sony Betamax VCR. Note timer setting switches on the left and tuning controls under flap at right.



Close up view of the video drum and tape path. Tape threaded.

Specification

The specification is again similar to its rivals, being based on a two-head helical-scan video system. The built-in tuner has eight presettable channels, covering the entire u.h.f. band. The modulator output can be adjusted between channels 30-39.

The horizontal resolution is 270 lines, and Sony claim a signal-to-noise ratio of 42dB. On test, a figure of 44dB was obtained. The audio response was measured and found to be100-5,000Hz ± 3dB, with a signal-to-noise ratio of 41dB. Total harmonic distortion was found to be about 5% at 1kHz.

These specifications are quite remarkable, especially when one remembers that the tape is running at only 18·73mm/sec, or less than $\frac{3}{4}$in./sec. The use of CMOS and low-current TTL i.c.s results in the low power consumption of about 80W.

Cassettes giving four different playing times are available – all are about the size of a small paperback book. They are designated L-125, L-250, L-500 and L-750, giving playing times of half an hour, one hour five minutes, two hours ten minutes and three hours fifteen minutes respectively. I'd be pleased if someone could explain why these designations were chosen to indicate these playing times!

Controls

Besides the memory control linked to the digital tape counter, the SL8000UB VCR has the usual set of fast forward, rewind, play, record, pause and eject piano-type keys. The record control acts on its own and does not have to be used in conjunction with the play control. A click-stop tracking control is situated on the front panel, at the left-hand side, and is intended to ensure compatability between different Betamax machines. In practice I've found I haven't had to use it. The pause control is linked to a timing circuit to prevent tape damage: if the pause control is operated for longer than about three minutes, the VCR reverts to either play or record as previously selected.

An input select control on the front panel switches between video input and off-air signals. The switch for the test pattern is on the rear panel, along with the video and audio input/output sockets, the mains socket and voltage selector.

The digital clock's controls are under a panel on the front left: the TV channel selectors are under a similar panel on the right. There's a facility to stop an unattended recording after 15, 30, 45, 60, 75, 90 or 105 minutes. If this is not used, the VCR switches itself off about 30 seconds after the tape has run out.

Mechanics

Mechanically, the Betamax VCR shows its U-matic (the

Sony professional VCR format) parentage. A robust metal chassis and generally accessible circuit boards are neatly housed in the grey plastic case. The tape wrap, i.e. the way the tape is wrapped around the video head drum, is essentially a U-format one – very similar to that used in professional U-matics. The tape remains laced up during fast forward and rewind.

Electronics

The video tracks are laid down on the tape using the slant azimuth system. This means that as in the VHS and Philips VCR-LP formats there's no guard band between adjacent video tracks, the video heads being tilted with respect to each other to minimise cross-talk between tracks. In effect, if the "wrong" head reads information it's effectively out of phase and thus there's no output.

The electronics are on eight main circuit boards as follows: (1) YC-E, containing the luminance and chrominance record/playback circuits. (2) RF-1, containing the r.f. record/playback amplifiers. (3) AS-1, containing the record/playback servo and audio record/playback circuits. (4) SY-1, the system control board, including remote pause. (5) IF-2, containing the vision i.f., sound i.f. and a.f.c. circuits and a d.c. to d.c. converter. (6) PT1 and PT2, containing the digital timer circuits. (7) PS1, the 12V supply. (8) The 10V and –20V supply board. Extensive use of i.c.s is made throughout, resulting in both low current consumption and easy setting up.

As is usual with domestic helical-scan VCRs, the colour information is not recorded as a composite video signal but on a low-frequency (688kHz in this case) carrier instead. Due to the very low tape speed, several sophisticated pre-emphasis and noise-correcting circuits are used to ensure satisfactory picture quality. More details of these will appear in a later article.

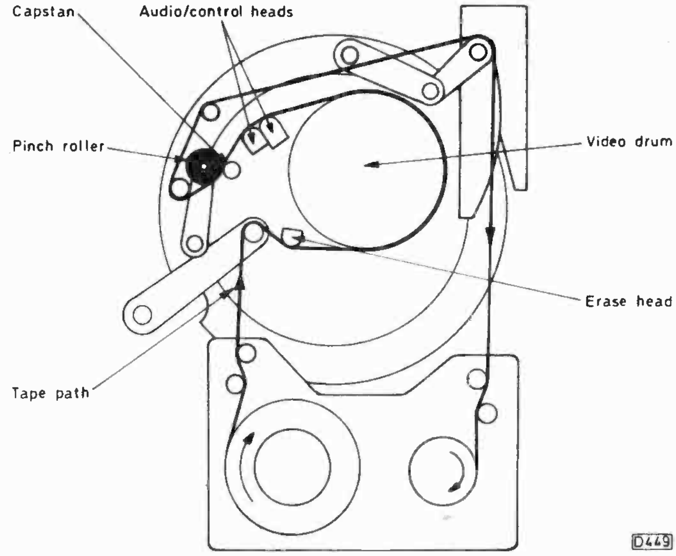
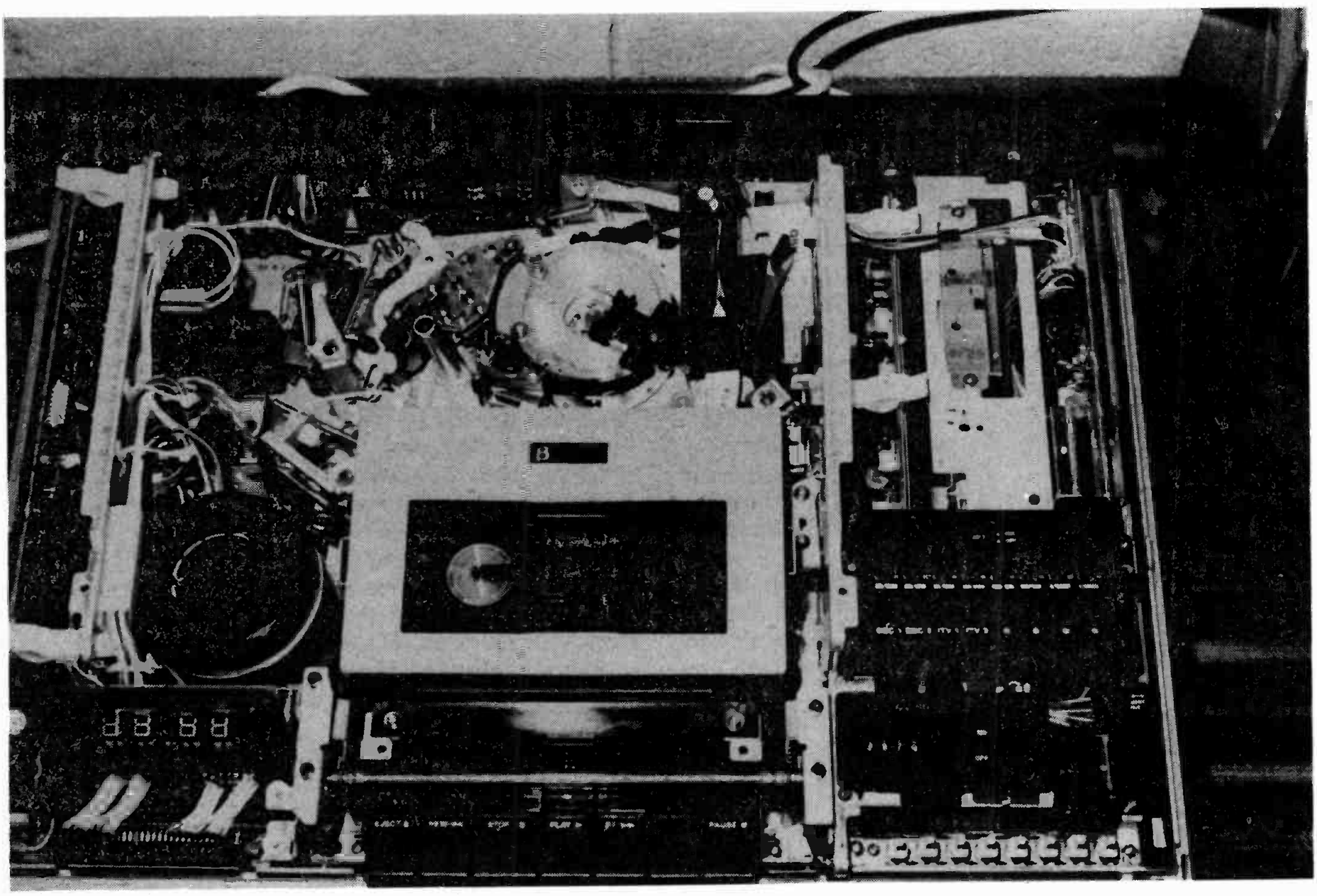


Fig. 1: Showing the tape path from the cassette to the video head drum and back again.

Conclusion

The arrival of the VHS machine forced Sony to advance their intended launch of the Betamax system in the UK market by about three months. For the average domestic user we feel that there's little to choose between the two formats, though the Sony one does provide a longer playing time and slightly reduced tape cost per minute playing time. ■



The interior of Sony Betamax VCR.

Miller's Miscellany

Chas E. Miller

Return of an Old Favourite

It's some years now since I wrote several pieces on the various field timebase faults which at that time bedevilled the Thorn 1500 chassis, and I must admit that I've had little trouble in this respect lately. Until last week, that is, when a trade customer asked me to look at a new set with no field scan and no response to a new PCL805. Sure enough there was a single bright line across the screen, but at the same time the timebase was audibly working. This was confirmed immediately with the scope. Casting my mind back to previous experiences, I resoldered the tags on the secondary of the field output transformer and was rewarded with full scan. This lasted for only a few minutes however before the scan again collapsed, then becoming "tap-worthy". I eventually discovered that the leadout of the transformer was broken just at the point (well hidden) where it was wrapped around its tag. Contact must have been made by only the tiny, bare end brushing on the surface of the tag – presumably long enough for the set to have passed its initial tests. It was a pig of a fault to find, and I'm only glad for my customer's sake that it showed up before he sold the set!

And Another

Curiously enough, another version of an odd fault which I wrote about some years ago also came my way recently. If you've a long memory you may recall my tale of a Rank v.h.f. tuner unit that would work with only one particular PCC89 – the one originally fitted. No other one would do anything at all and nobody, not even Rank themselves, ever came up with a really satisfactory answer. Well, whilst checking out a bunch of part-exchanges I picked up a similar set, which I assumed to be a dual-standard model. It wasn't until I'd put it on the bench that I realised I'd been fooled by the dummy push-buttons which Rank used to fit at the time these sets first appeared, to disguise the lack of a u.h.f. tuner unit. Although this made the set worth very little, just for the hell of it I plugged it in to see what would happen. Anyway, 405-line only sets still sell at auctions to the stray person who lives in a really bad u.h.f. reception area.

There was the usual long wait for the line timebase to get going and then, much to my surprise, a good bright raster. I don't have a proper v.h.f. aerial in my workshop, but rely on the remains of an old loft aerial to cater for the few occasions when one is called for. I'm in an excellent signal strength area however, and was rather disappointed to get only a weak, grainy picture. Although the age of the set didn't really warrant spending anything on it, I thought I might change the PCC89, if only to rid myself of one of the obsolete valves which have been hanging around on my shelves for years. To my astonishment, I found that someone in the past had fitted another PCF86, in addition to the one used in the frequency changer stage, and to judge from the amount of dust the set had been working for a long time with the incorrect valve. In fact the set had got so used to having a PCF86 r.f. amplifier that it refused to have anything to do with a PCC89 – the latter producing not even a trace of picture! I decided to let this one go without further investigation, even though a quick glance at the valve base diagrams suggested that there must have been an almighty burn-up of resistors when the "repair" was done. Maybe that engineer had no sense of smell!

In Check

We know, don't we, that if someone in a TV studio is wearing a checked coat or dress, the outfit will produce strange colour effects which often have to be explained to customers. Why don't the TV companies know this? Also, we know that if a green wallpaper is used in a setting for a play, any characters close to it will have the colour reflected upon their faces, which again causes enquiries from viewers. Why don't the TV companies seem to be aware of these effects and eliminate them?

Warts and All

There have been some really informative series of articles appearing of late to introduce the beginner to the technical mysteries of TV servicing. Excellent as these are however, there are aspects of our profession that seldom receive the attention of instructors. To redress the balance, M.M. proudly presents its own *Guide to Coarse TV Servicing:*

Ike Hodge is the proprietor of a small TV workshop. By his own admission, he started out at the bottom of the ladder some 20 years ago and has since worked himself down. His assistant, Willy, is fresh from the local college of further education. Knowledgeable technically, he has a lot to learn yet about the practical side of service work. Now read on....

The start of a new week and the workshop was crowded with TVs, many of them repaired.

"Can't we get rid of some of these?" pleaded Willy, tired of climbing over them.

"What day is it?" demanded Ike.

"Monday of course. Why?"

Ike sighed. "I know you're a fully qualified engineer – you must be, you say "field" instead of "frame" – but when will you learn the important things? Like pension day Tuesday, pay day Thursday. You take sets back on those two days, late enough for the punters to have drawn their cash, but not late enough for them to have wasted it on things like the rent or food. You collect sets on Mondays, Wednesdays and Fridays."

"What about Saturdays?"

"Saturday afternoons are all right for taking back too. The punters are so relieved about not being without their sets for the weekend, and the prospect of actually having to face talking to their wives, that they quite often hand over a tip." Ike frowned. "All the same, we could do with some room. Tell you what, let's take the old 25in. colour set back to Major Snodgrass. He won't pay until the end of the month, so it doesn't matter what day we take it. Then we'll do some service calls."

They loaded Snodgrass's set into the van and set off. Ike let Willy drive, so that he could make out the bill as they travelled. When they installed the set, Willy couldn't help but notice that the convergence was far from perfect, but he had learned by bitter experience that Ike would not thank him for commenting on it. The latter ran the set for only a few minutes, studiously avoiding BBC-1 which was showing the test card, before saying briskly:

"That's all right now. You don't want it left on, do you?" Before the Major could answer, he switched off. Moments later he and Willy were back in the van. Willy started to sort through the job cards to discover what would be their next call, but Ike stopped him sharply.

"Blimey, how many times do I have to tell you? The first priority when you leave a house is the escape – before the punter can find something wrong and call you back to adjust it. Most times they won't bother to call in or phone if they can't get you there and then, and it saves a lot of time and trouble. So get started and we'll decide where we're going when we get around the corner, out of sight."

"The convergence was a bit out on that set wasn't it?" ventured Willy.

"Of course it was. You couldn't converge those sets properly when they were new, let alone now they're ten years old. Why do you think I kept off the test card? The picture's not too bad in the middle, but any straight lines at the sides look like medal ribbons." He chuckled. "Snodgrass ought to appreciate that, being a military man, but I didn't want to risk it."

The next call was at a block of old people's flats. Mrs. Stanton was a frail looking white haired lady who had known Ike for many years.

"The picture's gone very dark" she said as she led them into her front room. From switching the set on, an elderly dual-standard 19in. receiver, it took some five minutes for anything at all to appear on the screen. When Ike turned up the brightness the images flared and went completely out of focus. Will pursed his lips. He knew a clapped-out tube when he saw one.

"Cor, that tu-" he began, to be silenced by a kick on the ankle from Ike, who continued to gaze thoughtfully at the screen.

"Needs a bit of adjustment" he told Mrs. Stanton. "Can't do it here though, it'll have to go into the workshop. We'll try and get it back to you tomorrow." The old lady looked pleased and relieved.

"Why wouldn't you let me tell her it was the tube?" asked Willy resentfully when they were in the van once more. "It is, isn't it?" He rubbed his ankle ruefully.

"Never seen one more gone. Shorted heaters, I should think. Point is, if you'd told the old dear she'd have had a fit. She'd never be able to afford a new one, and she's the type that's too proud to accept charity. When we get back you can rob the tube out of one of those old sets at the back of the workshop and stick it in hers. We'll charge her a couple of quid for a service call, and she'll be none the wiser."

Willy was surprised. "You won't make much profit on that."

"We'll make it up from someone who can afford it. Such as this next so-and-so for instance."

"Who's that?"

"Bloke by the name of Jones. Thinks he knows it all. A real solid, 22 carat, 18 jewel twit. I bet you he's done something stupid."

But even he wasn't prepared for what Jones had to tell them.

"The picture went all blurred, so I adjusted all those little knobs. That only made it worse."

"What little knobs?" asked Ike, suspiciously.

"Those on the small panel at the back – yes, those," as Ike pointed to the convergence board. By this time the set had warmed up and there was a jumble of three separate colour pictures on the screen.

"You've really mucked it up this time" said Ike dispassionately. "We can sort it out, but it'll be expensive."

Jones' face fell "How expensive?"

"I dunno exactly – but expensive."

"Well, if it's going to be over £20 let me know. Otherwise get on with it. I don't want to miss the big match on Thursday."

Ike made a non-commital answer. He and Willy lumped the set out to the van.

"What did I tell you" said Ike later. "Probably all it was to start with was the ten meg resistor in series with the focus control gone high. We'll have to hammer him regardless – it's the only way to dissuade him from mucking about with it again."

To be continued.

Square Valve in a Round Hole

Have you seen the new solid-state PL802? It consists of two transistors and a few components, with a resistor to take the place of the valve heater, mounted on a small printed panel with a square-U section heatsink. The makers claim slightly better performance than the thermionic original, and it's repairable or course! I was so impressed that I bought some at once, and it was typically my luck that the first set to need one was an old type Kuba. The PL802 holder in this is virtually out of sight, and it took some while to discover that it has a deep metal skirt which proved the truth of the old saying that you can't get a round peg in a square hole!

Postscript

My sincere thanks to all the readers who sent me letters and gen on the Toshiba TH9013P integrated circuits. I'll try to reply to you all personally, but this could take a little while. Thanks also for other letters, whether praising or criticising – I read them all with great interest. Same remarks apply re. replies!

STATION OPENINGS

The following relay stations are now in operation:

Balblair Wood (Highland) BBC-1 ch. 55, Grampian Television ch. 59, BBC-2 ch. 62. Receiving aerial group C/D.

Croyde (North Devon) Westward Television ch. 41, BBC-2 ch. 44, BBC-1 ch. 51. Receiving aerial group B.

Hutton (Avon) HTV West ch. 39, BBC-1 ch. 49, BBC-2 ch. 66. Use a group E or other special wideband aerial. In view of the unusually wide channel spacing, extra care with aerial installation may be needed.

Lairg (Highland) Grampian Television ch. 41, BBC-2 ch. 44, BBC-1 ch. 51. Receiving aerial group B.

Little Walsingham (Norfolk) Anglia Television ch. 41, BBC-2 ch. 44, BBC-1 ch. 51. Receiving aerial group B.

Penifiler (Skye) BBC-1 ch. 39, BBC-2 ch. 45, Grampian Television ch. 49. Receiving aerial group B.

Rheola (Glamorgan) BBC-Wales ch. 55, HTV Wales ch. 59, BBC-2 ch. 62. Receiving aerial group C/D.

St. Helier (Jersey) BBC-1 ch. 55, Channel Television ch. 59, BBC-2 ch. 62. Receiving aerial group C/D.

Spean Bridge (Highland) BBC-1 ch. 21, Scottish Television ch. 24, BBC-2 ch. 27. Receiving aerial group A.

Tomintoul (NE Scotland) BBC-1 ch. 40, Grampian Television ch. 43, BBC-2 ch. 46. Receiving aerial group B.

All the above transmissions are vertically polarised.

FET Meter Adaptor

Use of an f.e.t. to provide increased meter input impedance

John Law

THE quality of a voltmeter is judged by the current it draws from the circuit under test: in general, the lower the current taken the better the meter. The load which the meter imposes on the circuit being tested is determined by the power required to deflect the pointer across the dial to give full scale deflection (f.s.d.). Meters giving an f.s.d. for only 50μA are in common use today, two popular examples being the Avo Model 8 and the Philips UTS 001. The sensitivity of such meters is quoted as 20kΩ per volt, since from Ohm's Law 50μA flowing through a 20kΩ resistor in series with the meter movement gives an f.s.d. voltage reading of 1V. It will be appreciated from this that proportionate increases in the value of the series resistor will enable higher voltages to be measured, e.g. 2V will be registered with 40kΩ in series with the meter's movement and 5V with 100kΩ in series, in both cases at f.s.d. with 50μA flowing. Conversely, if only half the voltage is present in the circuit under test the meter's needle will register only half f.s.d. and consume 25μA.

Connecting a voltmeter across a circuit is the equivalent of connecting a resistor in parallel with the circuit. The meter takes power from the circuit, and imposes a load on it. The power drain is insignificant when the normal current flowing in the circuit is greater than one hundred times the meter's f.s.d. current – more than 5mA when measured with a meter having a 50μA movement – and fortunately most voltage checks required in TV sets, radio receivers etc. are on circuits where the current flow is sufficient to allow accurate measurements to be made.

There are occasions however where the use of a voltmeter results in quite meaningless readings. For example, in an a.g.c. circuit where a few microamperes are flowing through resistors in the megohms range, a 20kΩ/V meter will be unable to obtain sufficient current to register an accurate reading. Similar problems occur where voltage measurements are attempted in low operating current circuits such as audio amplifier stages using silicon transistors.

Take for example an amplifier circuit using a low-level, low-noise silicon transistor such as a BC109. The base voltage may by only 0·5V and the current flowing a couple of microamperes. A 20kΩ/V meter connected across this circuit will draw more power from the circuit than the amplifier transistor itself is taking.

To read accurate voltages in such cases the meter used must have a very high input impedance, i.e. its sensitivity must be very much higher, and amplification must be provided so that the minute voltages present can be raised to a level giving an accurate and meaningful reading. What we require in other words is an electronic voltmeter.

The use of a field effect transistor overcomes the low input impedance problem of a standard 20kΩ/V meter, since such transistors have an extremely high input impedance and in consequence impose a very low power demand on the circuit being tested. In addition, the amplification provided by the f.e.t. enables minute voltages to be built up to give accurate, easily read figures on the scale.

Circuit Description

The electronic voltmeter design shown in Fig. 1 uses a 2N3819 f.e.t. in a simple, well tried circuit. The input consists of a simple potential divider switch giving selection of three voltage ranges; a 9V PP3 battery will keep the meter going for months under normal workshop conditions. The input impedance is around 10MΩ, giving a sensitivity of 10MΩ on the 0-1V range, 1MΩ on the 0-10V range and 100kΩ on the 0-100V range.

The circuit is a bridge design, the transistor and its source resistor R6 forming one half of the bridge while VR2 with R8 and R9 form the other half. The preset VR2 is adjusted to balance the bridge, so that with the voltage at its slider equal to that across R6 and no input the meter reads zero. An external voltage will increase the conduction of Tr1 and the voltage across R6, unbalancing the bridge so that a meter reading is obtained. The degree of unbalance is proportional to the applied voltage, enabling the meter to be calibrated to show true voltage readings. VR1 is set to give the basic sensitivity of 1V f.s.d.

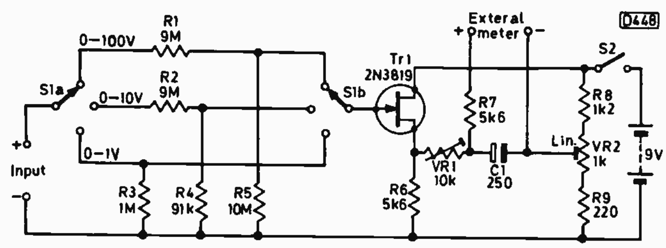


Fig. 1: The f.e.t. meter adaptor circuit. The f.e.t. is a junction-gate type operating in the depletion mode, i.e. reducing the gate-source bias increases the current flowing through it. It's connected as a source-follower, forming part of a bridge circuit with R6, R8, VR2 and R9. Being an n-channel f.e.t., Tr1's gate must be biased negatively with respect to its source: the bias is provided by R6 which develops a positive source bias voltage. Applying a positive input voltage to the gate reduces the bias therefore, the increased current flowing through R6 unbalancing the bridge arrangement.

CORRECTION

We regret that a resistor was omitted from the 625-line receiver circuit shown on pages 140-1 last month. There should be a 100kΩ resistor from pin 9 (triode grid) of the ECH84 to chassis.

On the 0-10V range the ratio of R2 to R4 reduces the sensitivity to the correct level, R1 and R5 providing the same action on the 0-100V range. The meter's accuracy depends mainly on the values of R1-R5. Using 5% or 10% types will not give adequate accuracy: it's much better to spend some time with an ohmmeter and a box of $\frac{1}{2}$W preferred-value resistors, when selection to a tolerance of around 2% should be possible. You may have to connect a chain of two or more resistors between the tags of the range selector switch S1 on each of the three ranges. For example, the value of R2, 9MΩ, is not readily available: it can be assembled using a 3·3MΩ, 2·7MΩ and two 1·5MΩ resistors in series. Care and patience are required in obtaining the nearest value to that specified, but the result can be a meter of nearly professional accuracy.

The 250μF capacitor C1 across the output terminals provides a degree of meter damping: it may not be required with every meter.

Setting Up and Use

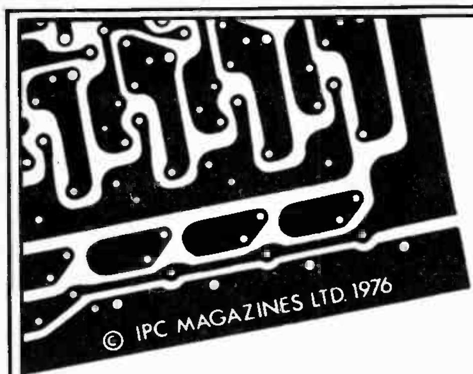
The meter can be self contained, with its own movement, or can be used as an electronic extension in conjunction with the normal workshop Avo 8 or similar meter. In use, switch the Avo 8 to the 0-1V range – the meter is already calibrated to read 0-100, matching the three selected ranges of the f.e.t. adaptor circuit.

Before connecting the Avo meter to the output terminals, turn VR1 and VR2 fully anticlockwise. Then check the battery voltage to see what it is exactly (Avo meter on 10V range). Connect the Avo (or other meter) leads to the output terminals, observing correct polarity, and set the meter to zero with VR2 (Avo on 0-1V range). Next switch the unit to its 0-10V range and, with the positive test probe connected to the battery's positive terminal, adjust VR1 for a reading identical to that noted when the battery voltage was previously measured using the Avo meter alone. The unit is now ready for use on all three ranges. Zero the meter with VR2 before taking voltage readings.

The range selector assembly consists of a three-way, two-pole wafer switch with resistors R1-R5 wired between the tags as previously mentioned. A simple toggle on/off switch is connected in series with the battery's positive terminal.

With no input, the unit consumes a standing current of 500μA, rising to about 8mA in operation. This gives some months' life from a PP3 9V battery, depending on how often the meter is used.

Most service manuals quote operating voltages as measured using a 20kΩ/V meter. The Avo 8 can be used as the standard test meter therefore, with the f.e.t. adaptor used for checking a.g.c. circuits and voltages in transistor circuitry, in particular where a low-voltage reading in a low-current circuit is required. ■



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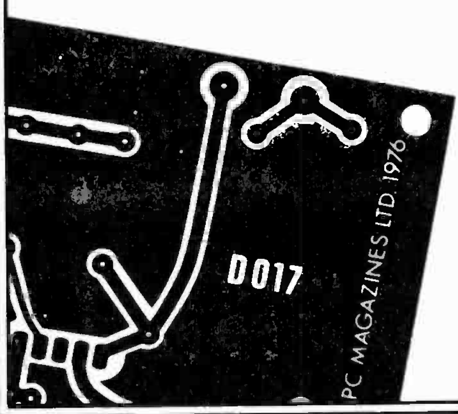

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The Pye/Philips TX Chassis

Harold Peters and Dave Adams

In these days when so much of UK industry has been infiltrated or come to be dominated by Far Eastern manufacturers, it's heartening to be able to relate a successful attempt to reverse the flow. A simple 12in. mains/battery monochrome portable, known as the TX chassis, is being made in the UK by the Philips/Pye group to compete in performance, appearance, price and reliability with its Japanese competition. How this came about is a story in itself, but our purpose here is to describe some of the technical features. The circuit is quite simple, but there are some unexpected bits here and there.

The chassis has one main printed board, with the tuning controls and switches on another small board. There are six pushbuttons for programme selection, an improvement on the conventional two-speed continuously variable tuning knob found on the majority of oriental sets. The power consumed is 27W from the mains, or 15W when run from a 12V battery. Access to the chassis for servicing simply involves removal of the back, pulling off the three front knobs, slackening the cable ties and sliding out the chassis. It can then be turned to stand on the power regulator heatsink, when it can be worked on from both sides.

Signal Circuits

An ELC2003 tuner unit was initially used, but this has since been replaced by the U321 fitted to the current range of Philips/Pye G11 chassis colour receivers. These two tuners are not directly compatible, and replacements must be of the same type therefore. The usual 33V tuning supply is conventionally stabilised by a TAA550 supplied from the 90V line. There's no a.f.c. The i.f. amplifier consists of a conventional flatly-tuned three-stage (discrete component circuitry) amplifier, which is preceded by a box of traps to set the bandpass response. Demodulation is by means of a simple OA90 diode envelope detector.

Apart from the TAA550 33V stabiliser already mentioned, the TBA120AS intercarrier sound i.c. is the only chip in the set. The intercarrier sound signal tapped from the OA90 demodulator circuit is peaked by S251 (S for spoel in case you'd ever wondered!), while the BC338/BC328 complementary-symmetry audio output circuit is as simple as they come. Frequency-selective negative feedback for tone compensation is taken to pin 4 of the i.c., where it modifies the response of the a.f. section within the chip.

Video Circuit

The output from the diode demodulator consists of positive-going video and negative-going sync pulses. This is fed to a pnp emitter-follower (TS350, BC558) which drives the BF442 video output transistor and the sync separator and a.g.c. circuits. The c.r.t.'s video drive is applied to its cathode, via a conventional diode/capacitor beam limiter circuit. Brightness control is effected in the c.r.t.'s grid circuit, and switch-off spot suppression is also effected at this point. As the supplies fall at switch off, so the bias on the tube is removed. Grid current flows, cutting off D570 (see Fig. 1) and charging C571 negatively. The tube is thus biased off again, preventing the appearance of a switch-off spot. Field flyback blanking is done in the video output transistor's emitter circuit.

AGC System

A sync tip a.g.c. system is used, the amplitude of the sync tips corresponding to peak carrier amplitude. The negative-going sync pulses at the emitter of the video emitter-follower are peak rectified by a BAW62 diode, charging an 0·0047μF reservoir capacitor. After amplification and inversion by a common-emitter d.c. amplifier, the a.g.c. voltage is used to bias the base of the first i.f. amplifier transistor – the action is forward a.g.c. The control is also applied to the second i.f. amplifier transistor – by biasing this from the emitter of the first i.f. amplifier transistor.

Forward a.g.c. lowers the collector voltage of the first i.f. amplifier transistor with increasing signal, so that more signal is wasted across the collector feed resistor than is developed across the tuning coil. With very strong signals, control would run out and lock-out would occur. To prevent this, one of the collector feed resistors is a potentiometer whose slider feeds the base of a d.c. amplifier transistor which is normally cut off. On very strong signals this transistor begins to conduct, applying a.g.c. to the tuner.

Sync Circuitry

Since the sync pulses at the emitter of the video driver are negative-going, a pnp sync separator is used, producing positive-going sync pulses at its collector. The field sync pulses go through a two-stage integrating network to the field oscillator, while the line sync pulses are differentiated (C380/R383), clipped (D380) and fed to the base of the flywheel sync detector transistor TS380 – see Fig. 2. Line flyback pulses from the line output transformer are integrated by R385/C381 to produce a 10V peak-to-peak reference sawtooth waveform which is fed to the emitter of this transistor. TS380 is cut off for most of the time, conducting briefly when the line sync pulse arrives at its base. The collector voltage at this point depends on the coincidence between the line sync pulse and the reference sawtooth, the output being filtered (more integration) and applied to the base of an emitter-follower connected across the lower resistor in the line hold control resistor network.

Line Timebase

Unusually, the line oscillator consists of an emitter-coupled multivibrator. The squarewave output from this is passed to a BC337 driver transistor and then to the now standard BU407 line output transistor. The supplies

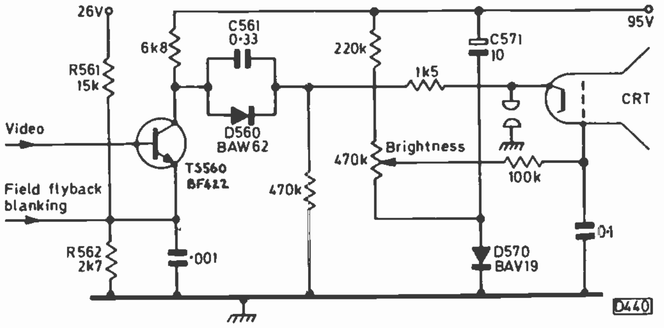

Fig. 1: The tube drive circuitry, including the beam limiter and switch-off spot suppression arrangements.

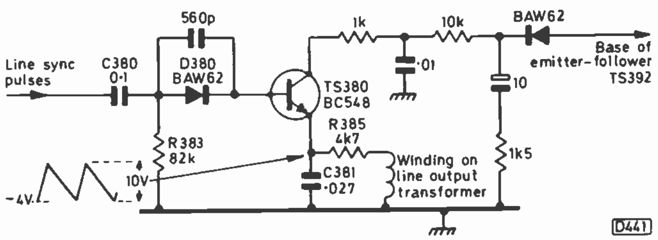

Fig. 2: The transistor flywheel sync discriminator circuit.

obtained from the line output transformer consist of a 26V boost rail, 9·5kV e.h.t., a 95V supply for the video output transistor and tuning system, and a 350V supply for the first anode of the c.r.t. There's no scan correction, the large 47μF electrolytic in series with the line scan coils simply providing a d.c. block.

Field Timebase

Perhaps the most unusual section of the whole set is the field oscillator circuit, which is shown in Fig. 3. Basically, the sawtooth is produced by C503 charging from the 26V boost rail via R507, TS505 being included to act as a constant-current source, thereby linearising the sawtooth. The base of TS505 is set at about 8V by the potential divider R502/R504. When, under the free-running condition, the sawtooth at TS505's emitter rises to this voltage TS505 cuts off. Its collector voltage then rises, switching on the pnp transistor TS509. This then switches TS515 on to discharge C503. The negative-going pulse at the collector of TS515 is coupled back to the base of TS509 to provide regenerative action. The field sync pulses are used to trigger TS509 just prior to the natural free-running time of the circuit.

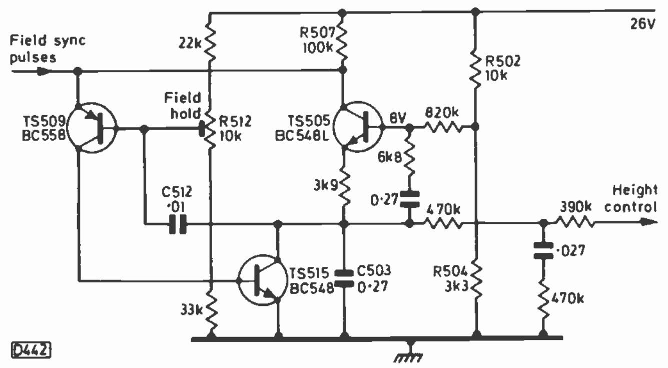

Fig. 3: The unusual field oscillator circuit.

The resultant waveform is shaped and fed to the height control network, which includes a thermistor to keep the height constant with changes of temperature. The following inverter, driver and complementary-symmetry output stages are conventional.

Power Supply Circuit

The mains supply is permanently connected to the mains transformer, the on/off switch being connected in series with the output from the bridge rectifier (see Fig. 4). One of the diodes in the bridge circuit, D110, also serves to provide protection against reverse battery connection – at the expense of 0·7V. Mains/battery switching is by plugging in the battery lead.

The 15·3V output developed across the reservoir capacitor C112 is fed to a fairly conventional series voltage stabiliser circuit, though it's interesting to note that the error detector transistor TS112 samples the boost voltage rather than the main 10·8V line. An additional zener-diode controlled series stabiliser transistor (TS113) delivers the low-current 11·3V supply to the tuner unit (there's no point in stabilising the tuning voltage if the l.t. supply to the tuner wanders up and down!).

Over-voltage protection is built in, since a sudden rise in the boost voltage will cut off TS112, which will in turn shut down TS111 and the series regulator transistor TS110, thus removing all the supply rails.

Later versions have two extra diodes to provide added over-voltage protection. These shut the 10·8V line off in the event of line scan failure. Otherwise, the 10·8V line would go up to 16V, unregulated, which wouldn't do the c.r.t. much good – its heater is connected between the 10·8V line and chassis. ■

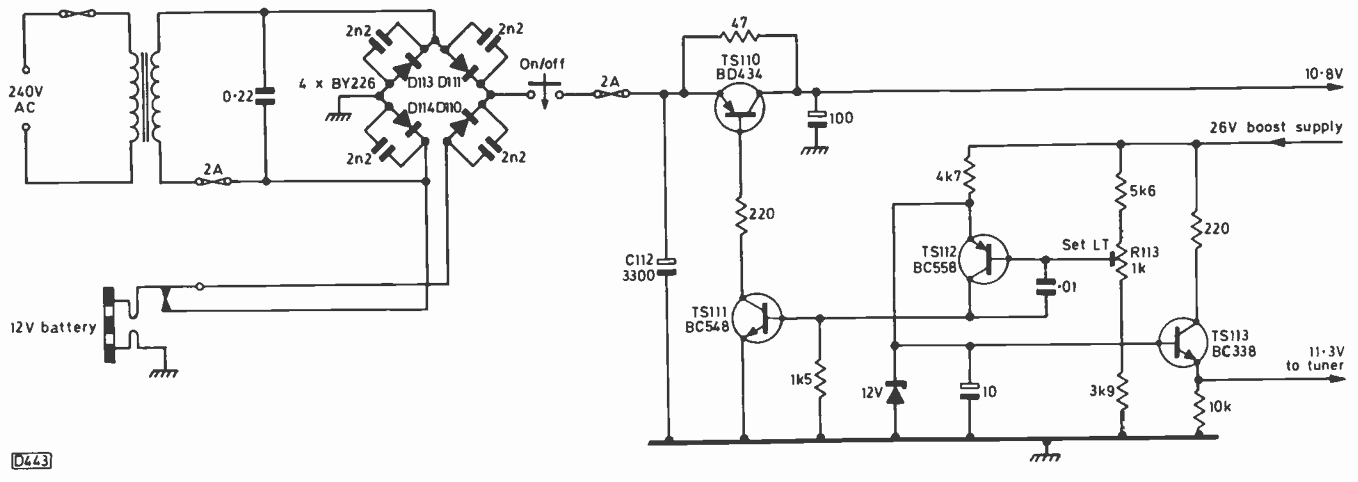

Fig. 4: The regulated power supply circuit. In later versions, a couple of series-connected diodes have been added between the boost rail and the slider of R113 to protect the tube heater in the event of line scan failure.

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GEC 2040 SERIES

The problem is loss of brightness control: the picture is displayed at full brilliance, with the brightness control having little or no effect.

Check the PL802 luminance output valve and its anode circuit: there should be 175V at pin 7 (anode). If all's well here, move to the brightness control circuit, which is linked to the PL802's control grid. The brightness control is slung between positive and negative l.t. supplies: there should be between −2V and −5V at its wiper. The beam limiter transistor TR535 is also associated with this circuit, and there should be 2·7V at its emitter. If the fault lies here, check the transistor and if necessary the associated components. We assume that the c.r.t. first anode voltages are correct: the voltage at the wipers of the presets should be adjustable between 275V-710V.

GRUNDIG 5011

The trouble is pincushion distortion at the top and bottom. No amount of resoldering or component checking seems to make any difference. The coils associated with the north-sound pincushion distortion correction transductor appear to be healthy, but adjusting the slugs has no effect. Incidentally, cutout tripping has been cured by replacing Di504 and R504 in the width stabilisation circuit.

The fact that there's field scan means that the field winding on the transductor must be intact. It appears therefore that the links (f and h) to the line output transformer are not making proper contact. Dry-joints are not unusual on this chassis, and we suspect that you will find one in the links between the line output transformer and the transductor.

WALTHAM W125

When the set has been on for about twenty minutes, an effect like sound on vision appears: then the line tears occasionally and the field trips. There's also buzz on sound, but this is not noticeable with the volume at minimum. Checks around the sync separator have been tried without success. The initial trouble with the set was a faulty line output transformer, but after replacement the trouble outlined above persisted.

We suggest you replace the PCL84 valve which could have heater-cathode leakage. The triode section of this valve acts as a gated a.g.c. stage: note the effect of setting R130 in the grid circuit to both extremes of its travel, since it could have a dud spot. If necessary, check the a.g.c. amplifier transistor T104 and the associated components, particularly the a.g.c. smoothing electrolytic C127 (2·2μF).

PYE 697 CHASSIS

There are field flyback lines on the screen. The blanking circuit in the PL802's cathode circuit has been checked to no avail. Also the brightness keeps varying every minute or so. The variations are less frequent when the set's been on for a few hours.

Field flyback lines will always be present to a little extent, though careful adjustment of the field output stage bias potentiometer RV24 should reduce them to a minimum. Brightness variations are usually due to faulty edge connectors, since half the brightness and beam limiter circuits are on the front control panel and the remainder on the line timebase board. Also check the 12·5μF reversible electrolytic C201 on the front control panel if necessary, and the clamp diode D39A.

SONY KB1810UB

The 2·5AT mains fuse F601 keeps blowing. The last time this occurred, smoke appeared to come from the c.r.t. base connector. Could the trouble be due to tracking here?

It's unlikely that tracking on the c.r.t. base panel could blow the fuse violently. We suspect that the smoke is coming from R607 and R608 on the power panel below the c.r.t. neck, in which case the following devices (gate-controlled switches) should be checked and replaced as necessary: the starter and regulator GCSs Q602 (SG609) and Q603 (SG608), and the line output GCS Q510 (SG608). The later equivalent of the SG608 is the SG613. As these devices are rather expensive, it would be best to start the set up gently after the repair, using a variac. You should see something on the screen at an r.m.s. mains input of 80V.

DISPLACED COLOUR

The colour is good but is tranposed somewhat to the right of objects, accompanied by slight ringing. The fault is most evident on BBC-2, being only very slight on the other channels. I assume that the fault could be in the luminance delay line circuit, but in that case why isn't it equally present on all channels?

This type of fault cannot normally occur in a receiver unless the i.f. alignment or the delay-line circuit has been altered. As neither presumably applies, it's almost certain that the problem is due to the aerial, confirmed by the fact that it's mainly present on one channel. It may not be necessary to install a different aerial: resiting the present one may well do the trick. Ensure that it's of the correct group, mounted in the correct plane and pointing at the transmitter.

THORN 1590 CHASSIS

The trouble with this set is field roll. The supply lines and a number of other voltages have been checked, but everything seems to be roughly right.

The first thing to check is the 3·3MΩ resistor R41 which biases the base of the sync separator transistor. If this is in order, try checking the field sync isolating diode W16. Alternatively the problem could be due to the field sync waveform being crushed in the video or i.f. stages. Check C36 which smooths the bias applied to the base of the video driver transistor, the a.g.c. reservoir capacitor C2, the a.g.c.

amplifier's emitter decoupling capacitor C1, and the a.g.c. smoothing capacitor C17: also ensure that the preset contrast control is not misadjusted. If all is well here, check the field oscillator transistors VT14/15 by substitution.

DECCA 30 SERIES CHASSIS

The trouble with this set is that the h.t. rectifier diode and the associated 3·9Ω surge limiter resistor keep going open-circuit – it's happened three times in four months. Twice this happened when the set was switched on: the 2A mains fuse also blew on these occasions. On the other occasion the set had been on for a quarter of an hour.

There may be different causes for the fault. A likely cause for its occurrence at switch on is that the line oscillator is slow to start up, the line output stage then drawing excessive current. The coupling capacitor C427 in the line oscillator stage is suspect in this event. We assume that a BY127 is being used as a replacement. If so, random occurrence of the fault could be due to its protection capacitor C603 being defective, or a fault in the h.t. reservoir capacitor C602. It's possible that your mains supply is full of spiky transients, in which case the GPO or the Electricity Board may be able to assist.

THORN 9000 CHASSIS

The trouble with this set is that R725 and R735 have overheated to such an extent that the values cannot be read, while fuse F4 has blown.

It's difficult to relate these faults, unless the thick film unit has failed with the result that the trip circuit is not operating. R725 (180kΩ) simply forward biases the beam limiter diode W722. F4 protects the 24V supply to the field timebase and, via R735 (3·9Ω), the signals panel. Either of the two decoupling electrolytics C171 and C196 on the signals panel could be leaking. If C196 is a tantalum type it should be changed to an aluminium type. The voltage at F4 can rise excessively if there's a fault in the field timebase: in this event, connect a 120Ω 5W resistor from F4 to chassis and check the field timebase circuit.

PYE 175 (PHILIPS TS7 CHASSIS)

The 10·8V supply from the regulator is present, and the c.r.t. heater lights up, but there are no h.t. supplies, which I take it are derived from the line output stage. The diodes around the line output stage have been checked but seem to be o.k., and I now suspect either the 2SC901A line output transistor (? suitable replacement) or the line output transformer.

The line output transistor is driven by TS28 (BC327). First ensure that this is being supplied (10V at its emitter), and that it's being turned on by the preceding oscillator transistor TS27 (BC407). If these stages are working, unload the line output transformer by disconnecting D19, D21 etc. to see if there's a short-circuit across any of these supplies. If the transformer is still dead, check the line output transistor: an RCA 16583 can be used.

ITT VC200 CHASSIS

I've replaced the line timebase valves, also the line output transformer, but there's still no e.h.t. What do I do next?

If the PL504 line output valve is running very hot and its anode glows dull red, there's no drive from the line oscillator. In this case, replace C124/C126/C127 in the line oscillator circuit and try again. Alternatively a defective stick e.h.t. rectifier may be overloading the line output stage: remove the e.h.t. connector to see whether the overheating stops. If only the PY88 boost diode glows hot, check the third harmonic tuning capacitors C135/C141. If the valves are running cool, check the line output valve's screen grid feed resistor R174, also R106 and R107 in the power supply section, in case one of them is open-circuit, and ensure that there's not a dry-joint on L57 which is in the feed to the anode of the PY88.

DECCA 30 SERIES CHASSIS

The problem is that when the set's been on for an hour or so the interference on BBC-2 progressively increases until finally there's no picture or sound. At this point the other two local channels can be obtained, but no amount of retuning will restore BBC-2. The fault is not present if the set is operated with the back removed, while if it's switched off for a few minutes BBC-2 can be restored for a time.

It seems that the mixer/oscillator stage in the tuner is faulty. You could try changing the transistor, but an exchange/replacement tuner is a better idea.

PHILIPS TS7 CHASSIS

Both the contrast and brilliance controls have to be at almost maximum in order to get a reasonable picture, while if the brilliance control is turned up any further the picture expands. Also, the picture sometimes judders up and down when the set is switched on, though the field hold remains stable.

The trouble would seem to be in the power supply: check that the main regulated line is at 10·8V, and if not whether it can be set to this figure by adjusting R104. If the supply is low, suspect the transistors in the regulator circuit, first the regulator transistor TS1, which is connected in series with the negative side of the supply incidentally, then TS3, TS2, TS4 and the zener diode D4.

SANYO 5TC1

White areas of the picture are greyish and lack detail, while the leading edge of a white area has a bright white line, with a black line following the area. The tube base voltages are correct, and those in the video output stage are within the range specified. I suspect the tube or an a.g.c. fault.

We doubt whether the tube is defective, and suggest you concentrate on the video output and driver stages. Check the operating conditions carefully, also any wirewound chokes and capacitors which could affect the frequency response of this part of the receiver. The a.g.c. system could be at fault, but this would show up by observing the difference between a weak aerial input signal and a strong one.

RANK A823A CHASSIS

This set was purchased secondhand and has a green picture – even with the colour control at minimum. The green output transistor, also the feedback resistor in the green clamp circuit, have been checked and I now suspect the SL901B demodulator/matrixing i.c.

The simplest step to take is to interchange the red and green leads from the top of the decoder panel to the c.r.t. If the fault now comes up in red, this proves that the fault is in the green video channel. Since you've checked the output transistor, the suspects are the clamp diode 3D6, the driver transistor 3VT5 and the clamp reservoir capacitor 3C48.

The SL901B is also a "possible". If the screen remains green, either the green first anode supply circuit (7RV12/7R9) is faulty or the c.r.t. has internal leakage in the green gun. This assumes that the c.r.t. base connector panel is in good condition.

THORN 3000 CHASSIS

The height has been slowly decreasing recently, and full height can now be obtained only by adjusting the two linearity controls. This of course affects the top and bottom linearity, while there's still some foldover at the bottom of the raster. Would you suggest replacing the BD116 field output transistor?

The field output transistor could be responsible, but if the linearity is unaffected by the fault we suggest replacing the two field charging capacitors C427/8. Also check that the supply to the field output stage is correct – about 40V across the decoupling electrolytic C432, which should be checked by substitution if necessary. If the fault persists, it would be best to check the voltages and waveforms in the field driver and output stages as given in the manual.

TEST CASE

194

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.

Following what was thought to be a successful repair to the video/sync section, a Thorn 1500 chassis was returned to the workshop a few days later with the complaint of intermittent picture roll. The previous trouble had been low video drive accompanied by critical line and field hold. The symptoms had been corrected by replacement of the 47kΩ resistor feeding the screen grid of the 30FL2 sync separator (it had increased significantly in value) and the 64μF capacitor (C37) which couples the video driver to the output transistor.

Investigation of the new fault in the workshop revealed that this time the video signal was quite strong, as also was the line lock, but the field had a distinct tendency to slip or trigger in a random manner. A reliable locking point could not be found, and apart from the random triggering effect the field would otherwise lock normally over an acceptable range of the hold control.

The symptom was not unlike the random triggering effect that's sometimes instigated by impulsive interference, such as that generated by a local, unsuppressed electric motor, but there was no sign of interference on the screen. Indeed, the picture was well defined and noise-free, owing to the good quality and strong signal from the workshop aerial system; the display also indicated satisfactory receiver alignment and video stage performance. In view of the above it was considered that the trouble must reside in the sync stages, a conclusion which seemed to be supported by the fact that the symptom became more apparent as the contrast control was retarded.

Sync separator voltages, components and the coupling to the field timebase all appeared to be in order, and no apparent loss of field sync signal could be detected. It was noticed however that the effect was far more troublesome when the chassis was hinged up than when it was fully lowered. In fact, in the latter position the symptom was virtually non-existent!

What was the most likely cause of the trouble? See next month for the solution and for a further item in the series.

SOLUTION TO TEST CASE 193
– Page 161 last month –

In the case described last month (Bush BM6514 mains/battery portable) the technician failed to investigate fully the operation of the video amplifier. Since he obtained a fairly normal bias swing between the grid and cathode of the picture tube with rotation of the brightness control, he automatically assumed that the video amplifier was being properly supplied. It will be recalled that he measured the 11V output from the regulator, the e.h.t. voltage, and the pulse-rectified 290V c.r.t. first anode supply, which were all correct. He overlooked the pulse-rectified 100V supply obtained from the line output transformer however.

This feeds the collector of the video amplifier and also the brightness control potentiometer – and hence the tube's grid. The trouble in fact was due to this voltage being low, stemming from a defective 10μF reservior capacitor (C44). The value of this capacitor had dropped, and it was leaking slightly though not enough to load unduly the line output stage via the associated 100Ω surge limiting resistor. The tube's bias had the correct swing (or a near enough value) since both the cathode and grid are supplied from the 100V rail.

The poorly defined horizontal scanning lines were caused by low voltage at the tube's focus electrode (also fed from the 100V line), the ragged vertical line was due to the line flyback pulses, while the flat picture was caused by the video transistor bottoming.

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TELEVISION FEB 1979

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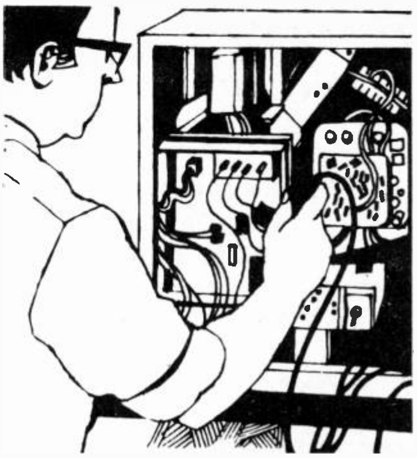

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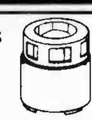

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DY802	80p	PC86	95p	PCF805	£1.70	PL84	70p	U26	60p	30PL1	P.O.A.
ECC81	75p	PC88	95p	PCF808	£1.70	PL504	£1.50	6F23	60p	30PL14	£1.20
ECC82/3	75p	PC97	80p	PCH200	£1.25	PL508	£1.55	6F28	£1.00	30PL15	£1.10
ECL80	70p	PCC84	35p	PCL82	£1.00	PL509	£3.00	20P4	70p	Etc., Etc.	
EF80	65p	PCC89	75p	PCL83	95p	PL802	£2.85	30C1	90p		
EF183	80p	PCC189	75p	PCL84	£1.00	PY81/83	90p	30C17	80p		
EF184	80p	PCF80	95p	PCL85 }	£1.15	PY800	90p	30FL1 }	£1.20		
EH90	70p	PCF86	95p	PCL805 }		PY801	90p	30FL2 }			
EY51	85p	PCF200	£1.65	PD500	£3.60	PY500 }	£1.75	30L15	75p		
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BY 100/127 etc. all 21p each with 10W resistor.

(Correct at time of going to press ONLY.)

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ECC81	54p	EF183	55p	PC97	72p	PCF806	75p	PL82	30p	UCC85	50p
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ECH81	55p	EL509	£3.00	PCC89	50p	PCL84	65p	PL504 }		UF89	52p
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ECL80	52p	EY86/7	46p	PCF80	80p	PCL805 }		PL509	£3.05	UL84	90p
ECL82	62p	EY500A	£1.60	PCF86	60p	PCL86	85p	PL802	£2.80	UY41	55p
ECL86	72p	EZ80	42p	PCF200	£1.60	PCL200	£1.40	PY88	85p	UY85	60p
EF80	41p	EZ81	44p	PCF801	60p	PD500	£3.60	PY800	65p	U25	60p
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A31/410W Mullard } A31/120 – CME1220 }	**£18.00.** (A31/300)*
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ALL TUBES GUARANTEED 12 MONTHS

CARRIAGE:
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Any 5–80p, 10–£1.50, 50–£6.00 Your choice from the list below.

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TV109	TV148	TV191D
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TV113	TV165	TV193D
TV115 or C	TV166	TV193S
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DR29	DR61	MS1700
DR30	DR71	MS2000
DR31	DR95	MS2001
DR32	DR100	MS2400
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19TG164a	G20T230a . . .	all models to
	all models to	23TG176a
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11u	40F	58	64	81	93		161
31F	43F	59	68	83	94	150	170
32F	48	60	75	84	95/4	151	170/1
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ST196 or DS
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64 Vic

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40 M/A
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250 M/A
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1 Amp
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1200PF 10Kv
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220M 25v
1000M 16v
220M 35v
220M 40v
220M 50v
470M 25v
22M 315v
100M 50v
330M 10v
330M 25v
330M 35v
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