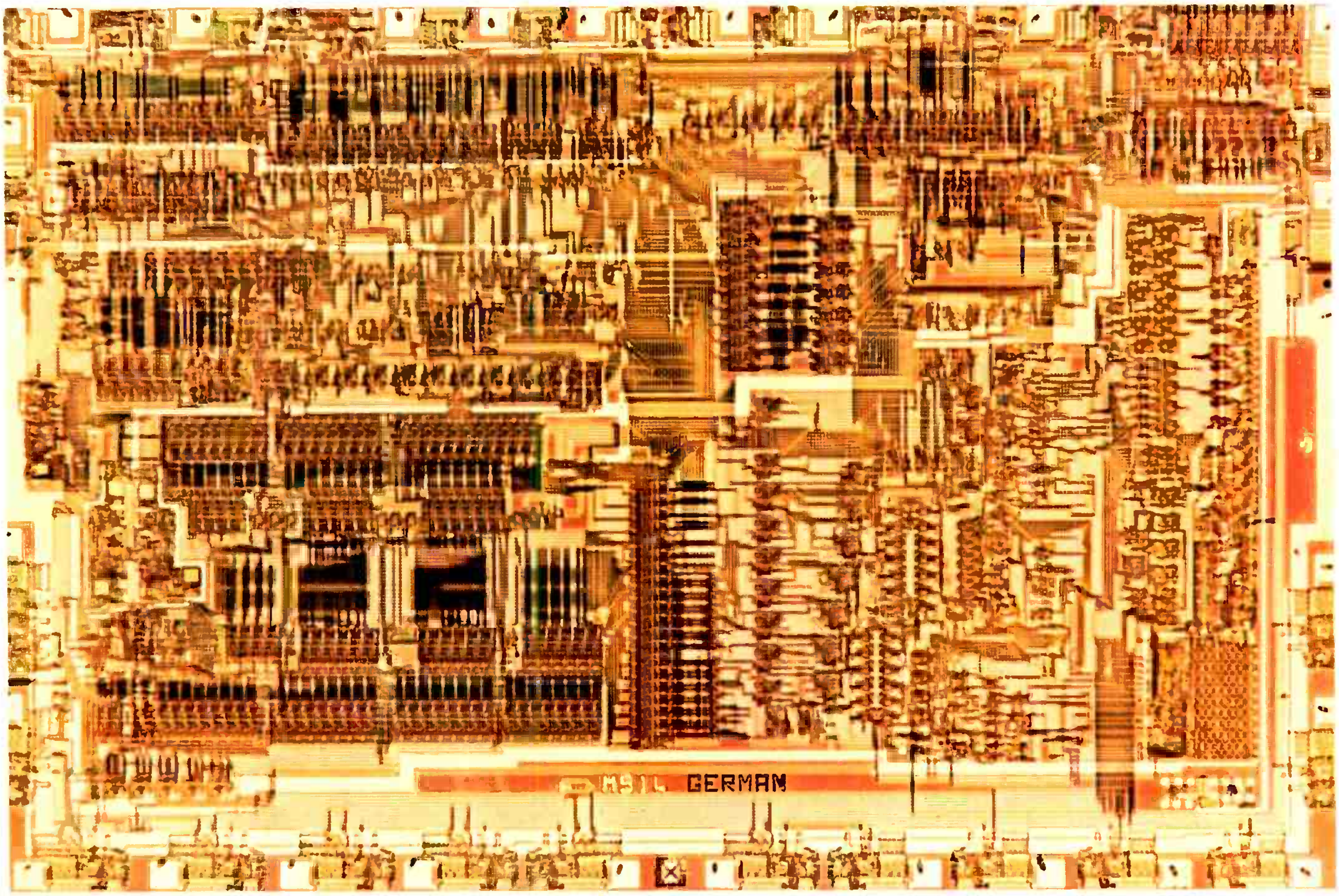
JUNE 1981 70p

TELEVISION

SERVICING·VIDEO·CONSTRUCTION·DEVELOPMENTS



SERVICING THE RANK T20/22 CHASSIS

DEALING WITH AFC FAULTS

COLOUR PORTABLE SIGNALS BOARD

VHF LOG - PERIODIC AERIAL

TELEVISION

June 1981

Vol. 31, No. 8
Issue 368

this month

OUR NEXT ISSUE DATED JULY WILL BE PUBLISHED ON JUNE 17

CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", King's Reach Tower, Stamford Street, London SE1 9LS. Editorial correspondence should be addressed to "Television", IPC Magazines Ltd., Lavington House, Lavington Street, London SE1 0PF.

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BINDERS AND INDEXES
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BACK NUMBERS
Some back issues are available from the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF at 85p inclusive of postage and packing.

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

P.V. TUBES

38A WATER STREET
ACCRINGTON LANCS BB5 6PX

PLEASE ADD 15% VAT TO ALL PRICES

SUPPLIERS OF TELEVISION COMPONENTS

Telephone: Accrington (0254) 36521

TRADE COUNTER OPEN MON–FRI 9a.m.–4.30p.m.
SAT. MORN. 9.30a.m.–12 NOON.

NEW MONO TUBES

Mullard A31/510 12" 110°	£17 00
Mullard A34/510 14" 110°	£18 50
Hitachi A31/300 12" 110°	£15.00
Vega 12" 90°	£15 00
Vega A50/120 20" 110°	£13.50
Vega A61/120 24" 110°	£15.00

1 year warranty except Mullards which have 2 years warranty.

REBUILT COLOUR TUBES

17" 18". 19". 20"	£28 00
22"	£30.00
25". 26"	£34 00
26" 110°	£36.00

Glass for glass exchange
2 year warranty.

MULLARD COLOUREX/OR THORN NEW LIFE

18"	£54.50
19"	£46.00
20"	£50.00
22"	£40.00
25"	£50.00
26"	£52.00
26" 110°	£55.50

Glass for glass exchange
1 year warranty 4 year optional.
Carriage incl. VAT on carriage

MONO	£5 00
COLOUR	£5 00
PORTABLE	£3.50

NEW VALVES

30FL2	1 21	EY86/7	68	PCL84	81
DY802	72	EY500A	1 33	PCL85/805	79
DY86/7	66	EZ80/1	56	PCL86	81
ECC81	60	GY501	1 45	PD500	2 93
ECC82	68	G234	1 56	PFL200	1 35
ECC83	60	KT66	6 98	PL36	1 15
ECC84	80	KT88	10.00	PL81	94
ECC85	98	PC86	81	PL82	46
ECC88	1 35	PC88	81	PL83	1 43
ECF80	80	PC92	80	PL84	84
ECF82	88	PC97	1 14	PL95	1 00
ECH81	1 04	PC900	80	PL504	1 32
ECH84	1 13	PCC84	70	PL508	1 43
ECL80	84	PCC85	85	PL509	2 39
ECL82	77	PCC88	82	PL519	2 78
ECL86	84	PCC89	79	PL802	2 15
ECF86	78	PCC189	1 02	PY33	61
EF80	68	PCC805	1 40	PY88	81
EF85	68	PCF80	75	PY500A	1 40
EF86	1 19	PCF86	1 13	PY800/1	69
EF89	1 43	PCF200	1 23	UCF80	67
EF183	68	PCF800	1 38	UCH81	1 43
EF184	68	PCF801	1 13	UCL82	84
EH90	1 02	PCF802	86	UCL83	94
EL34	1 63	PCF805	1 63	UL84	1 02
EL81	86	PCF806	1 30	U26	1 30
EL84	66	PCF808	1 63	U191	95
EL90	82	PCH200	1 45	6F23	85
EL509	2 22	PCL82	78	UY85	80
		PCL83	2 00		

All valves are new – boxed – guaranteed.
Please add 15% VAT to **ALL** items

RECTIFIER TRAYS

Thorn 950	£4 25	GEC 2110 before Jan '77	£6 95
Thorn 1500/1580	£3 85	GEC 2110 after Jan 77	£6 65
Thorn 1500 5 stick	£4 25	GEC 1028, 2028, 1040	£5 64
Thorn 1600	£3 45	ITT/KB CVC5/7/8/9	£5 35
Thorn 3000/3500	£6 99	ITT/KB CVC20/25/30	£5 35
Thorn 1400	£3 95	Korting (similar to Siemens TVK1)	£6 65
Thorn 8000	£3 51	Philips 3113 550/1/3	£5.85
Thorn 8500/8800	£5 40	Philips G8	£5.85
Thorn 9000	£7 43	Philips G9	£6 33
Decca CTV 19/25	£5 35	Pye 691/3	£5 13
Decca CS1730/3, CS1830/5	£3 68	Pye 731/25	£5 40
Decca 1910 Bradford 2213	£5 32	Rank BM A823/2179	£5 78
		Rank BM A823 A/V	£6 89
Decca 30	£5 92	Reddilusion MK1	£6.04
Decca 80	£6 28	BRC 2000	£6 60
Decca 100	£6 84	"Universal Tripler"	£5 40

MAINS DROPPERS

Type	Price (p)
Decca 20 Decca 20 Series	£1.10
GEC. 2018	70
Philips 210/5050	66
Philips G8 5061	35
Philips G8 5083	56
Pye 725	53
RBM 161	55
RBM A823	77
Thorn 1500	96
Thorn 3500	68
Thorn 8000	86
Thorn 8500	83

PREFERRED VALUES RESISTORS

WIREWOUND		Price Each (p)
4 watt	1 ohm 1 5kohm	15
	2 2k, 3 3k	17
	4 7k, 6 8k	19
	10k	24
7 watt	1 ohm-4 7 kohm	16
	5 6k-12k	17
	15k-22k	20
11 watt	1 ohm-6 8kohm	19
	10k-15k	20
	22k	23
17 watt	1 ohm-10 kohm	26
	15k, 22k	27

TRANSFORMERS

LINE OUTPUT TRANSFORMERS

Type	Price (p)
Bush A774	£11.75
Replacement Tripler for A774	£10 75
Decca 80	£8.58
Decca 100	£8.58
Decca 1730	£8.58
Decca 2230	£8.58
GEC 2040	£9.20
GEC 2110	£8 59
ITT CVC 25/30/32	£7.80
Philips G8	£10.00
Philips G9	£7.15
Philips G11	£13.50
Pye 691/693	£14.00
Pye 697	£14.00
Pye 731	£10 15
Thorn 3500 Scan AC EHT Transformer	£5.00
Thorn 8000	£9 00
Thorn 8500	£10.00

Type **MAINS TRANSFORMER**	Price (p)
Thorn 3000/3500	£10.50

PYE LABGEAR

Mast Head Amp WB 12V 26db gain	£12.00
Power Unit for above	£11.25
'Behind the Set' second set amp	£10.06
'Behind the Set' UHF amp (mains)	£10.73
Teletext Adaptor (Colourtext)	£206.00
VHF/UHF 8+1 distribution amp	£32.35

SEMICONDUCTORS

Type	Price (p)	Type	Price (p)	Type	Price (p)	Type	Price (p)
AC126	22	BC212	9	BF160	27	BU326A	£1 42
AC127	22	BC212L	9	BF167	24	BU407	£1 25
AC128	20	BC213	9	BF173	22	E1222	28
AC128K	32	BC213B	10	BF178	26	MJE340	40
AC141K	34	BC213L	9	BF179	28	MJE520	44
AC142K	30	BC214	9	BF180	36	OC71	27
AC176	25	BC214L	10	BF181	36	OC79	15
AC176K	32	BC237	9	BF182	30	R2008B	£1 80
AC187	26	BC238	8	BF183	30	R2010B	£1 80
AC187K	28	BC251A	12	BF184	30	R2265	£1 40
AC188	25	BC251B	15	BF185	30	R2322	58
AC188K	37	BC252A	12	BF194	11	R2323	67
AD140	75	BC252B	12	BF195	10	R2461	£1 50
AD143	82	BC261A	18	BF196	10	R2540	£2 80
AD149	79	BC261B	15	BF197	11	RCA16334	90
AD161	42	BC262A	15	BF198	18	RCA16335	80
AD161/2	£1.15	BC262B	15	BF199	15	TIP29C	43
AD162	42	BC300	30	BF200	30	TIP30C	43
AF124	34	BC301	28	BF224	16	TIP31C	41
AF127	32	BC303	28	BF241	15	TIP32C	42
AF139	42	BC307	10	BF257	28	TIP41C	46
AF239	45	BC307A	10	BF258	25	TIP42C	47
AL102	£2 00	BC327	11	BF259	26	TIP47	70
AL103	£2 00	BC328	8	BF271	24	TIP2955	90
AU110	£2 00	BC337	11	BF273	12	TIP3055	
AU113	£1 49	BC338	9	BF274	13	(SEP3055)	63
BC107	11	BC461	30	BF336	36	TIS91	21
BC107A	12	BC546	7	BF337	30	TV106/02	£1 20
BC107B	13	BC547	10	BF338	34	2N696	19
BC108	11	BC548	10	BF355	37	2N2905	22
BC108A	12	BC549	7	BF362	37	2N3054	60
BC108B	12	BC550	7	BF363	33	2N3055	60
BC108C	14	BC557	7	BF371	30	2N3702	11
BC109	11	BC558	7	BF457	23	2N3703	10
BC109A	14	BCY72	13	BF458	24	2N3704	10
BC109B	13	BD115	30	BF459	35	2N3705	10
BC109C	11	BD116	65	BFT42	28	2N3706	10
BC114	12	BD124P	60	BFT43	27	2N5294	38
BC116A	12	BD124=2N3054		BFW10	60	2N5296	48
BC140	32	BD131	33	BFX29	30	2N5298	38
BC141	26	BD132	35	BFX84	27	2N5496	53
BC142	21	BD133	40	BFX85	28	2SC643A	£1 50
BC143	24	BD135	26	BFX86	28	2SC1172Y	£2 20
BC147	9	BD136	27	BFX88	25	CRYSTAL	
BC148	9	BD137	23	BFY50	20	4 43MHZ	£1 30
BC149	9	BD138	23	BFY51	20	Crystal	
BC157	11	BD139	28	BFY52	20		
BC158	9	BD140	30	BFY90	75		
BC159	10	BD144	£1 20	BR100	17		
BC160	25	BD182	70	BR101	30		
BC161	28	BD183	65	BRC4443	80		
BC170B	10	BD201	85	BRX46 (TIC46)	40		
BC171	9	BD202	80	BRY39	30		
BC171A	10	BD203	80	BT106	£1 00		
BC171B	10	BD204	84	BT108	£1 24		
BC172	9	BD222	46	BT116	£1.21		
BC172A	10	BD225	47	BU104	£2 00		
BC172B	10	BD232	45	BU105	£1 25		
BC172C	10	BD233	35	BU105/02	£1 65		
BC173B	12	BD234	31	BU106	£1 50		
BC174B	10	BD235	31	BU108	£1 80		
BC182	9	BD236	31	BU124	£1.30		
BC182LB	10	BD237	31	BU126	£1 49		
BC183A	12	BD238	33	BU204	£1 50		
BC183LA	10	BDX32	£1 50	BU205	£1 34		
BC184	9	BDY 20	20	BU206	£1.80		
BC184LA	10	BF115	35	BU208	£1 60		
BC204	9	BF127	26	BU208A	£1 65		
BC208	13	BF154	12	BU208/02	£2.00		
BC209	10	BF158	18	BU308	£1 75		

ALL GOODS ARE BRAND NEW

THERMISTORS

VA1104	52
VA8650	45

INTEGRATED CIRCUITS

Type	Price (p)	Type	Price (p)
CA3065/ETT6016/ ML232B	£2 20	TBA120U	£1 00
ETTR6016/ ML231B	£2 20	TBA396	80
MC1307	£1 00	TBA4800	£1 25
MC1327	£1 00	TBA510	£3 00
MC1349	£1 20	TBA5200	£1 20
MC1351	£1.00	TBA530	£1 20
MC1352	£1.00	TBA5300	£1 28
SAS560S	£1 80	TBA5400	£1 49
SAS570S	£1 80	TBA5500	£1 58
SL901B	£4 45	TBA560CQ	£1 59
SL917B	£6.25	TBA570	£1 00
SL1310	£1 80	TBA7500	£1 39
SL1327D	£1 20	TBA8000	89
SN76003N	£1.75	TBA810AS	£1 35
SN76013N	£1.50	TBA920	£1 80
SN76013ND	£1.50	TBA9200	£1 99
SN76023N	£1 45	TBA9900	£1 49
SN76023ND	95	TCA2700	£1 20
SN76033N	£1 53	TCA270SQ	£1 25
SN76110N	89	TCA800	£1 99
SN76131N	£1 30	TCA940	£1 60
SN76226N	£1 55	TDA1170	£1 99
SN76227N	£1 10	TDA2030	£2 80
SN76532N	£1 50	TDA2522	£2 40
SN76533N	£1 30	TDA2640	£2 50
SN76544N	£1 35	TDA2690	£1.00
SN76650N	89	TBA641/B11	£1.50
SN76660N	60	TBA720AQ	£2.50
SN76666N	70	TBA950	£2.40
TAA550	28	TBA2532	£2.95
TAA570	£1 80	TDA2600	£3.25
TAA661B	£1 20	TDA2540	£3.15
TAA700	£1 70	TDA2560	£2.95
TBA120B	£1 30	TDA2591	£2.75
TBA120S	69	SN76220N	95
TBA120AS	70	TA7171P	£1.80
TBA120SQ	79	TA7172P	£1.80
		TA7173P	£1.44
		TA7074P	£1.00
		TA7176P	75
		TA300	56
		TA310	50
		TA320	59
		TA630S	60
		TAA840	£1.96
		TBA500P	£1.00
		TBA440	£2.50
		TBA673	£1.10
		TBA690	£1.50
		TBA700	£2.12
		TCA760	£2.30
		TCA160	£1.20
		TDA1004A	£2.95
		TDA1190	£2.60
		TDA2524	£2.25
		TDA2541	£2.65
		TDA2581	£2.25

SOCKETS

8 pin	24
14 pin	18
16 pin	20
14 Dil/Qul	24

WELLER

Irs Heat Gun	£10.50
Heat Gun Kit	£13.00
Min. Sold Iron	£5.20
Cordless Sold Iron	£22.00

SOLDER

50/40 Alloy 18SWG ½kilo	£6.85
Solder Remover Sucker	£6.50

ELECTRONIC TUNERS and ASSEMBLIES

AEG/NSF equivalent to ELC1043/05	£7 10
ELC1043/06	£7 10
4 way P/B for Decca etc	£5.80
6 way P/B for Decca etc	£7.00
4 way P/B for Pye 713	£9 00
6 way P/B for Pye 201	£18.00
G8 Tuner	£10.50
G11 Tuner	£9.00
Philips G8 Assembly (square/early)	£10.29
Philips G8 Assembly (sloping/late)	£10.63

THERMAL CUT-OUT

Thorn 3000 2 amp metal type	Price £1.30
Decca 2.5 amp plastic type	Price £1.30
G.E.C. 2040 (Metal)	Price £1.50
PL802T Solid State	Price £2.50

PANELS

Type	Price (p)
IF Gain Module (Pye/Philips Chassis 713, 715, 731, 735, 741 and 570)	£9.00
C.D.A. Panel (Pye/Ekco/Invicta/Dynatron Chassis 691, 692, 693 and 697)	£20.00

DIODES

Type	Price (p)	Type	Price (p)
AA119	7	BYX71/600	40
BA102	17	OA47	9
BA115	13	OA90	5
BA145	17	OA91	6
BA148	17	OA95	6
BA154	6	OA202	11
BA155	14	IN914	3
BA156	15	IN4001	4
BAX13	4	IN4002	4
BAX16	5	IN4003	4
BB105B	30	IN4004	5
BB105G	30	IN4005	5
BY126	10	IN4006	5
BY127	11	IN4007	6
BY164	45	IN4148	2
BY176	85	IN4448	10
BY199	10	IN5401	12
BY206	14	IN5402	14
BY210/800	22	IN5403	12
BY298/400	50	IN5404	12
BY299/800	50	IN5405	13
BYX10	20	IN5406	13
BYX55/600	£1.85	IN5407	15
BY182	£1.80	IN5408	16
BY184	41	ITT44	4
BY223	90	ITT2002	11

ZENER DIODES

Type	Price (p)
BZX61 6V2, 7V5 8V2, 9V1, 10V, 11V, 12V, 13V, 15V, 16V, 18V, 20V 22V, 24V, 27V, 30V 33V, 36V, 39V, 47V, 56V, 68V, 75V	20
BZY88 2V7, 3V 3V3, 3V6, 3V9, 4V3, 4V7, 5V1, 5V6, 6V2, 6V8, 7V5, 8V2, 9V1, 10V 11V, 12V 13V, 15V, 18V, 24V 27V	10

FUSES

	Price per 10
1¼" QB	
100ma	48
250, 500, 750ma 1A	49
1 5, 2, 2 5 3, 5A	40
1¼" AS	
250, 500, 600, 630, 750, 850ma	
1, 1 25, 1 5, 2A	£1 41
2 5, 3, 5A	£2 16
1" Mains	
2, 3, 5, 10, 13A	84
20mm AS	
80ma	£3 11
100ma	£2 08
160, 200ma	£1 89
315, 500, 630, 800ma	
1, 1 25, 1 6, 2A	£1 07
2 5, 3 15A	£1 43
20mm QB	
100ma	45
250, 500, 630, 800ma	
1, 1 25, 1.6, 2, 2 5, 3 15, 5A	37

DATA BOOKS

TRANSISTOR EQUIVALENTS

TVT 80/80 2 part A-Z/2N/2S	£5.95
TVT 80 A-Z	£3 05
TVT 80 2N	£3 25

REPLACEMENT ELECTROLYTICS

Type	Price (p)
Decca 30 (400-400/350V)	£2.82
Decca 80/100 (400/350V and 800/250V)	£3.00
Decca 1700 20-20-2420 (200-200-400-350V)	£3.00
Philips G 8 (600/300V)	£2.11
Pye 691 (200-300/350V)	£2.28
Rank A 823 (2500-2500/30V)	£1.08
Thorn 850-950 (100-300-100 16/275V)	£1.50
Thorn 1400 (150-100-100-100-150/320V)	£2.60
Thorn 1500 (150-150-100/300V)	£1.92
Thorn 3000 (100-100-200/350V)	£2.61
Thorn 3000-3500 (1000/63V)	62
Thorn 3000-3500 (1000/70V)	63
Thorn 3000-3500 (1500/70V)	80
Thorn 3500 (175-100-100-400/350V)	£2.34
Thorn 8000/8500 2500+2500 70V	£1.47
Thorn 8000/8500 700 @ 250V	£2.20
Thorn 8000/8500 400 @ 350V	£2.44

CAPACITORS

DOUBLE ENDED

Volts	MFD	Price (p)	Volts	MFD	Price (p)
10	22	7	63	4 7	7
10	47	7	63	10	9
10	100	8	63	22	12
10	220	11	63	47	16
10	470	18	63	100	19
10	1000	20	63	220	30
10	2200	30	63	470	38
10	4700	48	63	1000	53
25	4 7	8	63	2200	85
25	10	7	100	10	12
25	22	7	100	22	14
25	47	9	100	47	19
25	100	10	100	100	29
25	220	17	100	140	32
25	470	22	100	220	35
25	1000	36	450	1	23
25	2200	46	450	4 7	28
25	4700	80	450	10	28
40	2200	52	450	22	56
63	1	7	450	33	62
63	2 2	7			

MIXED DIELECTRIC

Volts (DC)	MFD	Price (p)	Volts (DC)	MFD	Price (p)
400	022	9	1000	47	75
600	1	38	1250	1	45
1000	01	20	1500	022	24
1000	047	29			
1000	1	32			
1000	22	48			

HOW TO ORDER

Add 15% V.A.T. to all prices.

IMMEDIATE DESPATCH

Add 70p per order to cover P&P on all items. – However customers who require 1 small single item need send only 25p.

Orders which amount to £20 before V.A.T. are Post Free.

Carriage on tubes is as stated on list. Aerials by collection.

ALL ENQUIRIES SAE PLEASE.
VAT invoice on request

BRIARWOOD

QUALITY SELECTED EX EQUIPMENT SPARES

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

MONO TUNERS

6 button integrated all at **£4.00**
U.H.F. P/Button D/S **£3.50.** U.H.F. P/Button S/S **£4.00.** Rotary **£3.00** + £1 P&P

MONO TUBES

(tested)

19" Rimguard	£3.00
23" Rimguard	£4.00
20" Rimguard	£5.00
24" Rimguard	£6.00

+ £5.00 P & P

MONO LOPTS

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

MONO PANELS

i.e. Philips, Bush, etc. **£3.50** + £1 P&P. Quotations for complete S/hand chassis if required. (Diff. prices)

PLEASE ADD 15% V.A.T. TO ALL ITEMS AND OVERSEAS AT COST. CASH WITH ALL ORDERS.

VALVES (MONO & COLOUR)

PCL82	0.10	30C1	0.10	PCC189	0.10	EF183	0.10	PL504	0.25	ECL80	0.10
PCL83	0.25	30C17	0.10	30C15	0.10	EF184	0.10	6/30L2	0.10	PL509	1.00
PCL84	0.10	PCF802	0.10	30C18	0.25	6BW7	0.10	30PL1	0.25	PY500	1.00
PCL85	0.10	PCF805	0.25	PC97	0.20	EH90	0.10	30PL13/4	0.10	GY501	1.00
PCL86	0.10	PCF806	0.10	PC900	0.10	DY802	0.10	30FL1/2	0.25	PL508	0.50
PFL200	0.10	PCF808	0.25	EF80	0.10	PY800/1	0.10	ECC82	0.10	PCF200	0.50
PCF801	0.10	PCF80	0.10	EF85	0.10	PL36	0.25	ECC81	0.10	EY51	0.15

Please note there is 50p 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/OUPUT
Bush/Murphy	5.00	5.00	6.50	—	—	5.00	1.50
GEC/Sobell	5.00	5.50	—	—	—	5.00	—
Philips	5.00	7.00	—	—	—	5.00	—
Decaa	5.00	9.00	9.00	—	—	5.00	2.00 (19" only)
Thorn 2000	5.00	5.00	5.00	6.50	6.50	7.00	—
Pye	7.00	6.00	7.00	—	—	5.00	—
Baird	6.50	8.50	7.00	—	—	5.00	—

POWER	L/TB	F/TB
5.00	—	—
—	—	7.50
—	—	5.00
6.00	—	5.00
6.50	10.00	5.00
—	—	5.00
—	—	5.00

Postage & Packing £1.25

S/STANDARD COLOUR SPARE PANELS

	IF	LUM	CHROMA	VIDEO	CON	POWER	L/TB	F/TB
Bush 184	9.50	—	12.00	—	6.00	6.00	12.00	—
GEC Hybrid	6.00	6.50	9.00	—	5.00	—	—	12.00
Philips G6 S/S	9.50	—	10.00	—	5.00	—	—	6.00
Thorn 3000	6.00	6.00	6.00		5.00	20.00	20.00	6.00
Pye 691/693	6.00	6.00	8.00	—	5.00	—	15.00	5.00
Thorn 3500	6.00	6.00	6.00	6.50	12.00	20.00	20.50	6.00

Kotring and other foreign panels available on request.

Postage & Packing £1.25

COLOUR TUBES

17"	£15.00
18"	£15.00
19"	£15.00
19" A49/192	£18.00
20"	£18.00
22"	£20.00
25"	£15.00
26"	£22.00

Plus P&P £6.00
New rebuilt tubes available on request.

COLOUR TUNERS

Bush	£5.00
GEC	£5.00
Philips G6 S/S	£5.00
Pye 691	£5.00
Thorn 3000	£5.00

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 £5.00. Both British & Foreign makers. Please ring or write.
P&P per Lopt £1.00

MISC.

S/Output transformer from £1.50.
F/Outout from £1.25.
Scancoils from £5.00.
P&P £1.00
Other spares available on request.

THORN 1500 TUNERS

NEW SPECIAL OFFER AT £8.00

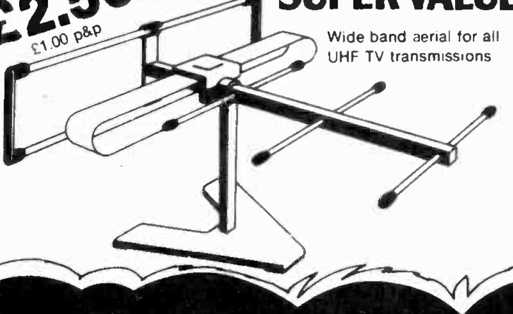
Postage & Packing £1.00

NEW PRODUCTS!

SUPER VALUE - SUPER QUALITY

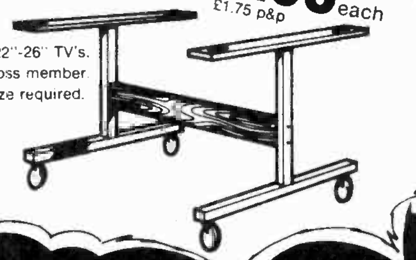
£2.50 each
£1.00 p&p

Wide band aerial for all UHF TV transmissions



£5.95 each
£1.75 p&p

Fits 22"-26" TV's.
wood finished cross member
State size required.



TV scores with quality

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

NEW SPARE SELECTION

TYPE	PRICE £	TYPE	PRICE £	TYPE	PRICE £	TYPE	PRICE £	TYPE	PRICE £	TYPE	PRICE £	TYPE	PRICE £
AC107	0.24	AF181	1.00	BC179	0.12	BD137	0.30	BF218	0.12	OC36	0.90	2N3053	0.21
AC113	0.22	AF186	0.90	BC182L	0.09	BD138	0.31	BF219	0.12	OC38	0.90	2N3054	0.60
AC115	0.23	AF239	0.46	BC183L	0.09	BD139	0.40	BF220	0.12	OC42	0.45	2N3055	0.60
AC117	0.30	AU113	1.40	BC183LA	0.10	BD140	0.37	BF221	0.21	OC44	0.60	2N3442	1.00
AC125	0.23	BA130	0.08	BC183LB	0.10	BD144	1.39	BF222	0.12	OC45	0.50	2N3702	0.15
AC126	0.23	BA145	0.14	BC184L	0.09	BD145	0.50	BF224	0.18	OC46	0.39	2N3703	0.12
AC127	0.22	BA148	0.21	BC186	0.21	BD177	0.50	BF256	0.37	OC70	0.39	2N3704	0.18
AC128	0.22	BA155	0.08	BC187	0.21	BD178	0.50	BF258	0.30	OC71	0.39	2N3705	0.18
AC131	0.13	BAX13	0.05	BC209	0.11	BD203	0.40	BF259	0.30	OC72	0.39	2N3706	0.14
AC141	0.24	BAX16	0.08	BC212	0.09	BD204	0.70	BF260	0.25	OC74	0.39	2N3707	0.14
AC142	0.24	BC107	0.11	BC212L	0.09	BD222	0.73	BF262	0.28	OC75	0.39	2N3708	0.14
AC141K	0.31	BC108	0.11	BC213L	0.09	BD233	0.36	BF263	0.25	OC76	0.39	2N3772	2.00
AC142K	0.31	BC109	0.11	BC214L	0.09	BD234	0.34	BF271	0.27	OC77	0.50	2N3773	2.50
AC151	0.21	BC113	0.11	BC237	0.09	BD237	0.44	BF272	0.27	OC78	0.23	2N3819	0.30
AC165	0.21	BC114	0.11	BC238	0.09	BD238	0.44	BF273	0.16	OC81	0.26		
AC166	0.21	BC115	0.11	BC240	0.31	BDX22	0.73	BF336	0.30	OC810	0.14		
AC168	0.22	BC116	0.11	BC249	0.35	BDX32	1.98	BF337	0.29	OC82	0.26		
AC176	0.22	BC117	0.12	BC251	0.22	BDY18	0.80	BF338	0.29	OC820	0.20		
AC176K	0.28	BC119	0.24	BC257	0.20	BDY60	0.80	BF479	—	OC83	0.30		
AC178	0.23	BC125	0.15	BC262	0.18	BF115	0.30	BFT	0.27	OC84	0.30	**VALVES**	
AC186	0.26	BC126	0.15	BC263B	0.20	BF121	0.29	BFT	0.27	OC85	0.28	DY87	0.60
AC187	0.23	BC136	0.15	BC267	0.19	BF154	0.12	BFX84	0.27	OC123	0.25	DY802	0.64
AC188	0.23	BC137	0.17	BC281	0.24	BF158	0.19	BFX85	0.27	OC169	1.20	ECC82	0.60
AC187K	0.30	BC137	0.23	BC300	0.27	BF159	0.24	BFX	0.30	OC170	1.20	EF80	0.55
AC188K	0.30	BC139	0.23	BC301	0.27	BF160	0.23	BFY37	0.22	OC171	0.92	EF183	0.70
AD130	0.58	BC140	0.24	BC302	0.30	BF163	0.30	BFY50	0.21	OA91	0.07	EF184	0.70
AD140	0.68	BC141	0.27	BC303	0.27	BF164	0.30	BFY51	0.21	BRC4443	0.65	EH90	0.75
AD142	0.80	BC142	0.27	BC307	0.11	BF167	0.30	BFY52	0.21	R2008B	1.50	PC86	0.85
AD143	0.70	BC143	0.27	BC307A	0.11	BF173	0.21	BFY53	0.27	R2009	1.30	PCC89	0.65
AD145	0.70	BC147	0.10	BC308A	0.12	BF177	0.26	BFY55	0.33	R2010B	1.50	PCC189	0.80
AD149	0.64	BC148	0.10	BC309	0.14	BF178	0.24	BFX	—	R2265	1.50	PCF80	0.80
AD161	0.42	BC149	0.10	BC337	0.12	BF179	0.28	BHA0002	1.90	R2305	0.38	PCF86	0.72
AD162	0.42	BC153	0.12	BC338	0.15	BF180	0.30	BSX20	0.23	R2305		PCF801	0.70
AD161)		BC154	0.12	BC487	0.20	BF181	0.34	BSX76	0.23	BD222	0.37	PCF802	0.85
AD162)	1.00	BC157	0.12	BC547	0.10	BF182	0.30	BSY84	0.36	R2540	2.50	PCL82	0.75
AF106	0.42	BC158	0.12	BC548	0.11	BF183	0.29	BU105	1.00	S2802	—	PCL84	0.80
AF114	0.37	BC159	0.12	BC549	0.11	BF184	0.27	BU105 02	1.50	SCR957	0.65	PCL86	0.85
AF118	0.45	BC160	0.26	BC557	0.12	BF185	0.29	BU105 04	2.00	TIP31A	0.38		
AF121	0.37	BC161	0.26	BCX33	0.10	BF186	0.32	BU126	1.40	TIP32A	0.36	PCL805	0.82
AF125	0.30	BC167	0.11	BD112	0.39	BF192	—	BU205	1.20	TIP3055	0.53	PLF200	1.00
AF126	0.30	BC168	0.11	BD113	0.65	BF194	0.15	BU206	1.60	TIP31B	0.39	PL36	£1.10
AF127	0.30	BC169	0.11	BD115	0.32	BF195	0.13	BU208	1.60	TIS90	0.23	PL84	0.80
AF139	0.40	BC171	0.10	BD116	0.47	BF196	0.13	OC22	1.10	TIS91	0.25	PL504	£1.30
AF150	0.27	BC171A	0.10	BD124	1.30	BF197	0.13	OC23	1.30	TV106	1.09	PL508	1.50
AF151	0.30	BC172	0.10	BD131	0.36	BF198	0.12	OC24	1.30	MJE340	0.50	PL509	2.45
AF170	0.92	BC173	0.12	BD132	0.36	BF199	0.14	OC25	1.00	MJE520	0.45	PL802	£2.75
AF172	1.00	BC177	0.12	BD133	0.37	BF200	0.28	OC26	1.00	2N2219	0.40	PY88	0.75
AF178	1.00	BC178	0.12	BD135	0.30	BF216	0.12	OC28	1.30	2N2646	0.40	PY500A	1.60
AF180	1.00	BC178A	0.12	BD136	0.30	BF217	0.12	OC35	1.00	2N2926	0.15	PY81/800	0.70

All transistors, IC's offered are new and branded. Manufactured by Mullard, I.T.T., Texas, Motorola etc.
Please add 15% VAT to all items and overseas at cost
P & P U.K. 50p per order, overseas allow for package and postage. Cash with all orders. All prices subject to alteration without notice.

E.H.T. Trays Colour

TYPE	PRICE £
Pye 691 693	4.50
Pye 715/731/735	5.50
Pye 737	5.40
Decca (Large Screen) CS2030/2232/2630/2632/2230/2233/2631	5.00
Decca 80	5.30
Decca 100	5.30
Philips G8 520/540	5.30
Philips G9	5.50
Philips 550	5.30
GEC C2110	5.50
GEC Hybrid CTV	5.10
Thorn 3000/3500	5.00
Thorn 800	2.42
Thorn 8500	4.75
Thorn 9000	5.50
GEC TVM25	2.50
ITT KB CVC 5/7/8/9	5.10
ITT KB CVC 20/25 30/32	5.50
Bush CTB25 MK3 Quadrupler	8.00
Bush X179	4.50
RRI (RBM) A823	5.00
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

E.H.T. TRAYS MONO

950 MK2 1400	4.20
1500 18" 19" stick	3.80
1500 24" 5 stick	4.25
Single Stick Thorn TV 11, 16K 70V	0.75
TV 20 2 MT	0.75
TV 2016K 18V	0.75
BUSH 718	1.30

MAIL ORDER TV BARGAINS

PYE 691	22" @ £55.00
PYE 691	26" @ £55.00
PYE 697	22" @ £65.00
PYE 697	26" @ £65.00
BUSH 184	19" @ £70.00
BUSH 184	22" @ £70.00
BUSH 184	26" @ £70.00
GEC 2040	19" @ £55.00
GEC2040	22" @ £55.00
GEC 2040	25" @ £55.00
GEC 2040	26" @ £65.00
KORTING	22" @ £70.00
KORTING	26" @ £80.00
THORN 3000	19" @ £70.00
THORN 3000	25" @ £60.00

Good working mono's Pye, GEC, Bush etc.

20" & 24" S/S	£20.00
20" & 24" D/S	£18.00
19" & 23" D/S P/Button	£15.00
19" & 23" D/S Rotary	£12.00

Cheques, P.O. or Cash with orders Please. Please note there is 15% VAT on all the above prices. Plus £10.00 p & p for colour TV, £5.00 for mono. ENGLAND, WALES and SCOTLAND Inland N & S IRELAND £15.00 for colour, £7.00 for mono.

IC's

TYPE	PRICE £
BTT6018	1.00
CA3605	1.20
MC7/c	
MC14016	0.50
SN76003N	1.40
SN76023N	1.20
SN76110N	1.00
SN76226DN	1.50
SN76227N	1.20
SN76532N	1.30
SN76550N	0.30
SN76666N	0.70
TAA570	1.38
TBA120AS	1.00
TBA120S	0.75
TBA120SQ	0.75
TBA395	2.20
TBA341	0.97
TBA520	1.40
TBA520Q	1.10
TBA530Q	1.10
TBA540	1.30
TBA540Q	1.45
TBA550Q	1.40
TBA560C	1.50
TBA560CQ	1.50
TBA570	1.00
TBA570Q	1.00
TBA800	1.00
TBA810	1.50
TBA920	2.00
TBA920Q	1.50
TBA990Q	1.50
TCA270SQ	1.45
TCA270SA	1.45
TCA270Q	—
TCA1327B	1.00
TCA800	2.00
TDA1010	—
TDA1327B	1.00
SBA750	1.75
SC9503P	1.20
SC9504P	1.20
SL901B	3.50
SL917B	5.00

DIODES & THYRISTORS

OA47	0.06
OA81	0.06
OA90	0.06
OA91	0.07
BA130	0.10
BA145	0.16
BA148	0.18
BA154	0.18
BA155	0.10
BAX13	0.08
BAX16	0.10
BY126	0.10
BY127	0.10
BY164	0.40
BY179	0.57
BY226	—
BY227	0.12
BYF206	0.14
1N4001	0.04
1N4002	0.05
1N4003	0.06
1N4004	0.07
1N4005	0.07
1N4006	0.08
1N4007	0.08
1N4148	0.05
1N4751	0.14
1N5401	0.12
1N5403	0.12
1N5404	0.14
1N5405	0.14
1N5406	0.14
1N5408	0.25
BR100	0.22
BR101	0.28
BT106	1.19
BT108	1.23
BT109	1.09
BT116	1.60
BT120	1.60
2N4444	0.90

EXPORT COLOUR & MONO TV's AVAILABLE READY FOR USE OVERSEAS

BRIARWOOD TELEVISION LTD

Briarwood House, Preston Street, Bradford West Yorkshire BD7 1LU
Tel: (0274) 306018

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.48
AC117	0.38
AC126	0.38
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	1.42
AD161	0.66
AD161/162	1.22
AD162	0.71
AF114	1.32
AF115	1.26
AF116	1.28
AF117	1.32
AF118	0.98
AF121	0.68
AF124	0.38
AF125	0.38
AF126	0.38
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	0.28
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*	0.12
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*	0.36
BC208*	0.37
BC209*	0.39
BC211*	0.38
BC212*	0.17
BC212L*	0.17
BC213*	0.16
BC213L*	0.16
BC214*	0.18
BC214L*	0.18
BC225	0.42
BC237*	0.16
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	0.29
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	0.88
BD175	0.90
BD177	0.58
BD178	0.92
BD181	1.94
BD182	2.10
BD183	1.84
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	1.56
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	0.46
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	0.49
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
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	3.35
BU105	1.80
BU105/02	1.95
BU108	2.98
BU126	2.91
BU204	2.50
BU205	2.68
BU206	2.59
BU208	2.75
BU407	1.38
BUY77	2.50
C106D	0.80
C106F	0.43
C111E	0.48
D40N1	0.64
E300	0.42
E1222	0.47
E5024	0.19
GET872	0.46
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	0.44
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
OC70	0.65
OC71	0.73
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	2.72
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	0.56
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	0.48
2N918	0.54
2N930	0.29
2N1164	10.29
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*	0.38
2N2926G	0.15
2N29260	0.14
2N2926Y	0.14
2N2955	1.12
2N3053	0.48
2N3054	0.68
2N3055	0.72
2N3250	0.52
2N3254	0.58
2N3391A	0.38
2N3633	0.80
2N3703	0.17
2N3704	0.19
2N3705	0.17
2N3706	0.16
2N3707	0.18
2N3708	0.17
2N3715	1.70
2N3771	2.09
2N3772	2.08
2N3773	2.90
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	0.66
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	0.46
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	1.03
MC1307P	1.82
MC1310P*	1.84
MC1312P	2.34
MC1327P*	1.86
MC1330P	0.83
MC1350P	1.22
MC1351P	1.42
MC1352P	1.42
MC1357P	2.92
MC1358P*	2.30
MC1458G	1.43
MC1496L	1.15
MC3051P	0.58
MFC400B	0.85
MFC4060A	0.98
MFC6040	1.11
MFC8020A	1.10
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	2.20

Type	Price (£)
SN76008KE	2.56
SN76013N	1.56
SN76013ND	1.40
SN76018KE	2.56
SN76023N	1.56
SN76023ND	1.40
SN76033N	2.20
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	1.46
SN76660N	0.64
SN76666N	0.96
TA7073P	3.51
TAA263	2.19
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	0.35
TAA560	1.83
TAA570	2.20
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	3.20
TAA970	2.81
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
TBA520*	2.98
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	2.31
TBA700*	2.50
TBA720AQ	2.38
TBA720Q	2.38
TBA750*	2.18
TBA800	1.65
TBA810AS	1.69
TBA920*	2.80
TBA940	3.52
TBA950	2.08
TBA990*	2.90
TCA270A*	3.55
TCA280A	1.43
TCA290A	3.46
TCA420A	2.10
TCA440	1.67
TCA640	4.26
TCA650	4.26
TCA660	4.26
TCA730	4.10
TCA740	4.04
TCA750	2.53
TCA760	1.52
TCA820	3.29
TDA440	4.16
TDA1003	1.68
TDA1004	2.73
TDA1005	3.04
TDA1022	6.89
TDA1024	0.97
TDA1034	2.98
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	0.45
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
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	0.13
ITT827	0.80
MCR101	0.48
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	0.06
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	3.0-75V	14p each
1/1.3W plastic	3.3-200V	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	0.68
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
PCF805	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 (£)
1½A 50V	0.27
100V	0.28
200V	0.32
400V	0.40
600V	0.50
800V	0.58
3A 100V	0.52
200V	0.55
400V	0.61
600V	0.67
800V	0.80
1000V	1.20

Rating	Price (£)
2A 100V	0.36
200V	0.40
400V	0.47
600V	0.53
800V	0.60
1000V	0.87
6A 100V	0.66
200V	0.68
400V	0.74
600V	0.80
800V	0.86
1000V	0.95

10A and 25A ranges also stocked.

RESISTORS

Carbon Film (5%)		10 of one E-value	Mixes of a minimum of 10pcs of any value: 50pc	100pc	500pc
½W 5.6Ω-330kΩ (E12)	3p	25p	95p	£1.49	£5.40
½W 10Ω-10MΩ (E24)	3p	25p	95p	£1.49	£6.40
1W 10Ω-10MΩ (E12)	5p	45p	£1.95	£3.40	£15.25
2W 10Ω-10MΩ (E6)	9p	80p	£3.60	£5.40	£26.90

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)

TELETEXT ADAPTOR 7066. An amazing box which can be used with any UHF Receiver. £213 + £2.25 P&P + VAT. – ask us for a fully descriptive brochure.
VIEWDATA ADAPTOR 7050. Prices and details on request.

COLOUR BAR GENERATOR
CM6052/DB. VHF/UHF gives standard 8 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. **£223.37**

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CAPACITORS

Metallised Paper

2n2F 1500V DC	60p	10nF 500V AC	80p
2n2F 600V AC	24p	15nF 300V AC	30p
3n6F 1700V DC	60p	22nF 300V AC	32p
4n7F 1500V DC	60p	100nF 1000V DC	46p
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	270, 300pF	39p
10kV	1nF	67p

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

VHF to UHF CONVERTER CM6022/RA. "Televerta" for DX-ing or uhf receiver use on relay systems, Eire etc. †£28.37

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COVER PHOTO

Our cover photo this month shows the Mullard SAA5040 i.c. before encapsulation. This MOS device provides teletext data acquisition and control, and is in production at the Mullard Southampton semiconductor plant.

State of the Market

Opinions are divided as to whether the worst of the economic recession in the UK is over and the extent, if any, of the recovery we can expect during the coming months. That may be so overall, but within our own industry it's possible to see things a little more clearly. The extraordinary thing is that trade at the retail level has kept up remarkably well. TV sets are things that people just have to have nowadays it seems. The total UK colour TV receiver market has remained steady at just under two million a year over the past two-three years. Deliveries of small-screen (14 and 16in.) CTV sets have risen from 175,000 in 1978 to 470,000 last year, while at the same time the replacement set share of the large-screen (18in. upwards) market rose from 30% to 64%. These figures suggest that a lot of small-screen second sets are being bought, and that the replacement cycle for sets sold during the famed 1972-3 boom is now peaking. It also suggests that the days of hybrid sets are now numbered, and leads one to wonder what sort of life expectancy their cooler solid-state successors will have.

On top of this reasonably healthy CTV market we've had something of a VCR boom – with the UK taking a European lead. Various figures have been quoted (it's never possible to be precise, since delivery figures are known but stock levels keep varying). It seems however that around 400,000 VCRs were sold/rented in the UK last year, representing over 30% of European disposals. This was a huge year-on-year increase, with a coverage now of some 3% of homes in the UK. There's still a substantial market potential here, and the message would seem to be to jump in while public interest is on the increase. Further sales potential exists in the imminent introduction of video discs.

The retail market is healthy then: what about the setmaking side? What's left of it doesn't seem to be doing too badly either. Thorn are understood to be producing sets at maximum capacity – the firm's always impeccable timing saw them with the advanced, simple to produce TX9 and TX10 chassis at just the right time (the far more cumbersome 9000/9600 series has now been finally phased out). Thorn's successes have been recognised with a 1981 Queen's Award for Technological Achievement for the TX colour television range, which has given Thorn a much increased share of the home market and has also been successful in export markets (with orders from Hong Kong, China, Scandinavia, Italy, Portugal, Nigeria, Zambia, Ireland and New Zealand to date).

Apart from Thorn, the Japanese firms active in the UK appear to be happily building up their set making capacity. Mitsubishi are looking for a site to increase production now that their Haddington plant is working at maximum capacity; Panasonic are to double their output in S. Wales; and Toshiba have restarted production at Ernesettle. One striking example of confidence is a newcomer to the UK's CTV market, and a home grown one at that – some advance details of Fidelity's interesting colour portable are given overpage.

The field in which most of us would like to see greater success is teletext. Here is one development in which the UK leads but has been unable so far to reap the commercial benefits. It seems that the public are unwilling to put their hands in their pockets and pay the extra required for sets incorporating a teletext decoder. This could change now that the price differential is decreasing sharply. In 1978 you'd have had to pay over twice as much for a set with full remote control and teletext as for a basic colour set (about £625 and £300 respectively). This price differential of around £325 is expected to fall to about £130 this year (£40 for the remote control facilities, £90 for the teletext decoder). Will the market take off now that the price barrier has been so significantly reduced?

Thorn's Commercial Director David Hewitt has put forward the interesting view that to achieve greater success teletext must become integral with the entertainment offered by the broadcasting authorities, rather than being simply a news and information service. He backs this up with the argument that there will be increasing demand for TV screen time, with four channels to choose from plus breakfast TV, discs, cassettes, games and so on. Teletext, he comments, must compete with these other demands for screen time. It's an interesting point, though we can't help but feel that news and information are basically what teletext is *for*.

Success with teletext would certainly mitigate for the fact that the UK's TV industry has lost out so far in the video field. The latter point is brought home to us whenever we try to get basic information on developments in this field – on VCRs, cameras or whatever. We find that we have to puzzle over poorly translated information, there being no home grown reference sources of the sort we've been used to in the past. What a life: from the commercial secrecy of EMI, Hayes in the early thirties to the inscrutable orientals of the eighties!

Teletopics

THORN BOOST FOR TELETEXT

Thorn have introduced a new range of models (37003, 3795 and 3796, with 20, 22 and 26in. tubes respectively) equipped for teletext reception. The sets use the basic TX9 and TX10 chassis, with remote control and a teletext decoder added. Thorn point out that, unlike their earlier teletext sets, the TX series chassis were designed with teletext in mind at the outset. The remote control and decoder use purpose-designed Mullard i.c.s, the net result being an efficient, cost-effective teletext system.

Introducing the new models, Thorn's Deputy Director of Engineering Doug Topping contrasted the present streamlined system with the dealer teletext demonstration Thorn had provided only some four years previously, when a 19in. rack behind a curtain had been required to house the necessary electronics! The arrangement used in the new sets allows extremely simple interfacing between the teletext decoder and the main chassis – in fact all that's required when adding teletext to a fully equipped remote control receiver is some plug and socket connections. A noteworthy technical feature is the extremely fast blanking, which enables the text to be inserted into the picture precisely when the mixed picture/text mode is selected. The interface panel also contains a simple audio bleep circuit, intended to give greater confidence when entering a long series of numbers, e.g. those required for the alarm page.

Since the rise and fall times of the teletext video signal are determined by the decoder's character generator and are not restricted by the transmitted signal bandwidth, the text display can be crisper than an off-air picture. To make the most of this, the large-screen TX10 chassis uses class AB video output circuits.

At the same time, Thorn introduced three accessories and a 25W hi-fi speaker/amplifier (Model 3739-7) for use with the TX10 chassis. The fact that the TX10 chassis employs a mains-isolated power supply means that video and audio signals can be fed in and out simply and safely. Hence the accessories. The TA110 extracts the audio signal for feeding, via a two-pin DIN socket, to an external speaker: it has a three-position switch for speaker selection and a jack plug socket for headphones or a hearing aid. The TA120 extracts the audio signal for feeding, via a five-pin DIN socket, a hi-fi system or the 3739-7 speaker/amplifier. The TA124 incorporates high-performance buffer amplifiers for video/audio input/output interfacing, the video connections being via coaxial sockets and the audio connections via a five-pin DIN socket.

To enable the 3739-7 speaker/amplifier unit to be positioned close to the TV set without affecting the colour purity, the loudspeaker drive unit employs a specially selected low leakage field magnet. The sound level remains under the control of the receiver's remote control system, the mains power also being controlled by the TV set. Muting is used to prevent objectionable plops and thumps when changing channels.

SALES/RENTAL FIGURES

TV rental has predominated for many years in the UK. There's been a fair amount of change however in recent years. The following figures were provided by Thorn's market analyst Nigel Schofield. Up to 1973, rental accounted for 75% of the market. 1975 saw a substantial decline, with rental falling below 50%. Various unusual circumstances played a part that year however, in particular the urge to beat the budget when an advance warning of a major tax increase was given. During 1976-7 the rental share of the market stabilised at just over 60%. After 1977, there was considerable growth in cash business, the rental share of the market falling to 51% in 1980. A factor here however has been the increased share of the market taken by small-screen sets. Rental still accounts for 61% of large-screen set deliveries.

FIDELITY ENTER CTV MARKET

Fidelity Radio have announced a 14in. colour portable which will be produced at their London factory. The new set, Model CTV14R, is expected to sell at around £200, including infra-red remote control for switching off and stepping through six preset channels. Use of the latest technology has enabled an extremely compact single board (plus c.r.t. base board) layout to be achieved, with low power consumption. The set can be powered from a standard car battery by fitting an adaptor. Fidelity report that advance orders for 25,000 sets have already been received.

The CTV14R joins the company's FTV12 and TVR120 12in. monochrome portables. We hope to give technical details of these sets in a later issue.

At the same time Fidelity unveiled a revolutionary new radio which will recharge an ordinary PP9 type battery up to four times. Recharging takes place whenever the set is plugged into the mains supply, whether or not it's switched on. With the high price of batteries, a substantial saving is possible – Fidelity estimate this at around £18 over a five year period.

TOSHIBA RESTART UK TV PRODUCTION

Following the closure of the joint Rank-Toshiba TV setmaking operation, Toshiba have set up a new company, Toshiba Consumer Products (UK) Ltd., and have restarted TV manufacture at the Ernesettle, Plymouth plant. The aim is to produce around 100,000 sets in the first year, the majority being destined for the UK market. Managing director Geoffrey Deith commented "we shall be making a proven product range on the world's most advanced colour television production line, manned by a fully-experienced workforce." Toshiba have achieved single union representation in the plant, and have set up an elected advisory board which will have access to full information about the company's operations. The purpose of the board will be to advise management on all matters affecting the running of the company.

GEC INTRODUCE VCR

GEC have introduced a VCR, Model V4000H, using the VHS format and based on the Hitachi 8000 series machine. The anticipated retail price is around £499, and features include microprocessor control, quartz locked direct drive motors, cord remote control, three hours' playing time, programming up to ten days in advance, twelve hour digital clock with fluorescent blue display, built-in test signal generator for accurate playback tuning, visual search at five times normal speed, both forwards and backwards, still frame and frame advance, and protection against humidity and tape damage by means of built-in sensors.

LOW-LIGHT TV ADAPTOR

Mullard Ltd. have introduced an add-on image intensifier which can be used to convert any standard closed-circuit

TV camera using a C-mount lens and $\frac{2}{3}$in. tube into a low-light level unit. Conversion is simply a matter of removing the existing lens and fitting the module in its place, the lens then being screwed on to the end of the module. The device can cope with car headlights, flashlights, etc. and has a gain of 70,000, being effective down to below starlight levels of illumination. It consists of a Mullard XX1500 image intensifier housed in a container along with a relay lens. The add-on unit plus camera would cost around £3,000, which is considerably less than a standard low-light level camera.

GRUNDIG-PHILIPS VCR SYSTEM

Grundig and Philips are both expressing optimism over the future of their joint V2000 VCR system – and backing this with further investment. The points being made are that the V2000 is a "second generation video recorder", with inherent potential for technical development, and that the European VCR market is rapidly increasing. Philips comment that European VCR sales are expected to reach 4·35 million by 1984 – and they are committed, with their partners, to taking a 50% share of that market. Philips are converting their Krefeld, West German TV factory to VCR production, giving the company a production capacity of well over a million machines a year, while production at the £75m Vienna plant is now getting into full swing. Grundig have announced that the production level at their Nuremburg plant is being increased.

At this year's trade shows Grundig will be showing a new machine called the 2 × 4 Super – supplies are expected to become available in September. The new machine has a very different look from Grundig's two previous V2000 system VCRs, being more compact and having a letterbox-style slot for cassette insertion. In addition to the standard record and playback facilities, the 2 × 4 Super will offer the following features: seven times normal speed picture search; five times normal speed reverse picture search; one third speed slow motion; freeze frame; timer can be set to record up to five programmes 99 days in advance; LED display of main function; optional infra-red remote control. A major advantage is that the memory is maintained when cassettes are changed or the recorder is used to play back another cassette between the timer being programmed and the start time being reached. Also, when a cassette is inserted the digital display shows its total hourly length and the time already recorded or, at the touch of a button, the time remaining.

Pye will also be showing at their trade show a machine, Model 20VR20, using the V2000 system.

GEC's 30AX CHASSIS

We've been taking a look recently at the circuitry used in the GEC 30AX chassis, which is produced at the joint GEC-Hitachi plant at Hirwaun, S. Wales. The front end is similar to the GEC-Hitachi 90° chassis, with the same interesting tuner (with its dual-gate MOSFET r.f. amplifier), SAWF and HA11215 i.f. i.c., but much of the rest of the chassis is quite different. For a start, there's a switch-mode power supply of the self-oscillating chopper variety, the chopper transformer providing mains isolation. Some extra circuitry in this area shuts down the power supply when the remote control system gives the stand-by command. Then there's the need for an EW raster correction diode modulator with the 110° 30 AX tube. The same HA11235 sync separator plus line and field oscillator i.c. is used, but this time with a discrete component field driver/output circuit. The RGB output stages, again mounted on the tube base panel, are similar, but the decoder chip on the signals panel is a µPC1365C. The over-voltage trip thyristor puts a short-circuit across the h.t. line, with the result that the switch-mode power supply shuts down. The infra-red remote control system uses ITT i.c.s, with a Texas i.c. employed for channel selection.

WORLD VCR MARKET

According to Mackintosh Consultants, VCR deliveries to the main world markets in 1980 were as follows: W. Europe 1,300,000; Japan 915,000; US 805,000. Substantial increases in all these markets are expected over the next few years – as our report in the March issue pointed out, planned Japanese VCR production for 1981 is around seven million units.

NAB CONVENTION

At the recent Las Vegas National Association of Broadcasters annual convention RCA unveiled the first broadcast quality combined TV camera/VCR unit – named Hawkeye. It's been jointly developed with Matsushita and represents a major step in electronic news gathering, giving the operator far greater flexibility. Half inch pickup tubes and half inch tape are used, and the quality is said to be superior to that provided by the $\frac{3}{4}$in. tape systems at present generally used for ENG purposes.

Also unveiled was the new Marconi Mk. IXB camera, an advanced variant of the Mk. IX fully automatic colour camera. It's an all electronic system with no motorised parts, a purpose-designed microprocessor controlling the automatic registration sequence of each channel.

STATION OPENINGS

The following relay transmitters are now in operation:

Amlwch (Anglesey) BBC Wales ch. 22, HTV Wales ch. 25, BBC-2 ch. 28, Welsh fourth programme ch. 32.

Cemaes (Anglesey) BBC Wales ch. 40, HTV Wales ch. 43, BBC-2 ch. 46, Welsh fourth programme ch. 50.

Kerry (Powys) BBC Wales ch. 21, HTV Wales ch. 24, BBC-2 ch. 27, Welsh fourth programme ch. 31.

Lea Bridge (N. London) Thames/London Weekend Television ch. 39, BBC-1 ch. 55, TV4 ch. 59, BBC-2 ch. 62. A wideband or group E aerial is required.

The above transmissions are all vertically polarised.

MATSUSHITA'S MINI TV

Matsushita (National Panasonic) is planning to start production of a miniature monochrome TV set with a $1\frac{1}{2}$in. c.r.t. A detachable hood with × 1·3 magnifying lens gives around 70 per cent enlargement of the screen. The set will be called the Solo, Model TR1010P, and will sell in the USA at around $200. Approximate measurements are $1\frac{3}{4}$ × $3\frac{3}{4}$ × $6\frac{1}{4}$in., and the set will operate from the mains, dry cells, nickel-cadmium rechargeable batteries or a car battery. For comparison, the planned Sinclair pocket TV (plus v.h.f. radio) measures 1 × 4 × 6in. and has a 3in. screen.

RETRA'S NEW PRESS OFFICER

Charles Ward has joined the Radio, Electrical and Television Retailers' Association (RETRA) as press and information officer and editor of the association's magazine *RETRA Dealer*. He takes over from Pam Calvert, who is now public relations executive with Mains Shop Superstores Ltd., a division of the British American Tobacco Company. Charles is well known in the domestic electrical/electronics field, having spent nine years as news editor of *Electrical and Radio Trading*.

Letters

Taking up the suggestion in your editorial entitled "Tackling Technology", I'd like to comment as one in a technical liaison department. The problem basically seems to be one of funding – or, if you like, how much the board is prepared to spend on a department which to them, normally being non-technical types, appears to do little to improve the firm's financial position. The old, old story of the accountants' tail wagging the technicians' dog.

Our technical department has three members who, in addition to answering phone queries both idiotic and uninteresting, have other duties to perform – such as writing letters, authenticating spares, checking circuit diagrams, etc. Apart from endeavouring, not always successfully, to keep up with new models – VCRs, hi-fi equipment, portable radios and so on as well as TV sets, also new techniques, and yet another i.c. – we go on courses (when the phone stops ringing) and are expected to be able to diagnose faults on equipment ranging from the latest to that of twenty years ago, some of which we've never seen let alone worked on. We're supposed to be experts you see – or did you say oracles? On top of all this we have to suffer barbs from people like Steve Beeching, who ought to know better.

It all seems to boil down to the problem of correct funding, and in these days of economic depression this is unlikely to happen. In conclusion, I only hope that copies of *Television* are distributed liberally round boardroom tables.

P.A.B.
Sutton.

I'm in complete agreement with the comments made in your April issue editorial leader – regarding manufacturers' technical liaison with those in the field, or rather lack of it. Yes indeed – including the ever engaged hot line to their technical offices. At least on the mainland various technical seminars are available however. Can you imagine the frustration that some of us servicing outside the Home Counties feel? Here in Northern Ireland, manufacturers' seminars just don't exist. Their products are on sale, but the technical back up is not available. How about a page in *Television* giving details of the venues of future seminars? Over to you!

E. Boyle,
Belfast.

Editorial comment: Seminars are usually run when a new chassis is introduced, and are notified to dealers through the usual channels. If setmakers would care to advise us of forthcoming seminars, we would be happy to publish details.

VIDEOTAPE SWAPS

I got in touch with Dr. Buchanan Jr. of Chattanooga, USA following his letter last August requesting those interested and with VHS recorders to consider swapping tapes on an exchange basis only. Since the US and UK TV standards are totally different, this is not an entirely straightforward business, but as Dr. Buchanan mentioned he has a PAL system VHS recorder and colour camera and is thus able to prepare "optical standards transfers" which can be played back on UK equipment. The results are obviously not as good as would be obtained with direct PAL exchange, but I must say that I've been very pleasantly surprised by the tapes I've received so far.

Unfortunately, problems have arisen in the form of HM Customs and Excise. A short time after starting my video exchanges I was surprised to receive a parcel containing two VHS tapes accompanied by a large surcharge. On checking, I was told that tapes coming into this country are subject to customs charges which can be up to £4 for each consignment, making such exchanges rather an expensive hobby. There appear to be no restrictions on tapes entering the USA. A spokesman told me that "gifts" would be allowed on an occasional basis only – occasional meaning once or twice a year. This seems ridiculous to say the least, and I'd be interested to hear from anyone else who's had difficulties in this respect.

I'd like to thank Dr. Buchanan for his kindness and consideration since we started exchanging cassettes. With the exception of the customs problem, the exchange has been most enjoyable.

Arthur Milliken,
64, Douglas Bank Drive,
Sprinfield, Wigan, Lancs.

THIS IS THE LIFE!

May I say how much I enjoy the magazine, particularly the doings of Les Lawry-Johns, who seems to echo so accurately the feelings of many of us near desperate dealer/engineers throughout the country. I often wonder whether there are any statistics for our profession relating to "suicides whilst the balance of mind was rational". It might be helpful to include articles on some of the more general aspects of servicing – things like "how to loose money and still look happy", "how to convince the customer that six hours' work on his music centre should command nearly the fee for changing a tap washer", "how to run your car for nothing for free and fictitious calls", and so on. A series could be called "how the hell do you make any money out of it", and would doubtless be popular, if only as a help in dispelling the incredulity of HM Inspector of Taxes.

There's a serious aspect to all this however – the trade's "image", certainly this branch of it. The multiples, rental organisations and so on can get round some of the basic problems by refusing unprofitable work, "take it or leave it" price structuring, dealing with only a limited range of models and so on. In addition, frustrating technical problems are not so formidable when they can be dealt with in a workshop employing several engineers – as the buck is passed from one to another, there's a fair chance that someone will have the appropriate magic wand! Alas for us small businesses, there's little recourse. Our customers stand there haggling over their bills (especially the ones with inconsequential occupations, who manage to earn twice what you do). You know the sort – "Daylight robbery. A pound for making a lead for my video?! Don't know what my missus will say when she gets back from Florida! Bloke at the cash'n'carry said they were only a couple of bob but he hadn't got one. My mate down the site would have done it for nothing, but I want to use it tonight having bought it this afternoon . . ."

All this might be going on just as an intermittent fault you've been waiting for all afternoon shows up. Why were you sitting waiting for it, you might ask? Because the bench you reserved for such cases when you built a nice system for in-out-soak test work flow is already occupied by a couple of other nasties, while the rest is full of sets waiting parts, sets waiting acceptance of estimate (while the customer takes three months to make up his mind to buy a

new one at the cash'n'carry instead), and sundry junk that was saved for some long forgotten reason.

One's off duty moments provide the relaxation necessary to be able to survive these rigours. The luxury of sinking into the tired Pirelli webbing of the armchair recently acquired from Oxfam, or the cup of coffee made from the week's special offer. This is the life! Serenity is likely to be short lived however as the distaff side asks "why do we have to put up with that funny looking aerial that works only when it's propped up against the wastepaper basket", or "can't you do something so that we don't have to wedge matchsticks in the front to make it work", or "while we're on the subject, what happened to the plug off my hairdryer?". The only counter to this is the take the dog for a walk ploy, popping into the local while you're about it. The perfect sanctuary, except when the fellow sidles up to you and says "I had this firm round to do my telly. The mechanic was there only thirty five seconds and I got a bill for sixty five quid . . ."

I suppose things are much as they've always been in this trade, though the complexities of present day equipment hardly seem to make it worthwhile. Oh for the days when distortion in a Marconi Jubilee set could be cured with a lead pencil, and you could blow all the valves in a Double Decca at the drop of a hat. That's let the cat out of the bag, hasn't it?!

There rests my case for your engaging an extra staff member – a resident psychiatrist.
Pat Mason,
Woodford Green, Essex.

THAT EHT CABLE

A further comment on the e.h.t. lead problem mentioned by Robin Smith last month may be helpful. The Philips TS7 monochrome portable chassis is unusual in having a screened e.h.t. lead – with the screening earthed at both ends. The cable contributes to the line output transformer tuning therefore, and for this reason must not be shortened.
L. Chilvers,
London E17.

SWITCH-MODE POWER SUPPLY

Luke Theodossiou has done a grand job with his colour portable project, but I think his description of the operation of the switch-mode power supply leaves something to be desired. Since the circuit is a bit unusual, and is not one with which many readers will be familiar, I hope that the following brief account may be of help.

The chopper transistor Tr2 switches on when a positive-going pulse from winding 11-13 on transformer T1 appears at its base. The current path when Tr2 switches on is from the negative plate of the mains rectifier's reservoir capacitor C19, via fuse F2, resistor R6, Tr2, winding 1-7 on the transformer, to the positive plate of C19. Now since the collector of Tr2 is inductively loaded by T1, the current will build up linearly, which in turn means that a sawtooth voltage will be developed across R6. This appears at the gate of SCR1, via R5, and when the gate is sufficiently positive with respect to the cathode, which is tied to the negative plate of C19, SCR1 fires. This places C5, which is charged by D3, across the base-emitter junction of Tr2. Tr2 switches off therefore. Regulation is achieved by varying the point at which SCR1 fires and Tr2 switches off.

This is where Tr1 and the associated circuitry come in. D4/C6 produce a negative bias for the gate of SCR1, the bias being modified by the action of Tr1, which is an error detector/amplifier. Winding 9-15 on the transformer senses the module's output conditions, D2 producing across C2 a voltage proportional to these. Tr1 compares a potted down (R1/VR1/R2) portion of this voltage at its base with a fixed voltage, provided by zener diode D1, at its emitter. The result is that variations in the output from T1 vary the conduction of Tr1, which in turn varies the bias at the gate of SCR1. SCR1's triggering time, and the point during the circuit's cycle of operation at which Tr2 switches off, are thus adjusted, providing the required regulation.

At the end of the half cycle following Tr2's switch off, tag 11 on the transformer swings positively and Tr2 switches on again.
A. Mole,
London W4.

Luke Theodossiou comments: It's a difficult task judging the amount of theory to include in any article, especially one concerned with a practical project. We try not to get too involved, sticking to points that will assist constructors in getting the circuit working should any problems arise.

I'm in agreement with Mr. Mole's account. There are some other aspects of the circuit's operation that are worth considering however. The diagrams below show the voltage and current characteristics of Tr2 and the output rectifier diodes. When Tr2 is conducting, its collector current is rising linearly due to the inductive load presented by T1. This period is known as the energy storage time and is designated *tc*. When Tr2 switches off, the polarity of the voltage across the primary winding reverses. The *RC* network comprising C8 and R9 together with the value of the rectified mains voltage and the peak current through Tr2 determine this period, known as the turn off transition time (designated *ta*). The next bit of the waveform is *td*. This is known as the energy transfer time, when the diode rectifiers at the output switch on and transfer the energy stored in the transformer to the reservoir capacitors. This time ends when all the energy has been transferred.

When the energy has been transferred, the voltage sustained across the primary winding of T1 collapses. This falling voltage causes a positive-going voltage to be developed across the drive winding (terminal 11 and 13), turning Tr2 on and starting the next cycle. The time taken for the primary voltage to collapse is known as the relaxation time (*tb*), and is a function of the transformer's primary inductance and capacitor C8.

On page 365 in last month's issue the mains fluctuation figure of ±2% should have read ±20%.

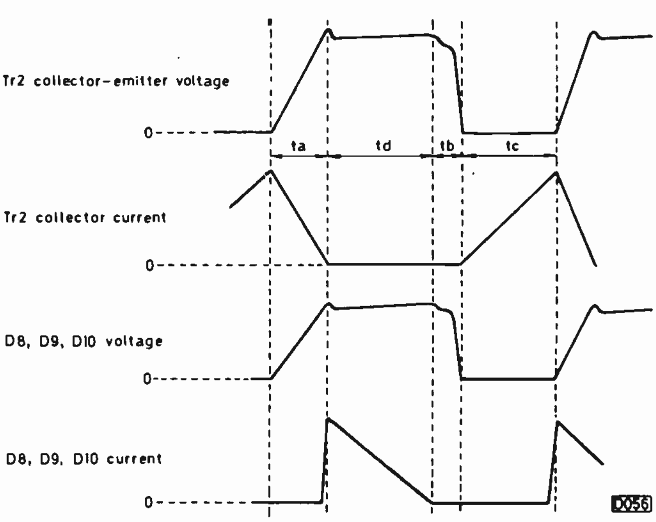


Fig. 1: Self-oscillating switch-mode power supply waveforms.

Knowing One's Job . . .

Les Lawry-Johns

EACH day that passes convinces me more that I don't know my job and never will. The fact that we successfully service thousands of sets is pure luck, backed by a little knowledge of some basic facts and polished by our experience gained over the years. Look at what happened yesterday for example.

A chappie, with some help, brought in a large Baird console that had a Thorn 3500 chassis lurking somewhere within. "Smoke" he said. "Lots of grey smoke every time we switch on." This to me meant that the fault was not a serious one, since there was not enough current passing to operate the trip – assuming that the trip was intact, and that it hadn't been shunted with 30A fuse wire. So I took a look inside and was surprised to find a strange small panel lying on the bottom left video board, connected by wires to the convergence assembly. It consisted of a couple of coils on magnets, with a knob for adjustment. Realisation burst upon me that it was the blue radial convergence assembly, snapped off the main block – probably by a heavy hand.

"The smoke comes from up here" he said, indicating the top right line timebase and beam limiter department.

"How long since this bit was snapped off?" I enquired.

"Oh that's not important: it was like that when I got the set a couple of years ago."

"That's not possible" I said with authority. "You just couldn't watch the picture with that off."

I removed the line timebase panel however, and found that C514 (4·7μF), which decouples the h.t. supply on the panel, was looking decidedly distressed. So I replaced it, refitted the panel, and switched on: first to prove that the smoke no longer issued and that the set worked, and secondly to show that you just can't do without blue convergence.

The picture took some time to appear, due to the age of the tube, but when it did become watchable (just about) it had only slight misconvergence. No doubt if the blue gun had been up to scratch the misconvergence would have been more noticeable, but there we were and I couldn't argue.

"That'll do me Lawry, at least until I start work and can afford one of those things you say I need." And off he went, after I'd secured the loose convergence assembly to prevent it shorting anything out. I was afraid to try fixing it back into its approximate position you see, because it might have messed up the convergence . . . Who needs blue correction anyway?

Another Failure

After this queer one, another one just had to follow. It was a Bush set, fitted with the Z718 chassis. I'd recently replaced the e.h.t. stick, as the original one had been causing the set to trip. So naturally the owner brought it back saying that the new stick was defective as the set was still tripping. It continued to do this with the stick disconnected, so even the owner had to admit that it must be something else. But what?

Tests proved that the line oscillator was working, and that line drive was reaching the output stage. To my befuddled mind it seemed likely that if the line output transistors were o.k., the line output transformer had probably taken exception to the load presented to it by the faulty stick, but I was loath to accept this diagnosis, mainly because I didn't have a transformer in stock. If it had been the T20 chassis, I'd have fitted a new line output transformer without hesitation, but the Z718 chassis is a different proposition altogether in this respect.

So I checked the line output transistors and found slight leakage in both. Two new ones went in and made no difference at all. "I must have the set today, because I'm going abroad on Monday and I must leave it working for the family." More frantic checks, all to no avail.

"I think it's the line output transformer" I confessed, "but I'm not sure. Nip it up to Geoff in Moon Lane and see what he and Eddy think. Two heads are better than one, and they probably have a transformer they can fit today." So off he went, leaving me with a severe dose of lost confidence, something that always makes me mean to the cat.

Some time later Geoff phoned to say that it hadn't been the transformer, and that Eddy had met this one before. After some preliminary checking, he'd diagnosed a faulty potentiometer – the NS pincushion phase control 5RV2. Later I had a look at the circuit. The defective potentiometer was presumably loading the field output stage, and as this obtains its 32V supply from the line output stage there would be an excessive load here as well.

Every One's a Killer

"Before you go" Geoff continued, "there's a little story you might like to hear." Apparently an engineer friend of his had been attempting to deliver a set to a customer, but couldn't get in through the front gate because of the ferocious dog that was barring his way, barking its head off.

The lady of the house looked out of the window and gave him instructions. "Kick his balls and he'll be friendly" – meaning the small balls it played with in the garden of course.

"If you'll turn him round I will" bawled the frustrated engineer.

"You horrid man. I'll report you for this."

Thank you Geoff. Every one's a killer. "You haven't heard anything yet" continued Geoff, warming to his task. "You remember Sam Magrew whom you described with such loving detail in the April *Television*?" As if I could forget him.

"He's on our back now. Came in for the cheapest colour set we could offer him, which also turned out to be the heaviest, a Thorn 3000 with sliding doors and all mod cons. Bloody great thing. Delivered it to his house and left it working fine. Next day he came in to say the set wasn't right and what were we going to do about it? Went up there and found that his crippled old mum had lugged it round to the other side of the room and mucked about with the aerial plug etc.

So we put that right and left it working again. We've been up there half a dozen times since to sort it out. She (or is it he?) can't leave it alone for more than a couple of hours.

I wish we'd never set eyes on him."

"What a shame Geoff" I tittered. "If there's anything I can do to help, like pushing him off the end of the pier, just let me know."

No on/off

A common complaint in recent years is that "the on/off isn't working." This is the customer's complaint, or rather statement, based on the fact that when they switch on nothing happens. Once in a while, usually after a lengthy explanation has been given as to why the switch need not be at fault, it turns out that they are right and the customer looks at you pityingly and says "what else could it have been?"

In the majority of cases however they're wrong and you could be on to a merry chase, especially if the fault is intermittent and the set comes on when you are about to make a key measurement that would solve the problem. The Philips G11 chassis is a particularly apt example: the upper right line output board can cunningly conceal dry-joints that contact at the slightest vibration. How you tackle this sort of thing is a matter for personal preference: resoldering every joint on the board may seem silly and time wasting, but it's often the only long term remedy if call-backs are to be avoided.

A Tedious G9

A recent time waster was a Philips set fitted with the G9 chassis. It turned out to have two intermittent faults, one producing the "dead set" symptom and the other an audible tripping as the h.t. line rose to 125V and then collapsed to zero, rising and collapsing cyclically. The faults would then clear and the set would behave impeccably for the rest of the day. We eventually managed to make some brief measurements at one or two points on the power supply panel, and discovered 10V across a 7·5V zener diode. When we replaced the diode the faults seemed to clear, but on switching on next day the h.t. was haywire again with a narrow, fluctuating picture.

We spent much time on the power supply panel, since the fault would clear for long periods. Whilst making a couple of adjustments on the line scan panel however we accidentally found that the fault could be provoked by applying pressure around the centre electrolytic C138 (2,200μF), which decouples the emitter of the line output transistor and acts as a reservoir for the 45V supply obtained from the EW diode modulator. Thinking that we were on to a dry-joint, much time was spent in the happy pursuit of resoldering, to no end of course. We then did what we should have done initially: we removed C138 and found that its end tags had deteriorated. A new electrolytic restored reliable operation, once the beam limiter had been set up correctly.

Enter the Flower Seller

A gypsy lady then came in and offered either to sell me some flowers or tell me my fortune. She seemed remarkably like the fortune teller I'd encountered at the seaside on that rainy summer day all those years ago – the one who warned me about the blue tants in Bob's TV set twenty years later. Not a person to be trifled with, even though it had cost me two and sixpence at the time. Seeing that I wasn't going to buy any flowers, she gave me a sample of her psychic power.

"You're not appreciated" she said. "People take you for granted and don't reward you enough for what you do."

"That's true" I agreed immediately. "Television sets cost no more now than they did ten years ago, so people don't want to pay any more for the repair than they did then, but everything else has gone up ten times. That's why I'm poor while everybody else is getting richer."

"You'd be better off emptying dustbins" she sympathized. "You need one of my lucky charms, then you'll be able to get away with charging more."

"Our dustbins aren't emptied" I protested. "We have to put our rubbish in these black plastic bags which they throw into the back of a big lorry thing with a big screw that goes round and chews everything up, and the dustmen tell me that if I don't give them a bigger tip this Christmas they'll throw me in and I'll be screwed."

"You'll get screwed if you don't stop talking rubbish and get on with some work" said Honey Bunch, trotting down stairs. "Oh what lovely flowers! Can I have some?"

So she and the flower seller lady engaged in some hard bargaining, whilst I was left out in the cold as usual without finding out whether red tants are any more reliable than blue ones.

SERVICE NOTES FROM PHILIPS

G11 chassis: Due to spreads in the characteristics of the TDA2591Q line oscillator/sync separator i.c., line jitter can be experienced. To overcome this problem, a 27kΩ resistor has been added in parallel with C2029 (0·1μF).

In models with full infra-red remote control, the SAA5000 i.c. (IC3606) used in the hand-held remote control unit has been superseded by the SAA5000A i.c., which has a lower power consumption. Along with this change, the values of R3601-5 and R3609 have been increased from 33kΩ to 100kΩ.

KT3 chassis: In sets that include teletext facilities, the value of C2160 in the i.f. module is 33pF – it's 120pF in non-teletext sets. A few cases of poor data capture have been reported due to C2160 not being of the correct value.

K30 chassis: To prevent power supply shut down when tuning, the value of R7322 on the U11 supply drive/control panel has been reduced from 3·9kΩ to 2·2kΩ.

To increase the field flyback blanking period and prevent the vertical interval test signals causing interference at the top of the screen, a 15pF ceramic plate capacitor has been added between the collector and emitter of transistor T1535, mounted on the print side of the panel.

TX chassis: On some sets a light vertical line may be present near the left-hand edge of the screen, more noticeable on dark scenes. The following modification should clear the trouble. Add a BY207 diode and a 10kΩ, $\frac{1}{4}$W resistor in series between the anode of the 95V rectifier diode D453 and the emitter of the video output transistor TS560. The anode of the added diode is connected to the anode of D453, i.e. the junction of R450/D453. Cover the diode and resistor with PVC sleeving, and connect a 7in. (18cm) length of wire to the free end of the resistor. The wire is taken to the video transistor: position the components in the sleeving along the near edge of the panel, away from the line output transformer, and keep the length of wire away from any components that generate heat.

VHF Log-periodic Aerial

Gareth Foster

WHEN I first started to think about a DX-TV installation, one of the prime considerations was a simple aerial system. I decided to use just two aerials, one covering the u.h.f. bands and the other the v.h.f. spectrum from 45 to 230MHz. For the latter purpose, a log-periodic aerial seemed a suitable choice, but of course such an aerial is not available commercially in the UK. So I had to build one, which is the subject of the present article.

The aerial has twelve elements, connected to a pair of parallel booms in the usual log-periodic alternating manner, i.e. element one has its left half connected to the top boom and its right half connected to the lower boom, the next element having its right half connected to the top boom and its left half to the lower boom, and so on. The booms consist of two lengths of 1 × 1 × $\frac{1}{8}$in. U-section aluminium, spaced at 0·6in., with a shorting link between the booms 16in. behind the longest element. Table 1 shows the dimensions of, and spacing between, the twelve elements. The first six elements were made of $\frac{1}{2}$in. diameter aluminium tubing, elements 7-12 being made of $\frac{3}{8}$in. tubing, with the wall thickness 22 SWG or thicker.

Construction

The elements were fixed to the booms by drilling holes along one side of each boom, the holes being drilled so that when the elements are inserted they lie flat against the bottom of the channel inside the U section – i.e. the edges of the holes are $\frac{1}{8}$in. up the side of the channel. Start by drilling the $\frac{3}{8}$in. holes for elements 12, 10 and 8, with centres $\frac{5}{16}$ in. from the bottom (outside) of the boom, then drill $\frac{1}{2}$in. holes for elements 6, 4 and 2, with centres $\frac{3}{8}$in. up. Element 12 is spaced 0·7in. from the front end of the boom. Then turn the boom over and drill the $\frac{3}{8}$in. holes for elements 11, 9 and 7 and the $\frac{1}{2}$in. holes for elements 5, 3 and 1. See Fig. 1. The two booms should be identical, so that when one is turned over and placed on the other they match up.

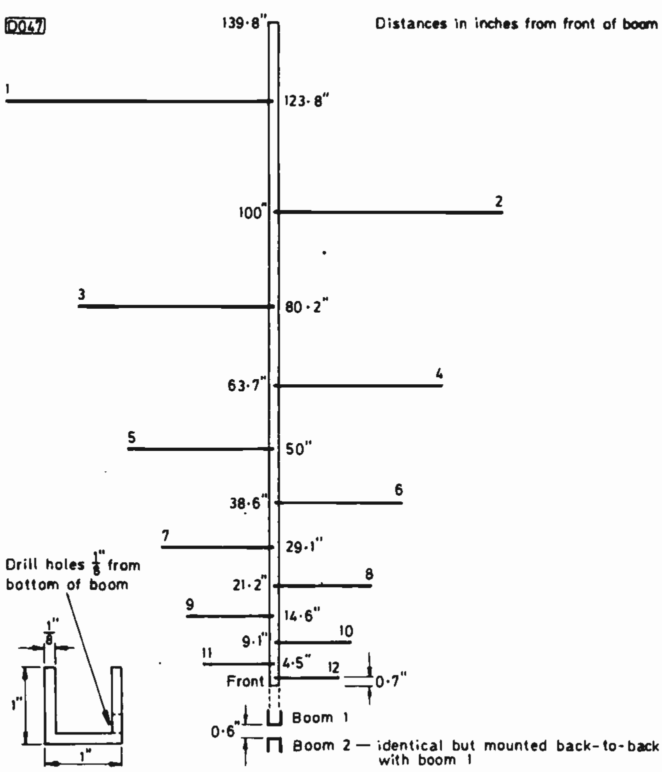


Fig. 1: Boom details.

When cutting the elements, remember to make each section $\frac{3}{8}$in. longer than half the full element length to allow for the part that lies within the U-section boom. Plug both ends of each element section to keep out water – aerial manufacturers use rubber or plastic bungs, I used Isopon. The longer elements, say all the half inch ones, should have rope inserted within them to prevent them resonating in the wind.

I clamped each element in position using a $\frac{1}{2}$in. strip of 20 SWG aluminium, bent to form a bracket as shown in Fig. 2. The element was inserted in its hole, squared up, and two 6BA clearance holes were drilled through the ends of the bracket and the boom, the holes being countersunk from the underside. Fixing was done with brass screws and star washers beneath the nuts. A third hole was then drilled through the centre of the bracket/element/boom, a long screw being inserted to give stability.

The booms were spaced apart using pieces of $\frac{3}{16}$in. thick Paxolin, screwed to the sides, one pair being adjacent to element one, with another adjacent to element 11 (see Fig. 3). Plated 2BA steel screws were used for this. The booms are cut off 16in. behind element one, a shorting link being fitted at this point. A small aluminium block, 1 × 0·6 × $\frac{3}{16}$ in., filed from a scrap piece of $\frac{3}{16}$ in. sheet, was used for this purpose, linking the booms and secured with 6BA screws (see Fig. 4).

Table 1: Element lengths and spacings.

Element	*Length (in.)*	*Spacing (in.)*
1	131·2	
		23·8
2	109·3	
		19·8
3	91	
		16·5
4	75·8	
		13·7
5	63·1	
		11·4
6	52·6	
		9·5
7	43·8	
		7·9
8	36·5	
		6·6
9	30·4	
		5·5
10	25·3	
		4·6
11	21·1	
		3·8
12	17·5	

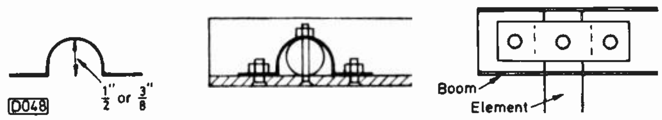
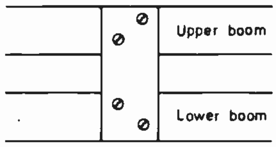


Fig. 2: Method of securing the elements to the booms.



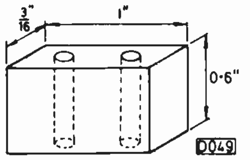


Fig. 3 (left): Boom spacing, with pieces of Paxolin at each side, towards the front and back of the aerial.

Fig. 4 (right): Boom shorting block.

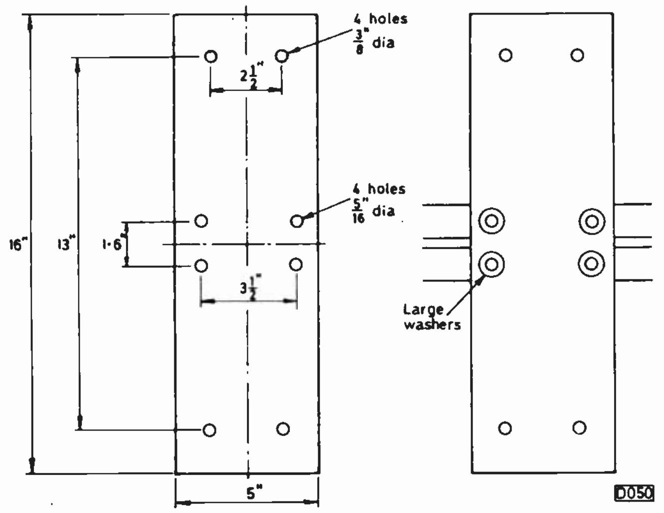


Fig. 5: Centre support/mounting plate.

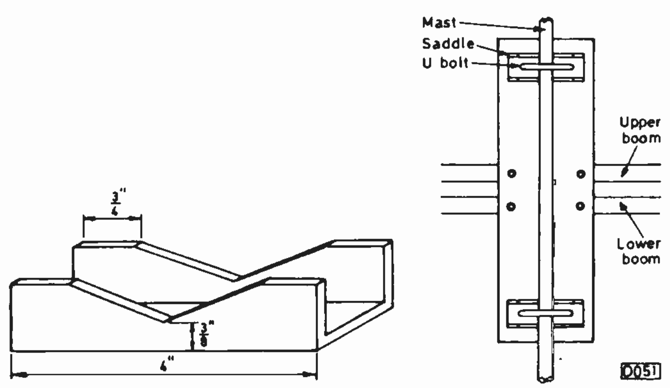


Fig. 6: Method of clamping the aerial to the mast.

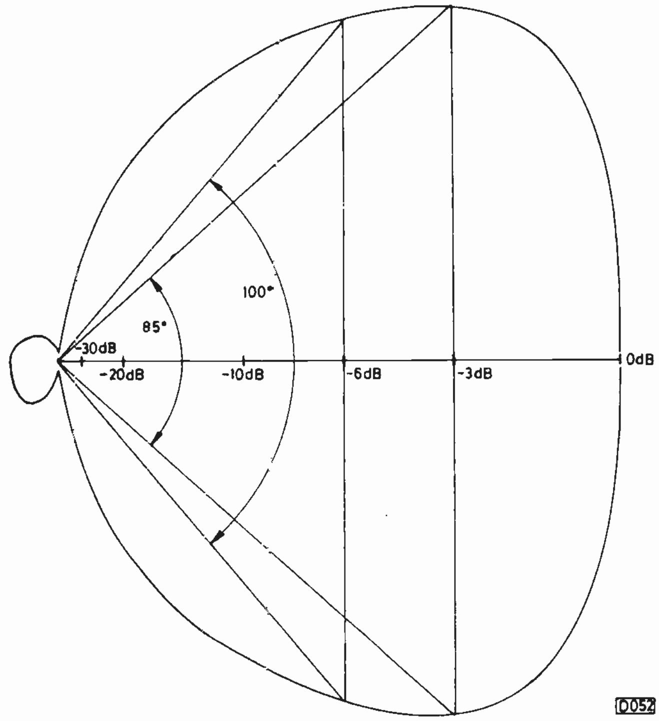


Fig. 7: Polar response at 94·9MHz.

The booms need support at the centre as well. The centre support, fitted on one side only, was also used to clamp the aerial to its mast. Ideally, a piece of $\frac{3}{8}$in. thick Paxolin, 16 × 5in., should be used (see Fig. 5). I used two $\frac{3}{16}$in. pieces together however as it was all I had available. Fig. 5 shows the positions of the eight holes that were drilled in the Paxolin, which is bolted at right angles to the booms, at their balance point, using $\frac{5}{16}$in. plated steel bolts. Large washers, about 1in. diameter, were placed under the heads of the bolts.

The top and bottom pairs of holes were used to clamp the aerial to the mast, using $2\frac{1}{2} \times \frac{3}{8}$in. U bolts – available from Tandy. It's not wise to clamp the mast directly to the Paxolin, which could bend round the mast and crack. Instead, I made a pair of saddles for the mast from pieces I'd cut off the booms, see Fig. 6. The Vs were cut out using a hacksaw: no attempt was made to smooth the cuts, a rough edge gripping the mast better.

The cable connection is made at the front of the aerial, with the inner of the coaxial cable connected to the upper boom and the screen connected to the lower boom. To achieve a self-balancing effect, the cable should be brought back under or inside the lower boom to the rear of the aerial, so that the cable cannot be "seen" by the upper boom. In practice the cable can be taken back as far as the mast and then brought down in the usual way.

The cable connection must be waterproof of course. I used a hard rubber junction box taken from an old Band I X aerial, filling the four holes for the original elements with Isopon. The box was bolted to a pair of small angle brackets at the end of the booms – the same bolts were used to make the connections to the cable inside the box.

Performance

The polar diagram (Fig. 7) shows that the acceptance angle, at 94·9MHz, is fairly wide – 85° at the –3dB points. The front-to-back ratio is 23·5dB. The wide acceptance angle often enables one to catch signals that might otherwise go unnoticed (with a sharper lobe). Experience with the aerial suggests that the polar response is similar throughout the frequency range. The gain is probably around 3-4dB, which is modest for Band III but o.k. for Band I.

The aerial has given good service for a couple of years at my location near Heathrow airport, at about 50ft. above sea level, with the aerial at about 42ft. I get virtually daily reception of Lopik ch. E4 and Lille ch. F8A, and during Sporadic E openings I've received signals from Iceland, the USSR and Spain, the latter giving a colour display. During tropospheric openings, low-power Band III transmitters in Switzerland have been received without a preamplifier. The aerial is mounted on a rotatable mast, along with a Vorta VPX22 u.h.f. aerial. Guying is essential, as the aerial is rather heavier than a commercially made one would be. ■

Servicing the Rank T20 Chassis

Derek Snelling

THE Rank T20 chassis has been around for three or more years now and, whilst reliable, is prone to cause problems for the unwary. One of the first things to do is to make sure that it actually is a T20 chassis, since Rank produced three similarly constructed chassis in succession. The earlier Z718 differs in several important respects, having a two-transistor line output stage, an unregulated power supply circuit and a Toshiba tube. The T20 chassis was introduced when the Mullard 20AX tube came along. The subsequent T22 is similar in many respects, differing mainly in having a totally different signals panel.

There are only two common faults in the T20's decoder/i.f. section. One involves the plug and socket via which the i.f. panel is connected to the decoder: the other is rather more awkward, giving misleading symptoms, and requires a modification to provide a cure. The symptoms associated with this latter fault are flickering of the picture and varying brightness, with possible faint interference on the sound – similar to the symptoms one would expect with a faulty aerial plug or arcing in the line output/e.h.t. area. The fault is caused by the earth connection from the c.r.t. base to chassis however: it's routed through plug 3Z6, then via the decoder to chassis. Two modifications have been introduced to cure it. The first involves connecting a heavy gauge wire from pin 9 of the plug (the one which protrudes on the component side of the decoder) to chassis. If this doesn't cure the trouble, carry out the second modification – remove the wire from the tube base to the socket, soldering it directly to the decoder instead.

Line Output Panel

The line output panel is where most of the problems arise, and it's easy to make mistakes here. Beginning with the easy faults, the line output transformer is not very reliable (unlike the earlier A823 and Z718 chassis). Failure is usually made obvious by the presence of burn marks on the e.h.t. overwinding. The next obvious problem is the line output transistor, and this is where mistakes can be made, particularly if the manual is not to hand. A large number of sets are fitted with a Toshiba BU208 line ouput transistor you see, so you naturally go and fit another BU208 – which will not work correctly. The manual indicates that a BU208A should be used, and the reason for the apparent contradiction seems to be that the Toshiba BU208 is in fact a BU208A. Always use a BU208A then.

The line driver transistor 5VT3 fails occasionally, and again care is required in fitting the replacement. Either a BD150A or a TE538 may be fitted, but these have different pin connections and use different holes in the print. Whilst they are interchangeable, they require different heatsinks. So replacement with the same type is advisable.

The main cause of confusion on this panel however is the protection circuit – transistors 5VT1/2 and a couple of resistors mounted on the main board, plus a small vertically-mounted subpanel. The circuit removes the drive at the base of the line driver transistor in the event of a faulty tripler or an overvoltage condition. Since most of the supplies in the set are derived from the line output stage, the set is apparently dead when the trip operates. To reset the trip, the set must be switched off for a few seconds. There are three inputs to the subpanel. The orange wire connects the line output transformer derived 36V supply to potential divider 5R7/6 on the panel; the mauve wire links the tripler to 5D5; while the yellow wire connects the slider of the overvoltage trip preset 5RV1 to 5D4. The preset is connected in series with 5R9 across the 50V pulse winding on the transformer, the pulses being rectified by 5D4/5C6. If any of these inputs rises sufficiently to exceed the zener diode's breakdown voltage (5D2), the diode conducts and both 5VT2/1 switch on, earthing the base of the line driver transistor 5VT3.

If you suspect that the trip is operating, first check the h.t. voltage. This should be 200V. Next check the voltage at the base of 5VT3. This should be 1V – significantly less suggests that the trip has operated. As a final check, switch off for a few seconds then switch on again: if the e.h.t. and the sound appear for a fraction of a second before the set goes dead, the trip is operating.

Having established that the trip is operating, finding the cause is not so easy. Try disconnecting the input to the tripler. If the set then operates normally (though without e.h.t. of course), the tripler may be at fault. The same effect can be produced should 5VT1 or 5D5 be defective however. The most common cause of the trip operating is failure of one or both transistors (5VT1/2) in the trip circuit. This can be proved by removing 5VT2, when the set should operate normally. Don't leave it at that however, and don't remove 5VT2 for test unless you are sure that the cause of the fault does not lie elsewhere. The simplest course here is to replace both transistors – they are not expensive. This can cause another possible problem however. 5VT2 is shown in the service manual as type BC158A, but for some reason fitting one of these won't always work. In fact I've taken a working set and several brand new BC158As, and on fitting them in turn to the set got normal working in only half the cases. A far better replacement is the BC308A, which is in fact fitted by Rank in most sets and always works.

If the set works perfectly for a couple of hours or so and then goes dead due to operation of the trip, check 5R8 which is in series with the base of the line output transistor. It has a tendency to go low, and should be replaced with a 2·5W wirewound type. If, after all this, you still have problems with the trip operating occasionally for no

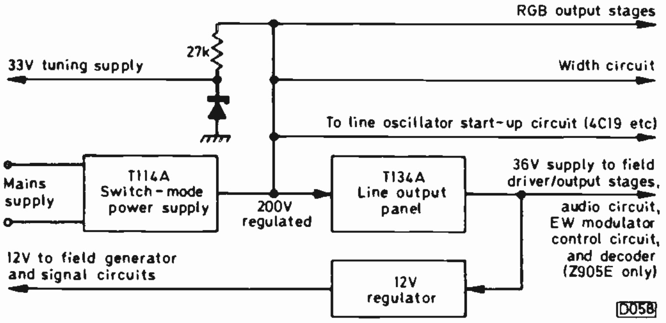


Fig. 1: Power supply arrangements, Rank T20/T22 chassis.

apparent reason, fit an 0·0022µF capacitor across 5R1: this will help to prevent spikes triggering 5VT2.

Should any components in the overvoltage trip circuit be replaced, 5RV1 may need resetting. Set the brightness and contrast to minimum, and turn 5RV1 fully anticlockwise. Connect a meter switched to the 100V range across 5C6, and adjust 5RV1 until the trip just operates. Note this reading. Switch off, reset 5RV1 fully anticlockwise, then switch on and readjust 5RV1 for a reading of 1V less than the previously noted trip reading. Finally, remember that the trip will operate if the h.t. rises significantly above 200V, so always check this and if necessary investigate the power supply.

Power Supply

This brings us to the regulated power supply, which is of the self-oscillating chopper type. 7VT2 is the chopper transistor, thyristor 7THY1 fires to switch 7VT2 off early during its cycle, while 7VT1 provides the regulating action, adjusting the bias at the gate of 7THY1. 7THY2 acts as an overvoltage/excess current crowbar, connecting 7R15 across the bridge rectifier's output when it fires, with the result that fuse 7FS1 blows. Note that the set's chassis – as with many modern chassis – is at half mains potential.

Faults in this area usually consist of failure of 7VT2, and when this has to be changed it's essential to change 7THY1 as well and preferably 7VT1 also. Failure to do this usually results in the replacement BU326 shorting at switch on. If fuse 7FS1 has blown, be careful when replacing it as 7C13 can hold its charge for thirty seconds or so after switch off. Note that 7FS2 was originally 1·6A, but was uprated to 2·5A to reduce the incidence of fuse failure.

If 7FS1 blows immediately after the set is switched on, disconnect plug 5Z2 to isolate the power supply from the rest of the set. If another fuse then fails, check the crowbar thyristor. If it seems to be o.k., it's being triggered by an overvoltage condition. Cold checks on the semiconductor devices in the power supply will usually reveal the cause of the problem. Failing this, a variac is really needed to carry out any detailed fault finding. With a variac, the mains voltage can be increased slowly and kept to a value that prevents the ouput voltage rising sufficiently to trigger the crowbar thyristor. Fault finding can then be carried out with a meter, and the operation of the stabiliser can be checked.

An unfortunate point is that the bridge rectifier's reservoir capacitor 7C13 is mounted on the panel vertically. As it ages, it tends to leak over adjacent components. In bad cases it can corrode the leads of these components, making their replacement necessary as well. It's a good idea to remove nearby components whilst cleaning up, so that they can be checked and a thorough cleaning job done.

Timebase Panel

The other board that gives rise to occasional problems is the timebase panel. Faults here generally centre around the field output stage, and can be resolved by changing one or more transistors. Other things to check in the field output stage are the biasing diodes and resistors. With all field faults, check any resistors associated with a failed transistor as they have a habit of becoming defective. Finally, note that the sync/line oscillator chip is a TBA950 rather than the more common TBA920, and that a tool suitable for adjusting the various controls on this and the other panels will be found clipped to the chassis by the convergence board. ■

Fault Summary: Rank T20/T22 Chassis

John Coombes

ONE of the most common faults on these sets is a defective on/off switch – this doesn't usually produce the dead set symptom, the switch sticking instead in the on position. The other common fault is no results. Unfortunately quite a number of things can produce this symptom: the cause can be in the power supply module, or on the line output or scan drive panel. The T114A power supply module and the T134A line output and T136A scan drive panels are common to the T20 and T22 chassis, the main difference between them being that the former is fitted with the Z923E signals panel (Z905E decoder panel plus Z908A i.f. panel) while the latter is fitted with the T130A signals panel.

Operation of the Power Supply

We'll take the power supply module first. It uses a self-oscillating chopper circuit (see Fig. 1) which at first sight looks a bit daunting. Before considering faults therefore it's worthwhile outlining what does what.

The mains bridge rectifier 7D14-17 produces an output of something over 300V across its reservoir capacitor 7C13. This is applied via fuse 7FS1 to the chopper regulator circuit. The output from this is rectified by 7D1, which produces a regulated 200V h.t. supply for the line timebase and the RGB output stages across its reservoir capacitor 7C2. The chopper transistor is 7VT2: it's connected across the unregulated 300V supply via 7R10 in its emitter circuit and winding 16-10 on the chopper transformer. Feedback between the base and emitter of the transistor is provided by winding 14-1 on the transformer and the network 7D3/7C3/7D4/7R2.

When tag 14 on the transformer swings positively, 7VT2 switches on. It's switched off when thyristor 7THY1 fires, the point at which this occurs being varied to provide the voltage regulation action. Let's consider first how 7THY1 is triggered on. The rectifier circuit 7D8/7C7 provides a negative bias for the thyristor's gate, while the rectifier circuit 7D5/7C5 provides a positive supply for its anode. Its cathode is connected to the negative side of the 300V supply. 7THY1 fires when its gate is made positive with respect to its cathode. When the chopper transistor 7VT2 switches on, a sawtooth voltage is developed across 7R10 (since 7VT2's collector is inductively loaded). This sawtooth is applied to the gate of 7THY1 via the set current limit control 7RV1. When the sawtooth has risen sufficiently, 7THY1 fires. This places 7C5, which has been charged by 7D5, across the base-emitter junction of 7VT2, which thus switches off. Regulation is achieved by using the circuit around 7VT1 to vary the bias at the gate of 7THY1 and thus its switch-on time.

For regulation purposes, winding 12-5 on the chopper transformer senses the module's output conditions, the rectifier circuit 7D2/7C4 producing a proportional voltage which is applied to 7VT1 and its associated components. 7VT1's emitter voltage is held constant by zener diode 7D6, its base sensing voltage variations. As a result its collector current, and thus the gate bias on 7THY1 and hence its firing point, are varied to effect regulation.

Though the circuit is self-oscillating, it's not self-starting. So to get things going a positive pulse derived from the mains is fed to the base of 7VT2. This is applied via 7D11, 7C10 and 7R9, zener diode 7D9 clipping the pulse.

Protection is provided by the crowbar thyristor 7THY2, which fires and thus blows fuse 7FS1 in the event of excessive current flowing in the circuit or the output voltage rising excessively. Excess voltage is sensed by zener diode 7D13. Excessive current flow is sensed across 7R10, via 7D3, 7D5 and zener diode 7D7.

Incidentally, the T114B regulated power supply module used in the later T26 (30AX tube) chassis is almost identical, the only difference being that the output voltage is reduced to 155V. To achieve this, 7D1 is tapped down the primary of the chopper transformer – it's connected to pin 7.

A useful feature of this type of power supply is that it can be removed from the set and repaired on the bench. A suitable load is two 60W bulbs in parallel to simulate the normal load condition (120W) and three 60W bulbs in parallel for maximum load (174W). The output should be set at 200V by means of 7RV2, under normal load conditions.

Power Supply Faults

Now to faults in this area, starting with the easy ones. There's quite a lot that can go wrong, resulting in some difficulty with fault finding, though the unit is generally reliable.

Assuming that the fault is no results, a simple first step is to disconnect plug 5Z2 and check whether there's 200V across 7R1. If there is, the power supply is operating correctly and attention should be directed to the line output stage. The BU208A line output transistor may well be short-circuit.

If there's no output from the power supply module, check the fuses. Note that 7FS1 is an HRC type, and that 7FS2 was uprated from 1·6A to 2·5A. If 7FS1 is open-circuit, check 7R15. If this is also open-circuit, suspect the crowbar thyristor 7THY1 of being short-circuit. If 7R15 is all right, check the chopper transistor 7VT2 (which must always be replaced with 7THY1 as a pair), the regulator transistor 7VT1, and the h.t. rectifier 7D1. 7D7, 7D12 and 7D13 can also be responsible for 7FS1 being open-circuit, by operating the crowbar.

If the mains fuse 7FS2 has blown on the other hand, the things to check are the filter capacitor 7C19, the bridge rectifier diodes 7D14-17, the reservoir capacitor 7C13 and the dual-posistor 7TH1 is the degaussing circuit. Both 7C19 and 7C13 can be responsible for intermittent fuse blowing.

7R17 can go open-circuit to give the dead set symptom: this usually happens when one of the bridge rectifier diodes has gone short-circuit.

If the fuses are in order but the receiver won't start, check the start circuit components – 7R9 for value and 7D9 by substitution. Note that 7R9 was 2·2kΩ in early production sets, and was reduced to 220Ω to ensure reliable starting – also there should be only one ferrite bead on 7VT2's base lead. Another possibility is that 7D8 is short-circuit.

If there's still no output, check diodes 7D3 and 7D4. If one of these is short-circuit, 7D7 may also be short-circuit. Also check whether 7R10, 7R2 or 7R11 is open-circuit. If

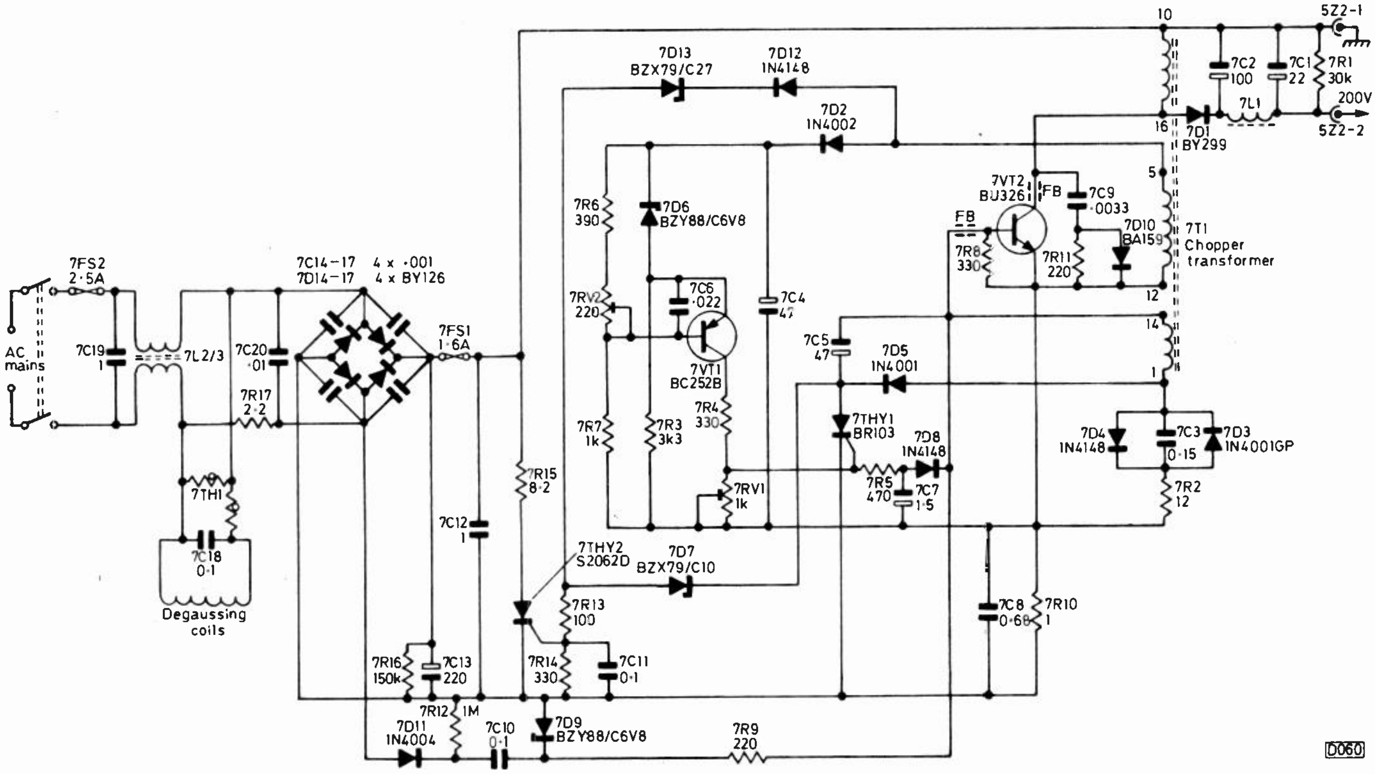


Fig. 1: Circuit of the self-oscillating switch-mode power supply (type T114A).

necessary, check the electrolytics 7C4, 7C5 and 7C7.

7C4 and 7C5 can also be responsible for the h.t. being low. Other things to check for this fault are 7C3 and 7D5 (by substitution). If 200V can be obtained only when 7RV2 is set to maximum, check 7VT1 and 7D6. If the output is low and fluctuating, 7C13 is probably open-circuit.

Line Output Panel

Returning to the no results fault, if the power supply is in order the line output panel is the next place to check. If, with plug 5Z2 connected, the voltage at pin 2 is very low, the line output transistor 5VT4 is likely to be short-circuit. Also check the line driver transistor 5VT3 and its fusible feed resistor 5R3. If the driver transistor is o.k. but 5R3 keeps opening, check 5C5 which may be short-circuit. On rare occasions, the problem could be due to shorted turns on the line driver transformer 5T1.

We've had more awkward cases of 5R3 going open. If you find that 5VT3's base voltage is varying, changing the TBA950 sync/line oscillator chip on the scan drive panel may cure the trouble. On one occasion however we found that the cause of the problem was the chassis connections between the scan drive and line output panels – at pin 2 of plug 4Z2. The other component that can result in 5R3 going open is diode 5D1 – check whether it's short-circuit.

If the line driver stage is all right, there may be a fault in the overvoltage protection circuitry. Check the transistors 5VT1/2 and zener diode 5D2, the operation of the trip control 5RV1, and for dry-joints around the trip subpanel. If 5R5 is cooking, check whether 5D5 is short-circuit and/or 5R13 open-circuit. Spurious operation of the trip can often be cured by adding a 2,200pF capacitor across 5R1 (5C19 in later production).

The overvoltage trip will operate, removing the drive from the base of the line driver transistor, if any of the following items are faulty: the tripler (try disconnecting it); the EW modulator diodes 5D6/7; 5C18/13; or the line output transformer.

The line output stage will be dead if 5R8 or 5R11 is open-circuit. 5R8 is a metal oxide type in early sets, and should be replaced using a wirewound resistor – the metal oxide type tended to change value, causing lack of width, sometimes intermittent, foldover and damage to the line output transistor. Other possible causes of a dead line output stage are a short-circuit flyback tuning capacitor (5C14), or fuse 5FS1 (if fitted) being open, possibly due to 5C10 being short-circuit. Note that the line output transistor may read all right on a meter but still be faulty.

If the tripler is faulty, make sure that 5C14 is in order. Note that the line output transformer is suspect on these sets. Finally, check that the chassis plug/socket connection between the scan drive and the line output panels is in order, that the wire link between pins 10 and 11 of plug/socket 5Z1 is making contact, and pin 1 of 5Z1 for discolouration. In the latter case, check for dry-joints – it's best to replace the plug and socket and the cableform. This particular point can give the alternate symptom of line collapse.

Scan Drive Panel

If everything associated with the line output panel is in order, you may have to turn attention to the scan drive panel for the cause of no results. The TBA950 sync/line oscillator chip may not be operating. It's easy to check this by plugging in a replacement. Other things to check are 4C17 which decouples the supply pin, the presence of the 12V supply at 4R48, and the various components associated with the start-up supply – 4C19, 4R49 and 4D11/13/14. The 12V supply comes from a series regulator on this panel, and on one occasion we traced the dead set symptom to the absence of this supply as a result of 4R16 being open-circuit. Awkward, that one.

Scan Derived Supplies

Why all these possible causes of no results? Because, apart from the regulated 200V line, all the other supplies in the set are derived from the line output stage. Thus a faulty line output stage, or loss of line drive, shuts everything down. The EW modulator produces the 36V line (across 5C8), and the 12V supply is derived from this via a series regulator circuit (4VT6/7).

Focus Faults

Focus troubles are common on these sets, usually due to pin 9 of the tube base socket being corroded. The only sure cure is to replace the socket, using the modified type available from Rank. A temporary cure can be achieved by cleaning, but the corrosion is usually so bad that the socket pin is broken. Other things that may need to be checked for this fault are the focus unit 5RV2, which is mounted on the line output transformer, and 12R1 (100kΩ) on the c.r.t. base panel.

Excessive Width

Excessive width is an occasional problem. If the width control has no effect, check the associated transistor 4VT14 (BC148B) for being short-circuit. If this transistor is o.k., check the Darlington pair EW modulator driver transistors 4VT17 (BC157) and 4VT18 (2N5296). One of them may be open-circuit. Excessive width with bent verticals and no voltage at the collector of 4VT18 was traced to the EW modulator diode 5D7 (BYX71) reading about 10Ω each way.

Sync Problems

Next sync problems. For no sync, plug in another TBA950 sync/line oscillator i.c. If this doesn't solve the problem, check the video input coupling/biasing network 4C18 (0·068μF), 4D12 (1N4148), 4R50 (1·2MΩ) and 4R51 (470kΩ). If the sync is still poor, check whether the correct input is coming from pin 10 of the TCA270Q i.c. (T20 chassis) or pin 15 of the TDA2560 i.c. (T22 chassis).

If the line hold doesn't break correctly at each end of the control's range, check that 4R59 is 10kΩ rather than 11kΩ as originally fitted.

With field sync problems, the TBA950 i.c. is again suspect. If necessary, check the pulse integrating/feed components 4R53 (4·7kΩ), 4C20 (0·0047μF), 4C7 (0·047μF) and 4R22 (22kΩ).

Field Faults

For field collapse, first check the output transistors 4VT3 and 4VT4 (both type 17466) by substitution and adjust the field output bias control 4RV6. Check the condition of 4R8. If it's burnt up, replace it along with the biasing diodes 4D1/2/4. Other things that might need to be checked are the feed resistor 4R13 (if open-circuit, check the decoupler 4C4 for being short-circuit), the discharge transistor 4VT10 (BC252), 4R40 (8·2kΩ), the flyback clamp diode 4D3, 6R9 (1·8Ω) on the convergence panel and the continuity of the scan coils. 4VT10 can be responsible for intermittent field collapse or intermittent lack of height. For height variations, replace the height control 4RV4 (100kΩ).

Signal Circuits

A common fault on these sets is intermittent black lines. Clean the pins of plug 3Z6, and remove the earth braid from pin 9 (Z905E decoder panel only), soldering it direct to the earth print adjacent to 3R65. Another cause of this

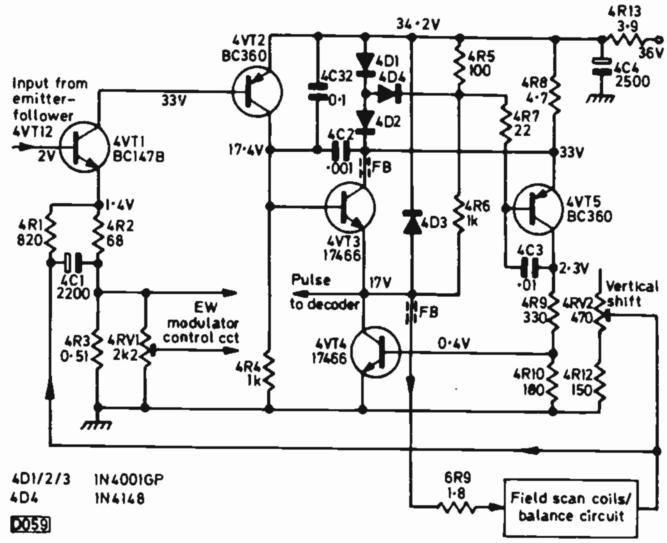


Fig. 2: field driver and output stage circuit.

trouble with the Z905E decoder is dirt or a thin film on the pins of the TCA800 demodulator/matrixing i.c. Scrape the pins carefully, taking care not to bend them. It's advisable to remove and replace the i.c. using an extractor and an inserter. The T603A/B tuner unit used in the T20 chassis can also cause this trouble: check by replacement.

The decoders used in the T20 and T22 chassis are completely different. The Z905E decoder used in the T20 chassis employs the earlier Mullard three-chip arrangement (TBA560C/TBA540/TCA800), with class A RGB output stages. The T22's decoder uses the later TDA2560/TDA2522/TDA2532 i.c. combination and class AB RGB output stages.

We'll deal with the Z905E decoder first. If the problem is a bright raster with flyback lines, check transistor 3VT10 (BC328) which forms a common low-impedance emitter load for the RGB output transistors. Also check the setting of 3RV13 (set black level) which biases 3VT10's base. This control may require adjustment if a new decoder panel is fitted.

A key check is the voltage at 3TP2. If this is 0·8-1V, the decoder is generally working correctly. If the reading is 2·5V and colour is restored after removing the colour-killer link 3LK2, the TBA540 i.c. should be replaced. If the reading is 4V, the burst signal is missing. The burst signal can be removed by shorting test points 3TP3/4: the set a.c.c. control 3RV2 can then be adjusted for 4V at 3TP2. If the reading is 6·5V, the ident is incorrect.

With no colour, check first that the 12V supply is present at pin 3 of the TBA540 i.c. If there's no voltage here, check whether the feed resistor 3R47 (10Ω) is intact. If so, replace the i.c. If these points are in order, check the crystal, the TBA560C i.c. and the chroma delay line, all by substitution. Also check the line pulse clamp diode 3D2 (1N4148) and 3C22 (22μF) which decouples pin 13 of the TBA560C for shorts. 3C24 (10μF) is another possibility. Intermittent loss of colour is often due to the set a.c.c. control 3RV2.

The single T130A signals panel used in the T22 chassis combines the i.f., audio, decoder and RGB output circuits. If there's loss of colour, check the TDA2560 i.c. by replacement, and that the 12V supply is present at pin 8 of this i.c. If the supply is missing, check R98 (10Ω) and C81 (100μF). Note that C84 (0·22μF) was a tantalum capacitor and was later changed to a polymylar type to overcome lack of colour or colour drop out. In the i.f. section of the

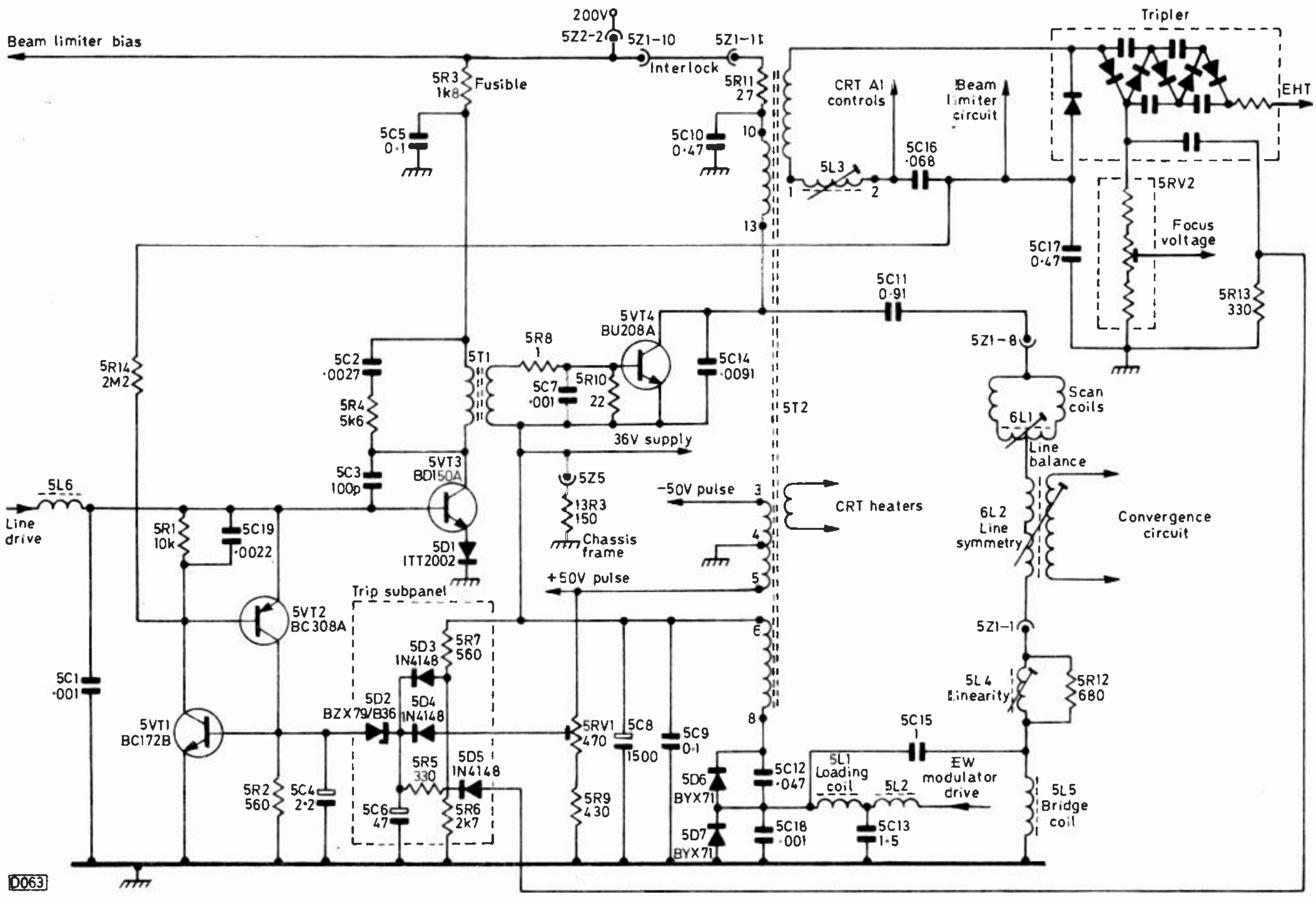
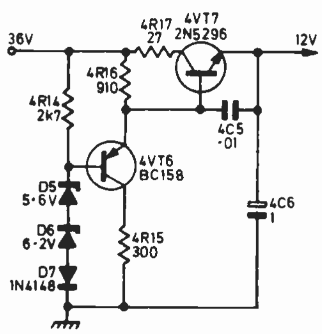


Fig. 3: The line output, line driver and overvoltage trip circuits (T134A line output panel). In earlier production models an 800mA fuse (5FS1) was included in series with 5R11. A short-circuit between the tripler's focus voltage terminal and chassis will also operate the trip, the high negative voltage which then develops across 5C17 being detected by 5VT2 via 5R14. In later production an 0·0027μF capacitor (4C33) was added between the collector and base of the EW modulator driver transistor 4VT18 on the scan drive (timebase) panel to eliminate possible line tearing at the top of the raster.



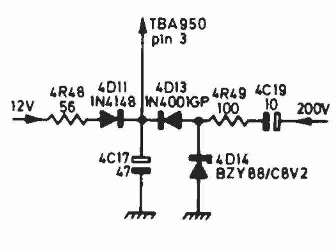


Fig. 4 (left): The 12V regulator circuit.

Fig. 5 (right): Power supply feeds to the TBA950 sync/line oscillator i.c. The 200V feed via 4C19, 4R49 and 4D13 provides a start-up supply. In later production a 1N4001 diode was used in position 4D11 to avoid possible failure of the oscillator to start.

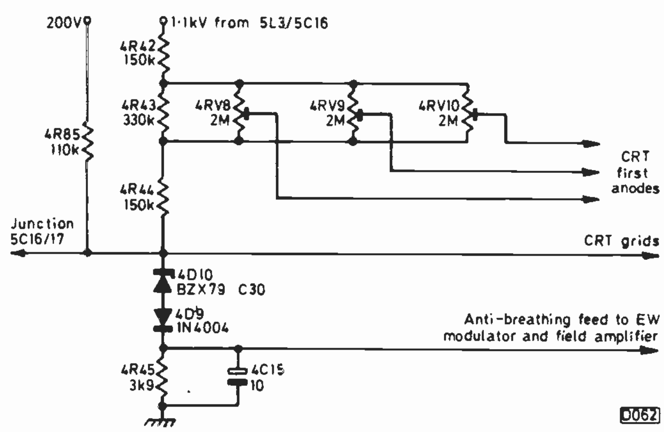


Fig. 6: The first anode supply and beam limiter circuit. The e.h.t. current returns to chassis via 4R42-4/4D10/4D9/4R45, 4R85 providing bias for 4D10. In the event of excessive e.h.t. current, 4D10 ceases to conduct and the negative voltage then present at the junction of 4R44/4R85 is applied to the c.r.t. grids, biasing back the tube. E.H.T. variations are sensed across 4R45, which provides an anti-breathing signal for the line and field timebases. 4R85 later changed to 150kΩ.

panel, C16 was changed from 1μF to 2·2μF to avoid field bounce. For tuning drift, check the ZTK33 voltage stabiliser.

Returning to the signals side of the T20 chassis, excessive volume with the volume control having no effect, or alternatively intermittent loss of volume, can be due to pin trouble on the i.f. subpanel. Remove the panel and clean the pins. If there's no sound, check the sound output transistor 3VT14 and its constant-current feed transistor 3VT15 (both type BD166). If the fault is distorted sound, check 3R88 (2·2Ω) and the setting of the set audio current control 3RV9 – this should be adjusted for 0·44V across 3R88. If these points are in order, check the TBA120SB intercarrier sound chip on the i.f. subpanel.

The 33V stabiliser in the T20 chassis is type MVS460-1 and is mounted on the Z912D tuner subpanel. It's often the cause of tuning drift. If replacement doesn't cure the fault, change the tuner. Note that the T603A or T603B tuner is used in the T20 chassis, the tuner in the T22 chassis being type T603D. ■

Colour Portable Project

Luke Theodossiou

Part 2: The Signals Board

This month we are tackling the signals board, which is virtually identical to the one published in the September/October 1980 issues. The principal circuit differences involve the deletion of the teletext connections, removing the contrast control from the p.c.b. (since this can now be operated via the remote control) and some component pruning to simplify the circuit as much as possible.

The original design

For those readers who built the 1980 signals board, it is a simple matter to make it compatible to the updated one. All component references refer to the original circuit.

Remove: R2, R11, R13, R17, R19, R20, R22, R24, R25, R26, VR1, C26, C27, C28.

Replace with wire links: R23, R42, R43, R44, D2, D3, D4.

Changed values: R14 is now 1k5. R12, R18 and R21 are now 10k. VR2, VR3, VR4 and VR5 are now 470Ω.

Add: 100pF ceramic plate capacitor in parallel with R5.

The major difference between the two boards from a practical point of view is the different connections, although since every connecting terminal on both circuits is labelled, this should not result in any serious difficulties.

Circuit description

From now on, we shall refer to the new circuit, shown in Fig. 1. A full circuit description was given in the October/November issues and of course this still applies, but for the benefit of new readers, here's a brief account of how the circuit works.

The tuner used is a Telefunken unit which has the advantage over similar tuners of using a dual-gate MOSFET input stage resulting in better overall performance. A slight modification to the tuner is recommended and details are given in the section dealing with construction.

The output from the tuner is coupled to a ready-built and aligned i.f. module which provides the following outputs: a 1V pk-pk positive-going video signal which is fed to the colour decoder; a 3V pk-pk negative-going video signal which is used for sync separation on the timebase board; an audio signal controlled by an electronic attenuator (volume control) which is fed to the audio output amplifier; an a.f.c. signal for the tuner which is mixed with the incoming tuning voltage from the tuning potentiometers; and an a.g.c. output for the tuner.

The audio signal is fed to IC2 which is connected as a virtual earth amplifier and then to the loudspeaker. The addition of capacitor C31 ensures complete stability of the amplifier under all operating conditions.

The 1V composite video signal is split into two paths by R2 and R5. The luminance content is delayed by 270ns by the luminance delay line DL1 after the chrominance content has been removed by the *LC* network C1 and L1. It is then capacitively coupled to the luminance processing section of IC3. The second path is connected to the resonant circuit comprising L2 and C4. This filters the chrominance information which is then fed to the chrominance section of IC3 via C6.

Single chip decoder

The TDA3560 is a single-chip colour decoder that combines all the functions required for the identification and demodulation of PAL signals. It also contains a luminance amplifier, an RGB matrix and output amplifiers which enable direct drive of the video output stages. It also features separate inputs for data insertion such as teletext, but these are not used in this project. It offers d.c. operated controls for contrast, brightness and colour saturation with a control range of roughly between 0V and +5V. This is conveniently derived from the remote control system, thus minimising the component count around the control pins.

The video output stages are of the class AB type noted for their good performance and low power consumption. The addition of another small signal transistor offers freedom of black level drift with temperature variations and better performance due to the extra gain being utilised in increased negative feedback.

The board also incorporates the +33V regulator for deriving the tuning voltage and the +12V regulator which powers all the small signal sections.

Construction

The p.c.b. copper track pattern and component location are shown in Fig. 2. Construction is very simple; we suggest you start by soldering all the low-profile components first and gradually progress to the i.f. module, heatsink and finally the tuner. We do not recommend the use of a socket for IC3 – the i.c. is more reliable than most sockets!

In order to increase the bandwidth of the tuner so that it doesn't interfere with the bandpass shaping characteristics provided by the SAWF in the i.f. module, a 1k resistor should be wired directly across the i.f. output coil inside the tuner. We suggest a very small resistor ($\frac{1}{8}$ or $\frac{1}{16}$W) and a little care.

Setting up information will be given in a later issue. Next month we shall deal with the timebase board.

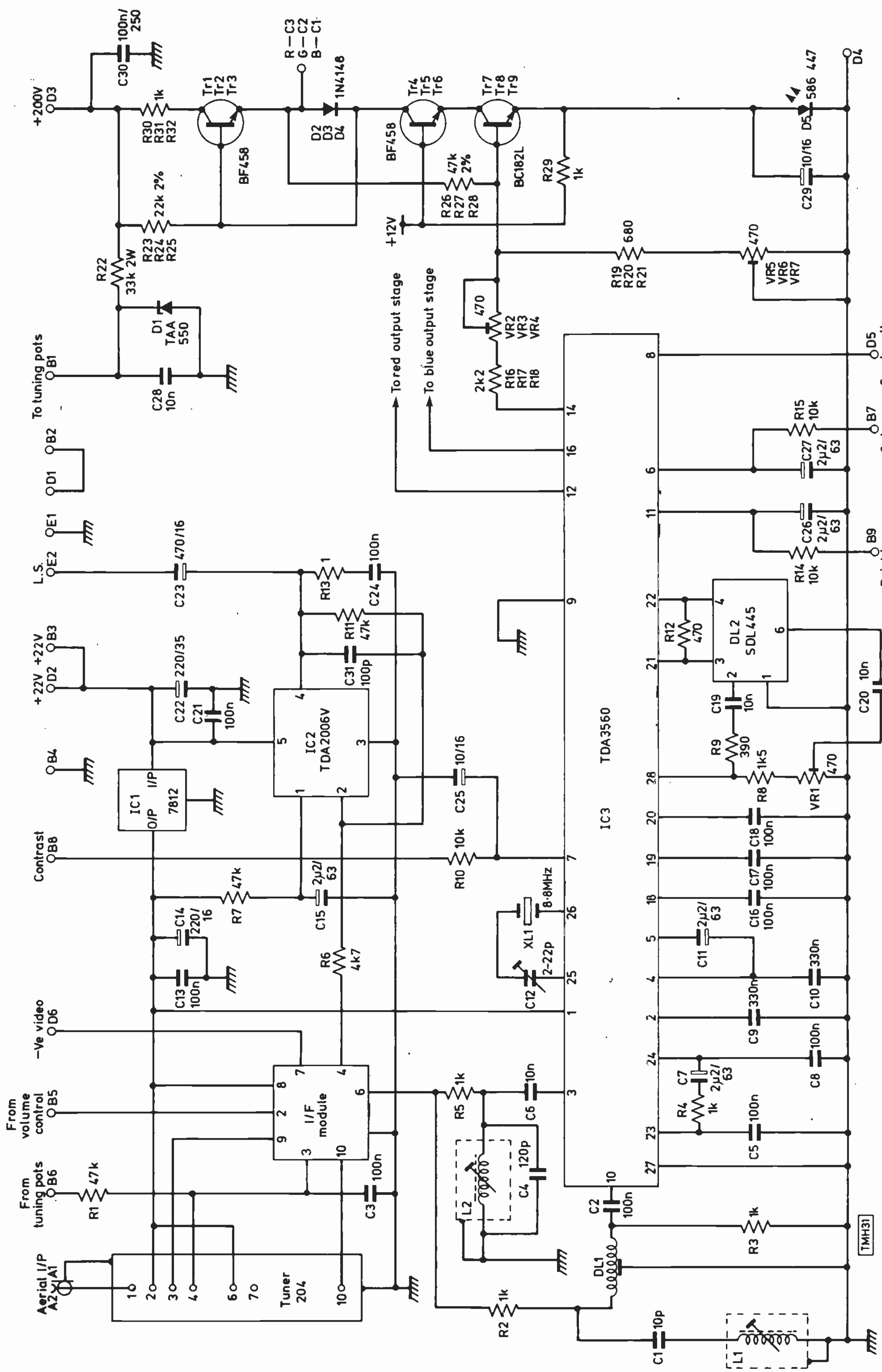


Fig. 1: Circuit diagram of the simplified signals board.

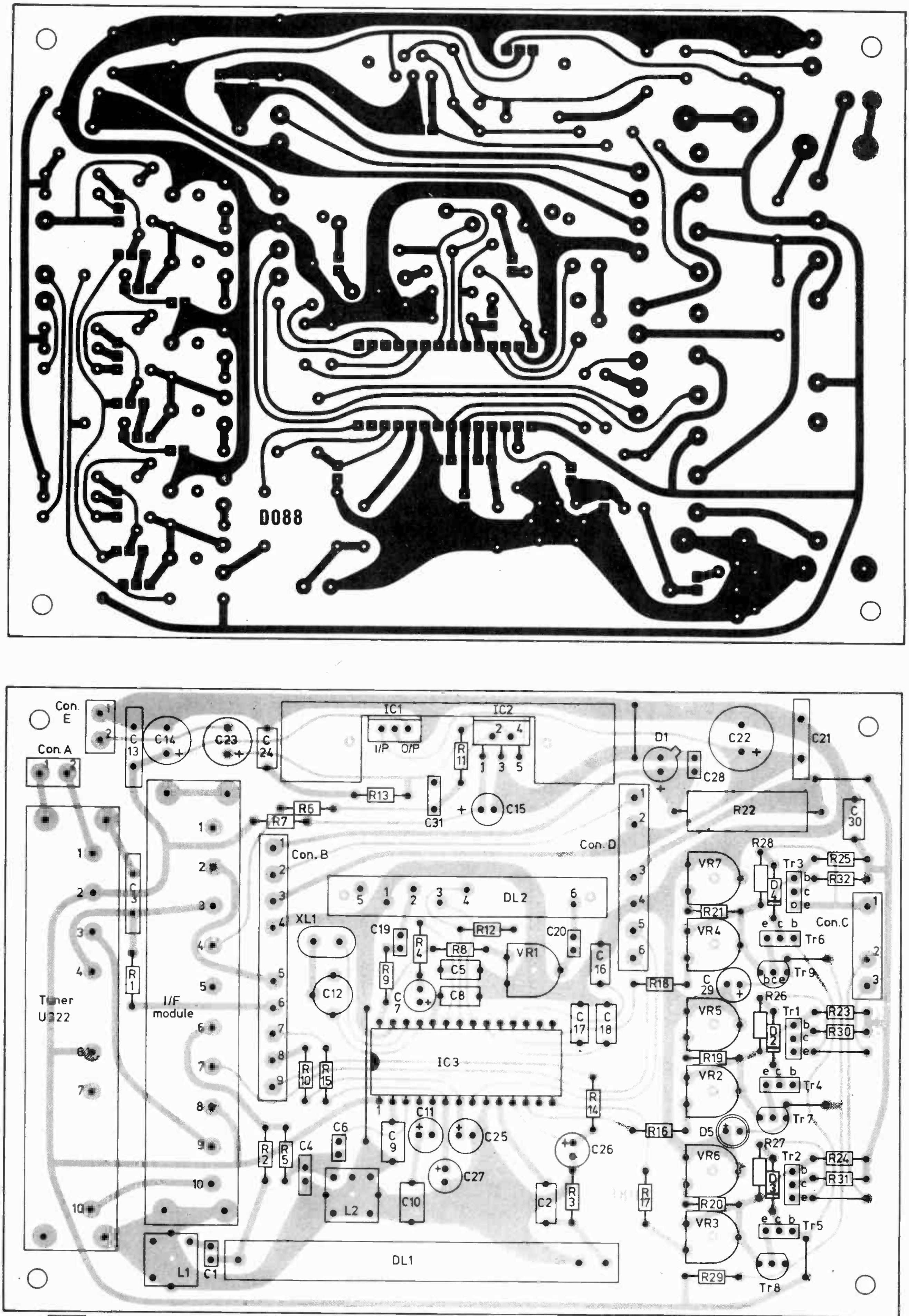


Fig. 2: The copper pattern (top) and component location diagram (bottom).

★ Components List

Resistors: 0.25W carbon film, ±5% except where stated

R1	47k		
R2	1k		
R3	1k		
R4	1k		
R5	1k		
R6	4k7		
R7	47k		
R8	1k5		
R9	390Ω		
R10	10k		
R11	47k		
R12	470Ω		
R13	1Ω		
R14	10k		
R15	10k		
R16	2k2		
R17	2k2		
R18	2k2		
R19	680Ω		
R20	680Ω		
R21	680Ω		
R22	33k	2W	
R23	22k	±2%	0.5W metal film
R24	22k	±2%	0.5W metal film
R25	22k	±2%	0.5W metal film
R26	47k	±2%	0.5W metal film
R27	47k	±2%	0.5W metal film
R28	47k	±2%	0.5W metal film
R29	1k		
R30	1k		
R31	1k		
R32	1k		
VR1 – VR7	470Ω		miniature horizontal mounting skeleton presets

Semiconductors:

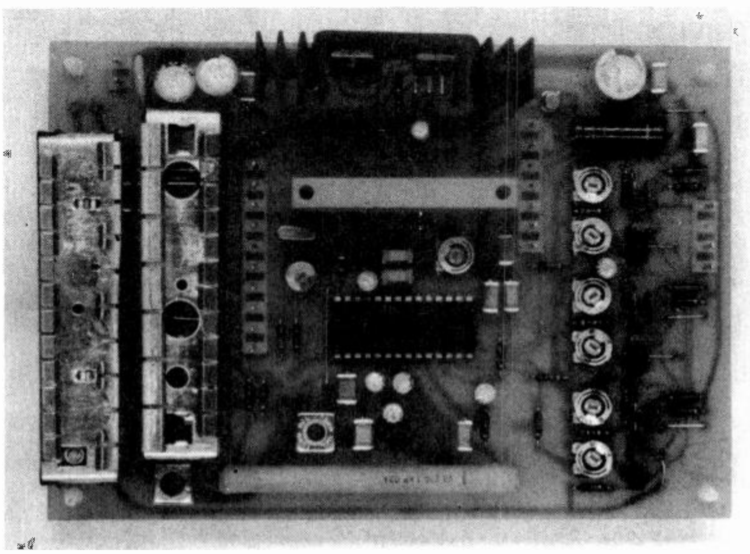
D1	TAA550
D2-4	1N4148
D5	RS Components 586-447
Tr1-6	BF458
Tr7-9	BC182L
IC1	7812
IC2	TDA2006V
IC3	TDA3560

Capacitors:

C1	10p	ceramic plate	
C2	100n	100V	Siemens B32560
C3	100n	100V	Siemens B32560
C4	120p	ceramic plate	
C5	100n	100V	Siemens B32560
C6	10n	ceramic plate	
C7	2μ2	63V	Dubilier CEB2R263
C8	100n	100V	Siemens B32560
C9	330n	100V	Siemens B32560
C10	330n	100V	Siemens B32560
C11	2μ2	63V	Dubilier CEB2R263
C12	2-22p	miniature trimmer	
C13	100n	30V	ceramic disc
C14	220μF	16V	Dubilier CEB22016
C15	2μ2	63V	Dubilier CEB2R263
C16	100n	100V	Siemens B32560
C17	100n	100V	Siemens B32560
C18	100n	100V	Siemens B32560
C19	10n	ceramic plate	
C20	10n	ceramic plate	
C21	100n	30V	ceramic disc
C22	220μF	35V	Dubilier CEB22035
C23	470μF	16V	Dubilier CEB47016
C24	100n	100V	Siemens B32560
C25	10μF	16V	Dubilier CEB1016
C26	2μ2	63V	Dubilier CEB2R263
C27	2μ2	63V	Dubilier CEB2R263
C28	10n	ceramic plate	
C29	10μF	16V	Dubilier CEB1016
C30	100n	250V	Siemens B32560
C31	100p	ceramic plate	

Miscellaneous:

Tuner: Telefunken type 204
I.f. module: Ref. no. 39-13-09
L1 00D0-914-001
L2 PC501-L602
XL1 8.8MHz crystal
DL1 Orega TLC1392
DL2 Sylvania SDL445
Heatsink for IC1/IC2 is 50mm length (i.e. half) of RS Components type 401-497
P.c.b. ref. no. D088
Molex 0.2" pitch connectors
P.c.b. pillars



We understand from TW Electronics (Kennet Building, Woolton Hill, Newbury, Berks RG15 9U5) that they have experienced difficulties in supplying the i.f. module specified in the September/October 1980 issues. At the time of going to press we are informed that an alternative manufacturer for the module has been found and that delivery is iminent.

Practical TV Servicing: Dealing with AFC Problems

S. Simon

AUTOMATIC frequency control (a.f.c.), like its sister automatic gain control (a.g.c.), is a feature that's rarely appreciated until it goes wrong. A.G.C. is simply a matter of adjusting the gain of a signal amplifier strip to cater for varying signal strengths, so that the output obtained from the amplifier remains fairly constant despite varying reception conditions. It's also a must in radio receivers – reception without it would be well nigh impossible.

The general public expects to be able to select a programme and receive it, and to go on doing so each time without retuning for optimum reception. To be fair, most tuners are perfectly able to do this without correction, i.e. once a particular frequency has been selected, the tuner will stay tuned to this frequency for a considerable period of time without drifting off frequency. It's inevitable however that sooner or later, and in some cases sooner, the setting will vary slightly, and the first casualty will be the colour. This is because the colour signal occupies a narrow frequency band at one side of the channel bandwidth, and is thus easily lost. It's most desirable therefore that some means of correction, i.e. a.f.c., is employed.

AFC Action

It's impractical at u.h.f. to alter circuit inductance, but it's quite easy to alter the capacitance. We've seen before in this series of articles – well, in the previous Beginners' Guide series – that some types of semiconductor diode are made so that the capacitance across them varies with the voltage applied across them – varicap diodes of course. As far as mechanical tuners are concerned, and as the correction required is only small, all that's necessary is to correct the frequency of the tuner's local oscillator. We can therefore use just a single varicap diode to apply a.f.c. to such a tuner. More modern, i.e. varicap, tuners use varicap diodes to adjust the tuning of all the tuned circuits in the tuner – except the i.f. output tuned circuit of course. A tuning voltage swing of 0-30V will cover channels 21-65, and once the correct voltage is applied the tuner will produce the correct output frequency to feed into the i.f. strip where the main amplification and bandpass filtering take place. So we can apply our a.f.c. voltage to the common varicap diode tuning line.

If the tuning is inaccurate, the tuner's output will not correspond with the i.f. strip's tuned passband. This gives us a simple method of obtaining our a.f.c. voltage. At some point in the i.f. strip we can compare the signal with a fixed frequency, and use the output obtained as our control voltage. We use a circuit which produces zero output when the two signals are of identical frequency, the output being positive- or negative-going as the frequency of the input signal varies up or down. The control voltage is fed back to the tuner to correct the tuning error there. This is something of an over simplification, but serves to outline the basic idea.

Initial Tuning

When the set is first tuned in, or when it's being retuned to a different channel, it's an advantage to be able to render the a.f.c. inoperative. Otherwise it will be difficult to achieve accurate tuning. In many older sets a switch was fitted in an obvious position to enable this to be done. In some more modern sets a small rotary switch is fitted near the tuning presets, which may be found under a flap at the rear; in other sets the channel selector button defeats the a.f.c. action when pushed in and held.

If the desired channel can be tuned in accurately with

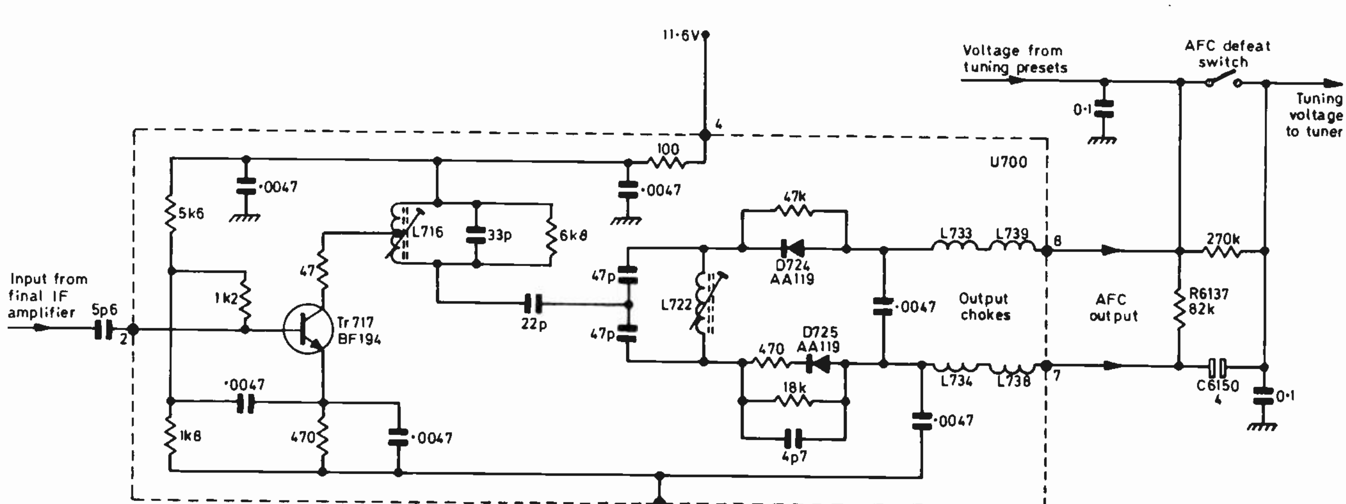


Fig. 1: The a.f.c. circuit used in the Philips G8 chassis. The a.f.c. voltage, which is developed across R6137, is applied in series with the tuning voltage from the channel selection presets. When the tuning is correct, the voltage across R6137 is zero. To prevent signal lock-out when switching to a new channel, the a.f.c. defeat switch is operated by the latch plate on the push-button selector. For ease of tuning, the a.f.c. defeat switch is also operated when a selector button is fully depressed.

the a.f.c. defeated, but is detuned when the a.f.c. action is restored, the reference, i.e. fixed frequency, coil in the a.f.c. circuit is in need of adjustment. First identify the correct coil, recheck the tuning with the a.f.c. switched off, restore the a.f.c. and tune the coil to get the same results as with the a.f.c. off. The setting should thereafter hold the channel even though the button or selector is slightly detuned. If you have the appropriate service manual, follow the instructions given for the correct setting up of the a.f.c. circuit – there may be more than one coil to adjust.

The Philips G8 System

Let's take a typical example, the a.f.c. circuit used in the popular Philips G8 chassis – see Fig. 1. As you can see, there's not a lot to consider. The a.f.c. module (U700) is located to the right of the tuner. Replacement modules can be obtained and fitted in a few minutes, but it's instructive to remove a faulty unit and strip it down. After the bottom cover has been removed, the small panel can be taken out for inspection. Before going this far however we would first check that the circuit is receiving its 11·6V supply (from TP19). This would hardly be in doubt, since the supply is common to other parts of the set.

Having removed the panel from the module, we can proceed to check the transistor and diodes in the usual way, but before doing this it's a very good idea to prove the continuity between the output chokes and pins 7 and 8. It's extremely likely that one of these will be found open-circuit, and with the aid of a magnifying glass you may be able to locate the break – it will probably be in the locality of the soldering post. Some dexterity is required to carry out the repair, but it can be done. If the chokes have continuity, the next thing to do is to check the back-to-front resistance of the two detector diodes.

With the unit repaired and refitted, adjusting the coil core nearest the rear of the set should prove that the unit is now fully functional. Slight adjustment of this coil core can sometimes help to clear vision buzz on the sound – when the buzz can be tuned out using the selectors, but returns as soon as the selector unit is restored to its "parked" position.

AFC Inoperative

If there's no difference whether the a.f.c. is defeated or not, and the tuning of the channel selectors is critical, it's likely that the a.f.c. is inoperative. This could be due to several factors of course, including the switch. It may be incorporated in the station selector unit and may be permanently lodged in the on position – when the switch closes, it shorts out the a.f.c. voltage. So the first thing to do is to make sure that the switch is off. Then check any plug and socket connection before moving on to the a.f.c. circuit itself. The circuit may consist of one or two transistors (with the second one used to amplify the control voltage), a couple of coils, a pair of diodes and a pair of output chokes in addition to the resistors and capacitors. In more recent chassis the a.f.c. circuitry is tucked away inside an i.c., but an external tuned circuit is still required.

Circuit Details

Let's take a closer look at the circuit shown in Fig. 1. An input from the collector of the final i.f. amplifier transistor is fed via the small 5·6pF capacitor to the base of the a.f.c. transistor Tr717. The primary and secondary windings L716 and L722 of the a.f.c. discriminator transformer are both tuned to the vision i.f. carrier frequency (39·5MHz). Should the output from the i.f. amplifier vary due to mistuning, the discriminator circuit will be detuned and instead of 0V (the balanced condition) appearing across the output pins 8-7 a positive- or negative-going output voltage will appear. This, as you can see, is added to the voltage from the tuning potentiometers. In short then a shift in signal frequency unbalances the a.f.c. circuit, as a result of which a correction voltage is produced and applied to the tuner to correct the error.

On the Bench

If the G8's selector unit is examined, the small button at the rear will be found to lift a spring from the print when it's depressed. When the spring is in contact with the print, the a.f.c. is shorted out ("defeated") and the channel can be accurately tuned in by means of one of the small tuning wheels. A.F.C. action is restored by pressing the button, thus lifting the spring. Ensure that this is happening, and that the contact is good. With the unit in its parked position, the button is permanently depressed and the a.f.c. is operative – provided the a.f.c. module is functioning.

If the tuning is changed when the a.f.c. action is restored, the previously mentioned coil core is in need of adjustment. The top of the coil can is covered (initially) with paper, which identifies it. The fine trimming tool required to adjust the core can be used to carefully puncture the paper at the rear end of the can and locate the coil: the heavy-handed should remove the paper and use a light to locate the core.

We don't wish to flog dead horses, but the reason we chose to deal with the G8's a.f.c. system (and thus the G9 also) was that the U700 module is likely to give trouble leading to the set being left without a.f.c., the effects of this not always being apparent because of the tuner's inherent stability. Just to make one point again, the usual cause of failure is open-circuit output chokes.

Having said that the tuner is inherently stable, we must hasten to add that the selector unit is not. This is because of poor contact between the leaf springs and the print: careful cleaning will put this right once the two halves of the unit have been separated. Cleaning is by spirit, not by switch cleaner, by the way. We mention this because poor contact here can throw suspicion on the a.f.c. module. Just remember that hinging the unit down shorts out the a.f.c., so that any tuning inaccuracies must then be due to the selectors – or to the components that provide and stabilise the tuning voltage supply, or the tuner unit of course ... Finally, in awkward cases of tuning troubles the non-polarised electrolytic C6150 is not above suspicion, and in some sets the capacitors which decouple the tuning line (0·1μF here) can give rise to difficulties.

CORRECTIONS

Last month's issue seemed to be bedevilled by more silly slips than usual. Apart from the literal in the leader, points we've since noticed are as follows:

(1) Fig. 1, page 352. The electrolytic that decouples the U4 supply to the TBA800 audio i.c. is Co1, not Ca1.

(2) The colour portable power supply regulation performance (page 365) – mains voltage fluctuations of ± 20% (not 2%!) are reduced to below 1%.

(3) The zener diode in the Sanyo VTC9300 VCR's 12V regulator circuit (mentioned on page 373) is a 6·2V type (not 10V). Some confusion can arise since the circuit in the manual shows a voltage reading of 10·6V across the diode.

Long-distance Television

Roger Bunney

As a result of solar activity during late February and early March there has been an increased number of reports of signals received via F2 layer propagation – a welcome continuation of signals I'd thought we'd seen the last of until (hopefully) next winter. Unusually, the reception has been more from a southerly/south easterly direction, giving enhanced reception from Zimbabwe on many days. In fact from March 1st to the 18th, Zimbabwe was received (signals of sorts, anyway) on most days, sometimes with Ghana on the same channel (E2). Hugh Cocks (East Sussex) even reports receiving Dubai ch. E2 at 1000 GMT on March 13th.

Cyril Willis (Cambridge) also logged ZTV ch. E2 on several days, though farther north Arthur Milliken (Wigan) was generally unsuccessful despite considerable monitoring. ZTV and Ghana ch. E2 were logged here at Romsey on several days: perhaps the best reception was on the 7th, when additional F2 signals were received from Russia (ch. R1). The first sighting of Gwelo/ZTV using the PM5544 test pattern was reported by Hugh Cocks on the 19th!

An aurora on the 5th was widely reported, with enhanced signals from around 1530 GMT, fading out at 1800. The second phase of the aurora apparently started at around 2200, and continued until well after 2400. During the first phase, several Scandinavian Band I stations, northern/Scottish BBC Band I transmitters and RTE (Eire) ch. B signals were received in southern UK. Despite the disruption of the ionospheric conditions, extremely strong ch. E2 signals were received here from the south via F2 the following morning – a test raster followed by a programme, starting at 0820 GMT.

Sporadic E conditions have been improving slowly as the main SpE "season" approaches. Strong ch. R1 signals from CST (Czechoslovakia) were seen on February 25th, with the EZO test pattern. The tropospherics have been mainly quiet, apart from a lift on the 26th when many W. German, RTL (Luxembourg), French and Benelux signals were received in the eastern and south eastern parts of the UK, in Band III and at u.h.f.

Our Australian correspondents Robert Copeman, Wenlock Burton and Norman Edge report continuing F2 reception, with Vladivostok ch. R1 being received on the 15th, both on test pattern and with programmes, and further evidence of the same signals on the 16th. Todd Emslie remarks that his ch. R1 reception near Sydney has been the strongest he's ever seen.

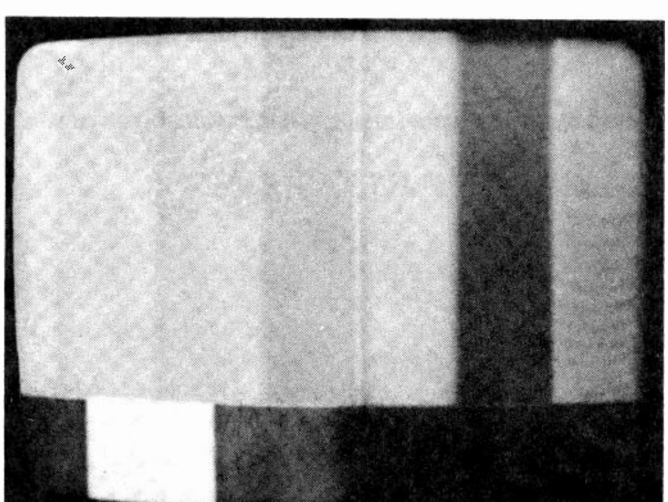
CB Interference

Interference of two types from CB equipment has been reported – harmonic interference and overload breakthrough. The harmonic radiation, appearing at around 54MHz in Band I from equipment operating in the 27MHz band, is a problem that's likely to get worse. Some CB units produce more harmonic radiation than others, the "Midland" series apparently being without any harmonic suppression (at least the cheaper models). The radiation can be suppressed only at source – once the operator can be located. Since operators give unusual call signs and no home address, the only way of doing this is to contact the local CB club or one of its members.

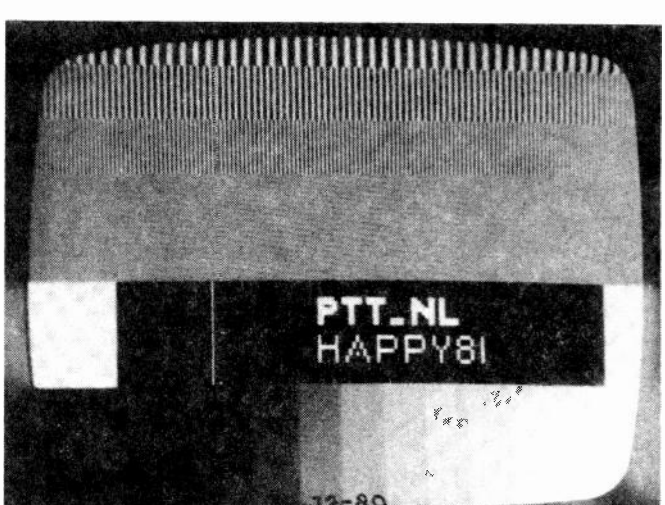
Firms dealing in CB accessories can provide in-line low-pass filters that have an insertion loss of under 1dB and provide attenuation of over 40dB above 30MHz. Such firms can be found by referring to CB publications, e.g. *Breaker* and *CB World*. When the trouble is overload interference due to the proximity of a CB transceiver on the other hand the fault lies with the TV set. It can normally be overcome by fitting a high-pass filter in series with the Band I feeder – before any amplifier that may be used. Such 75Ω filters as the Post Office type 45A provide over 40dB attenuation below 40MHz, with a low insertion loss above 45MHz.

Amateur TV Handbook

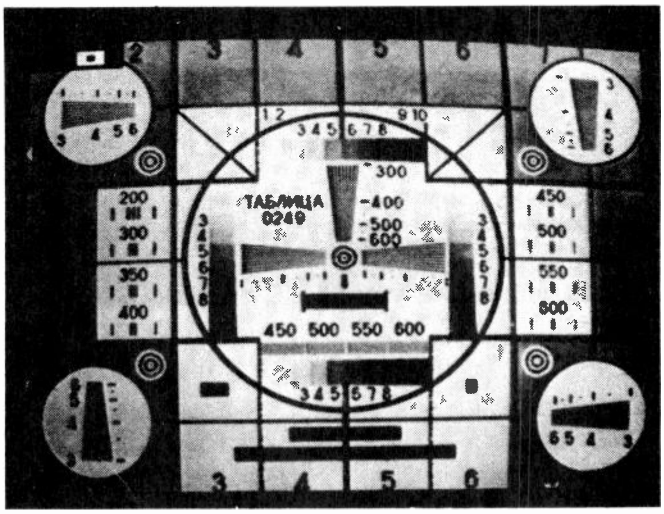
The British Amateur Television Club recently sent me a copy of their new book, the *Amateur Television Handbook*, by John Wood and Trevor Brown. It runs to 100 pages and includes practical sections on aerials, receivers, transmitters, cameras, pulse generators, PAL colour – in fact all you need to know about amateur TV transmission/reception. One section even gives details of



The AFN-TV (Munich) test pattern, which is commonly used in N. America. Photo courtesy Alexander Wiese.



The standard EBU test pattern – with Dutch greeting! Photo courtesy Ryn Muntjewerff.



Satellite reception of the familiar Russian 0249 test pattern by Steve Birkill, at 3·675GHz.

simple modifications to the ELC1043/05 u.h.f. tuner to enable it to cover the 430MHz band. I can highly recommend this to all readers interested in ATV activities, and feel that for a specialist publication the price is very reasonable – £2·35 including post and packing to non-members of the BATC, from BATC Publications, 14 Lilac Avenue, Leicester LE5 1FN.

News in Brief

A scheduled TV service has been started in Burma, using system M and equipment provided by Japan. There's a two-hour programme period during week days and more during the weekends . . . Quatar is to open a high-power ch. E37 transmitter covering the whole gulf area . . . China is to start a second TV network with transmissions at u.h.f.

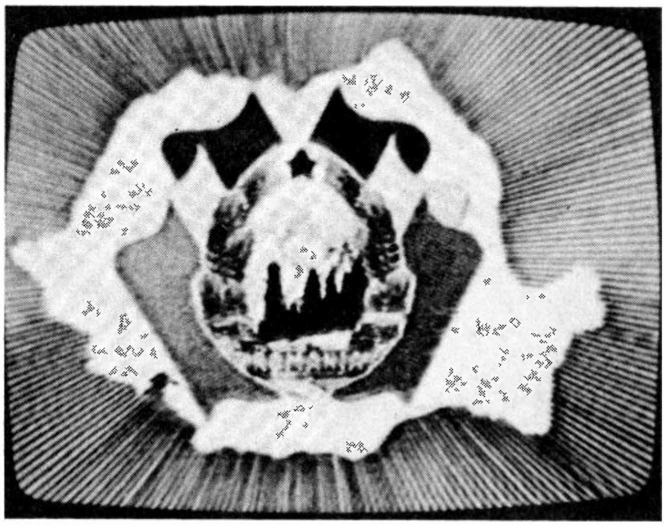
The East German DDR-2 Helpterberg ch. E22 transmitter is now in operation.

Turkey via SpE?

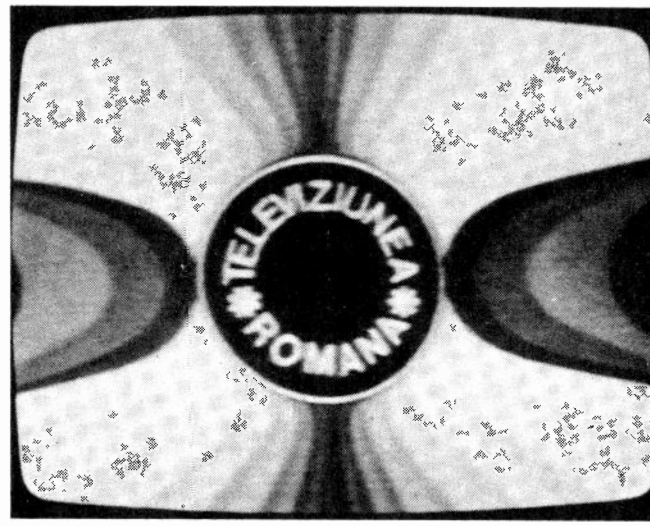
The latest EBU station supplement reports that the Turkish broadcasting authority TRT opened a 5kW e.r.p. ch. E3 transmitter at Bagisli on November 11th. This suggests that reception from a new country may be possible during the coming SpE season, probably via double hop. The co-ordinates are 44E03 37N43, and the transmissions are horizontally polarised.

Monitoring the Low VHF Band

The 30-50MHz band is used extensively in the USA and Canada for mobile police communications and other utility purposes (paging stations etc.). Most SW receivers end their coverage at 30MHz, while v.h.f. receivers covering the spectrum above this point tend to be expensive and in short supply. The Radio Shack/Tandy company however have on offer in their retail outlets an American Realistic "Patrolman 50" for only £39·50. This has five bands – MW (a.m.), v.h.f. 88-108MHz, v.h.f. 108-174MHz, 450-512MHz (using an internal wire aerial) and, of greatest interest, 30-50MHz. All bands except MW are for f.m., and all v.h.f. bands use an extending whip aerial. Typical sensitivities, according to the service manual, are 7μV for the 30-50MHz and 88-108MHz bands and 10μV for the 108-174MHz band. The set is a portable type, and an external aerial can be connected on all the v.h.f. bands. It



TVR (Rumania) network identification.



TVE (Rumania) station identification, ch. R3.

Photographs courtesy Henny Demming

uses four SP7 batteries or an external 120V a.c. input (not 240V!). I've been using one of these sets for two years and can recommend it – the Tandy catalogue number is 12-776. A similar radio set, called the Portavision 5, catalogue number 12-775, is available in the USA, covering Band I (ch. A2 upwards) and Band III for TV sound, but with easy modification can reach down to ch. E2 sound. When switching between bands, different front ends are brought into circuit rather than just switching in different coils!

From our Correspondents . . .

Petri Pöppönen (Lahti, Finland) has now heard from East Malaysian TV at Sahab: they confirm his reception of their Network 3 on November 7th last from the ch. E2 Limbang transmitter, which runs at only 10kW e.r.p. (the only ch. E2 transmitter incidentally, and not others listed elsewhere). Petri also suspects that he's receiving weak signals from the Russian Stat-T satellite (99°E) at 714MHz. The craft is a hundred miles over his horizon (−1·5°), so the signals would be received via tropospheric scatter. Our Indian friends tell us that the Stat-T programmes now run daily from 1300-2200, 1015-2200 on Sundays (Madras time). The new direct broadcast craft will operate at 754MHz, replacing the 714MHz transmissions. Changeover is expected later this year.

A long letter from Jerry Pulice of Staten Island, NY, USA contains much of interest. His F2 successes have included W. Germany, France, UK, Sweden and Zimbabwe – all with pictures. Unusually, Jerry uses a crystal lock for the various line standards. His equipment is certainly sophisticated. In answer to a query of mine regarding a 655-line TV standard, Jerry comments as follows: "It's a non-broadcast standard that's been used for film production – cinema producers have been using TV equipment for movie production in the USA, later transferring from tape to film for release in the form of 35mm prints. The quality obtained is fairly good. Part of the Star Wars sequel was shot in this way and most people didn't notice, even with 70mm film stock. The industry wanted a 24 frame/second TV standard that was as close as possible to the 525-line standard (15,734·26/60Hz), and the answer was 655 lines (15,720/48Hz). It's too bad that a world standard can't be achieved: it seems that we shall forever be saddled with the 50 and 60Hz difference. An interesting point is that in Venezuela both 50 and 60Hz mains supplies are found – depending on where the local power supply company got its generators. So you get 525- and 625-line transmissions, depending on the station's location. This means that when you change channels you may have to fool around with the hold controls. That's the legend anyway, but I think it's true. Incidentally, WNEW (ch. A5) have switched over to a new World Trade Centre transmitter and use the PM5544 test pattern, with identification MTM-NYC!"

Finally, Jerry gives details of an experimental u.h.f. preamplifier he's built, using a Mitsubishi MCF1400 gallium arsenide f.e.t. (see Fig. 1). The performance is remarkable – gain 25dB, noise figure less than 1dB, and overload proof. The device is expensive however ($28) and narrow band. Construction is reasonably straightforward, but the power supply must be well regulated and care taken since the device can be destroyed if incorrectly powered.

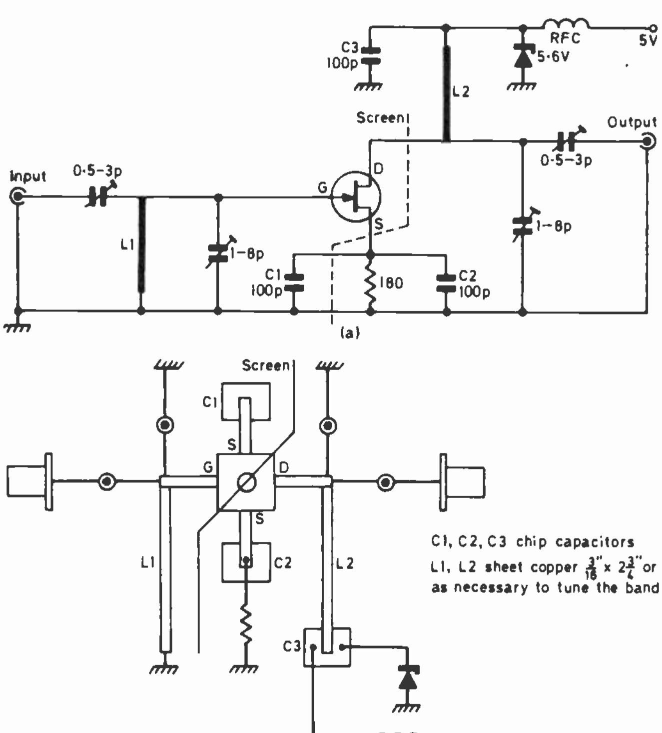


Fig. 1: Experimental gallium-arsenide f.e.t. u.h.f. preamplifier constructed by Jerry Pulice. (a) Circuit. (b) Layout.

Fault Report

Mick Dutton

Rank Z718 Chassis

The complaint with a set fitted with the Rank Z718 chassis was field foldover at the bottom and a trapezium shaped scan at the top. Adjusting the height control would simply move flyback lines up and down the screen, but tapping the panel would cure the fault. We eventually discovered that the trouble was due to the top field linearity control 4RV3 being intermittently open-circuit at one end, a replacement providing a complete cure.

Quite a common fault now on these sets seems to be failure of the line hold control, due to dirt on the track.

Rank T20 Chassis

A Bush set fitted with the T20A chassis was brought into the workshop with the complaint that it was intermittently dead. We switched on, but nothing happened. So we checked the power supply module's output, which was correct at 200V. There was no voltage on the main chassis however – due to plug/socket 5Z2 being open-circuit on the earth connection side.

A case of intermittent tripping on one of these sets was traced to the 36V zener diode 5D2 in the trip sensing circuit.

Thorn 9800 Chassis

We've had several sets fitted with the Thorn 9800 chassis for attention recently. The first one suffered from intermittent tuning drift, which could occur when the set had just been switched on or when it had warmed up. It was also sometimes apparent on one channel only. These sets use touch tuning, so to decide whether the fault was in the touch tuning department or on the tuner panel we fitted the latter in another set, which promptly produced the same fault. The TAA550 tuning voltage stabiliser and the tuner unit were both replaced in turn, but the fault persisted. We then noticed that there are a couple of AA143 diodes in series with the TAA550 stabiliser. Replacing the one on the chassis side (W13) cured the fault, though the diode worked perfectly when tried in another set. Presumably the heat used to unsolder and solder it had cured an intermittent connection in the glass body of the diode.

The second of these sets led us a real dance – the complaint was no raster. Initial checks revealed that the main power supplies were in order and that a very faint raster could be obtained by advancing the preset brightness control. The first anode and e.h.t. voltages were low, so it seemed likely that something in the line output stage was amiss. The line output transformer is of the diode-split variety, so we decided to try a new one. This made no difference, neither did a replacement line output transistor and tuning capacitor. Every component on the line output panel was checked and found to be o.k. The line drive waveform was checked with the scope, and corresponded exactly with that shown in the manual. Time to look elsewhere.

Disconnecting the line scan coils made no difference, neither did removing the scan correction transductor. The only possibility left was the convergence circuitry, so I started disconnecting the feeds to this from the line output stage. When C504 (0·1μF) was disconnected, up came a lovely picture. This capacitor couples line flyback pulses to the blue width coil L503 in the blue lateral convergence circuit (see Fig. 1). Close inspection revealed that L503 was slightly discoloured, and when its resistance was compared with that of another coil in a working set it was found to be a virtual short-circuit.

Intermittent loss of colour was the problem with another of these sets, and a scope check revealed that the level of the reference signal dropped when the fault was present. So we checked around the TBA395 reference oscillator i.c. with the freezer, and found that when C190 (0·0039μF) was cooled the colour reappeared. A replacement provided a complete cure.

Colour was the problem with another of these sets, which was at a house in a heavily wooded area where ghosting was a problem. The set would work perfectly elsewhere, but on a signal with bad ghosting the colour would drop out on ITV during commercials. A friend suggested I try a modification that was introduced on later versions – adding a 12kΩ resistor (R270) in series with C194, and this provided a complete solution.

A frequent trouble spot on these sets is the soldering on the line output panel, under sockets PL851 and PL852. Symptoms are an intermittent dead set, field jitter or field collapse.

If the set fails to start up from cold, it's worth checking the 10μF tantalum capacitor C720 in the ramp generator transistor's base circuit (this capacitor, and resistor R740 in series with it, were deleted in later production).

Print Faults

A couple of awkward faults due to cracked print have come our way recently. The first was on a Philips set fitted with the G8 chassis, the symptom being that the set would die very occasionally – usually in the middle of the customer's favourite programme. I had the set for several days, but it worked perfectly: back in the customer's home, it started to act up again. When I at last saw the fault, I made checks and discovered that the power supply was working and that the h.t. supply was reaching the line output transistors. I suspected line oscillator failure, but whilst trying to take voltage readings on the timebase panel the set came back to life. The transistors and capacitors around the line oscillator were changed, but the trouble remained. I eventually found that there was a crack in the print from the cathode of D4513 to earth – this diode is in series with the emitter of the line oscillator transistor. The print from this point passes very close to the panel fixing screw, and the crack had occured close to this point.

The second case concerned a set fitted with the Pye 741 chassis, the symptom being intermittent loss of EW correction. The fault was not tap sensitive, and could occur

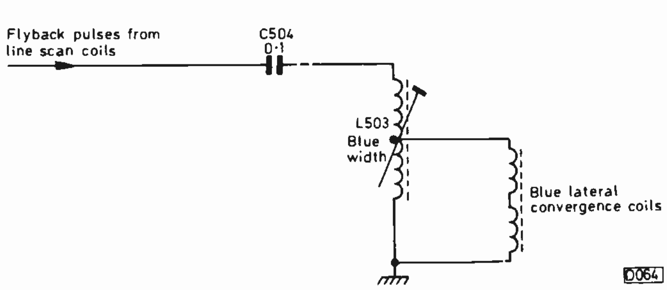


Fig. 1: The blue lateral convergence circuit used in the Thorn 9800 chassis.

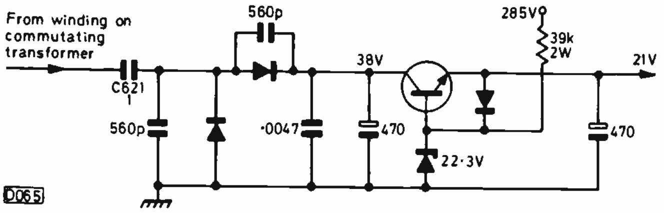


Fig. 2: 21V regulator circuit, Grundig 5010/6010 series.

at any time. The EW modulator diodes and the three transistors in the drive circuit were changed: no difference. We tried to take voltage readings under the fault conditions, and eventually found that the voltage at the junction of the modulator transformer T588 and C589 (4·7μF) was different from that at R610, which is in series with the drive to the transformer, though these points are directly connected. The print path was carefully traced, and a crack was found above the line output transistor heatsink. Linking this cured the problem.

Distorted Sound

The complaint with a Grundig 6011 colour set was sound distortion. When we checked, we found that the set would operate normally for a few minutes, after which the sound would gradually become distorted. Easy we thought, change the TBA800 audio i.c. No difference! So we monitored the 21V supply to the i.c., and found that though this was correct with the volume at a low level, the voltage began to drop and vary in sympathy with the sound as the volume was advanced.

The supply is obtained from a winding on the commutating transformer in the line timebase, via a rectifier and a simple stabiliser circuit (see Fig. 2). The voltage at the collector (input) of the stabiliser transistor was found to be low, at only 25V instead of 38V, and as the setting of the volume control was advanced the voltage fell to just 20V. Hence the stabiliser circuit couldn't operate correctly. The rectifier circuit itself was in order. The feed comes via a 1μF capacitor, C621, and when this was bridged up came the volume and the sound returned to normal. C621 had fallen in value to 0·2μF, increasing the supply impedance and thus reducing the output when a load was applied.

Grundig Model 1510

The owner of a Grundig 1510 portable colour set complained that sometimes when he turned the set on it made a "pinging" noise and kept going on and off. The "pinging" turned out to be the commutating transformer rattling. This sort of thing is usually caused by dry-joints in the line output stage, so we removed the back with some confidence. There were several bad dry-joints, but the fault was still present after these had been resoldered.

We next found that the width control was inoperative, due to the control transistor Tr524 (BC237S) being open-circuit base-to-emitter. After replacing this the width control worked normally and the set seemed fine. When we turned it on next morning however the original fault was present – it cleared before any action could be taken. The set was left switched on, and when the test card appeared later in the morning we noticed that the width was a little wide. Tr524 had again failed, and whilst replacing it we noticed that C517 (0·47μF), which is in series with the load winding on the width control transductor, had a black burn mark near one of its leadout wires. When the outer casing of this capacitor was broken away, we found that large areas of the foil inside were burnt. Fitting a replacement cured the Tr524 failure problem and the hunting effect when the set was first switched on.

It's unusual to find a capacitor in series with the width transductor load winding – it's not present in the larger-screen Grundig models.

GEC Portable

A GEC 3133 monochrome portable was brought in as dead. When switched on however it worked for a while then died. The set is one of those using a transistor pump power supply circuit, Tr451 (BU111) being the pump transistor. Replacing this cured the fault, but I've since been told that other causes of these sets switching themselves off after a period of use are D451 and D452 (both type 1N4004) and C451 (0·022μF). These components are in Tr451's base circuit.

Fuse Blowing

The problem with a 20in. Decca colour set (88 chassis) I was called to see was no results. The mains fuse had blown, but a quick check proved that the bridge rectifier diodes and the regulator thyristor TY600 were o.k. So I replaced the fuse and switched on. Up came the picture – and remained. The grey scale needed adjustment, but I couldn't find anything else wrong. A few days later however the customer called back to say that the set had gone dead again, and this time the fuse was blackened. Once more the bridge rectifier diodes and thyristor read o.k., but a replacement fuse blew just after I switched on. So I connected the meter across the power supply output, fitted another fuse, and switched on and off. The h.t. rose to the correct 165V. Maybe the over-current protection trip, which fires a crowbar thyristor, was operating? There were no h.t. shorts however, and the line output transistor was o.k. Next disconnect the tripler and try again: the line output stage came to life, and this time the fuse didn't blow. So I replaced the tripler and switched on again – only to be greeted by a loud bang as the mains fuse shattered.

I checked the wiring connections, and was just about to condemn the new tripler when I noticed that R330 (2·7kΩ) and R331 (33kΩ) looked as if they'd been getting a bit warm. Now these two resistors are on the earthy side of the e.h.t. circuit, their junction being taken to the beam limiter circuit. When measured, their total resistance was only 160Ω. Fitting replacements of the correct value cured the fuse blowing, and after adjusting the grey scale again the set produced an excellent picture.

Philips G8 Chassis

We've encountered a couple of interesting faults recently on the Philips G8 chassis. The first was on one of the earlier sets, with the separate i.f. and decoder panels. The customer's complaint was that the channels would change on their own, which proved to be so – the tuning would drift by two-three channels. The a.f.c. was defeated by holding the tuning button in, and things then returned to normal. I've had cases of similar symptoms due to dry-joints in the a.f.c. can and poor contact of the small ceramic capacitors here (the cement continuing too far down the leads). All the joints were resoldered and the can replaced, but the fault was still present. Substitute panels were then tried, and it was discovered that the fault was on the tuner subpanel. A look at the circuit suggested that the most likely culprit would be the 4μF non-polarised electrolytic (C6150)

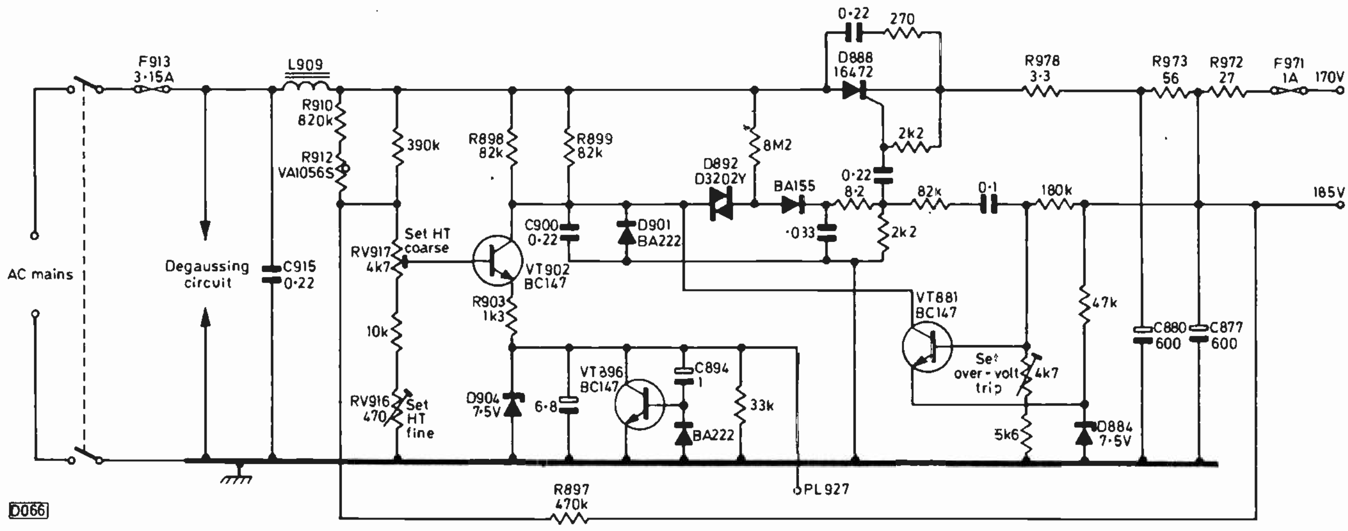


Fig. 3: Regulated power supply circuit used in the Pye 725 etc. chassis. If the zener diodes need to be replaced, use type BZX79C7V5. To reduce drift and improve the regulation, the following modifications were introduced in late production: R898/899 changed to 56kΩ, 1W; R910/R912 deleted; R897 changed to 330kΩ and R903 to 680Ω; an 82kΩ, 1W resistor (R929) added between the collector of VT896 and the cathode of the thyristor D888.

which smooths the a.f.c. voltage, and after replacing this no further trouble was experienced.

The second G8 was one of the later type with the single i.f./decoder panel. The complaint was picture jitter, which turned out to be h.t. hunting due to the over-voltage circuit operating. So we changed the h.t. rectifier thyristor and adjusted the presets. Everything seemed fine. Two days later however the customer complained that the same thing was happening. The h.t. was found to be high again, so this time the trigger diac and the control transistor were replaced and the circuit was set up once more. The next day there was a repeat call, and the h.t. was high at around 220V. This time however adjusting the set h.t. control had no effect, and when the 470kΩ resistor (R1368) in series with the control was checked it was found to be completely open-circuit. We assumed that its value had been drifting gradually, so that resetting the h.t. had made the circuit operational for short periods.

Pye 731 Series Power Supply

Intermittent field bounce was the problem with a Dynatron set (Model CTV20) fitted with the Pye 741 chassis. The diagnosis was jitter due to the over-voltage protection circuit in the power supply tripping, so we measured the h.t. voltage which was high at 198V, even with both the coarse and fine controls backed off fully. Any slight voltage rise would operate the trip.

In the past I've found that the first thing to check when this sort of fault is present is the voltage across the 7·5V zener diode D904 (see Fig. 3) in the control transistor's emitter circuit. If this diode goes open-circuit, the transistor's emitter voltage follows its base voltage and there's no regulator action. If the diode is o.k., the next thing to check is the two resistors in the charging circuit that fires the diac to trigger the thyristor. These are R898/9, both 82kΩ, and both can go low in value. Another possibility is a leaky thyristor, though I've found this to be unusual. In this particular case none of the above faults was present, the trouble being eventually traced to the feedback resistor R897, which had fallen in value.

It's quite common to find these sets dead due to a fault in the power supply. If the set is a Dynatron model however the fault may be on the control panel rather than the power supply panel. This point can be checked by unplugging the flying lead to PL927. If the set then works, the fault is on the control panel (see later).

Given a dead power unit, the first thing to check is for 250V a.c. at the anode of the thyristor. If this is present, the continuity of the mains switch, the fuse and choke L909 has been proved. Next check whether there's any voltage at the cathode of the thyristor. If the voltage is low, at approximately 100V, it may just be that there's a dead spot on the coarse set h.t. control, in which case it's best to fit a replacement. If there's only some 5-10V present, the cause of the problem is usually that the 3·3Ω surge limiter section (R978) of the power resistor is open-circuit. If there's no output at all, there are probably no pulses to trigger the thyristor. Check for 7·5V across D904: if this is missing, either D904 or the slow-start transistor VT896 is short-circuit. If all's well here, check for voltage at the collector of the control transistor (VT902). If this voltage is missing, check whether the clipper diode D901 is short-circuit or VT881 and/or D884 in the trip circuit is short-circuit. Less likely possibilities are an open-circuit thyristor or diac.

D884 and VT881 can be damaged by a dry-joint on the input choke L909. The result in this case can also be a large hole in the board. While a patching up job will work for a time, it's very likely that the choke will become noisy and will probably fail again after a short time.

An unusual fault I've had twice is the power supply taking a long time to get going, due to C894 (1μF) in the slow-start circuit. In both cases the capacitor measured o.k. out of circuit.

In the case of a dead Dynatron, if disconnecting PL927 brings the set back to life check the 6·2V zener diode D1022 on the control panel – it will probably be found to be short-circuit. VT1019 (BD131) and D1020 (1N4148) may also be damaged. If VT1019 has gone short-circuit collector-to-emitter, approximately 9V will have been applied to the remote control receiver, which will probably mean that the 5·1V protection zener diode in the receiver will have gone short-circuit. Any other faults in the remote receiver unit are best dealt with by obtaining an exchange panel from Philips!

A confusing fault on these Dynatron sets occurs when the 33V supply fails, for example if the TAA550 has gone short-circuit. There are no channel lights, giving the impression that the fault is in the remote control receiver or on the control panel.

Developments in Projection TV

Vivian Capel

PROJECTION TV has been a part of the domestic television scene since the earliest days – in the thirties. The period of its greatest popularity was in the mid-50s, when the standard c.r.t. screen sizes were only 9 and 12in. Most of the projection sets of those days were self-contained, with the projection unit and the screen combined in a single cabinet: the screen sizes were modest by today's standards. Other larger systems projected the picture on to a separate screen.

The development of large-screen, wide-angle c.r.t.s put paid to domestic projection systems for some years, though enthusiasts claimed that they gave the better picture when correctly set up – the overall focusing was certainly better. In recent years there's been a general tendency towards smaller TV screen sizes, with portable models becoming increasingly popular. At the same time however there are now probably more domestic projection TV systems on the market than for many years, mainly as a result of technical developments and an increased market for such sets in the USA and Japan.

The problem today of course is colour. Though systems using a single colour tube and a lens have been produced and sold, the brightness of the projected picture is limited. So colour projection sets generally employ three tubes, one for each of the primary colours red, green and blue, with various lens systems. This makes them proportionately more expensive in comparison to conventional sets than their monochrome counterparts of old.

Basic Optical Systems

There are two basic optical systems used in domestic projection TV equipment, the Schmidt type and the refractive lens system. Fig. 1 shows the basic Schmidt system (the technique was originally devised for astronomical photography). A small c.r.t., operated at high e.h.t., projects a picture on to a mirror. The mirror then reflects the light back through a correcting lens on to the screen. The use of a combined mirror/lens system is optically efficient and thus capable of producing a bright picture. All the early monochrome domestic projection sets sold in the UK used a modified version of this system – extra mirrors were employed so that the light path could be "folded", thus reducing the overall size of the unit. The optical system employed was the famed Mullard one.

Current Techniques

Direct projection systems, giving a colour display and using the basic Schmidt technique (in triplicate) with a separate screen, became popular in the USA some years ago – mainly for use in shops and bars. As those familiar with the old UK domestic monochrome projection sets will know however, a certain amount of maintenance is necessary. To reduce this problem, the US Advent Corporation developed the lightguide tube. This is a projection tube in which the Schmidt mirror is housed within the tube itself (see Fig. 2) – a sort of integrated Schmidt system. Sets using integrated Schmidt optics have been distributed in the UK – in fact the current Panasonic Model TC6200G is of this type.

Most of the domestic colour projection systems at present on sale in the UK use three tubes, with three refractive lenses, to project the three primary-colour pictures on to the screen (see Fig. 3). The current Advent, Grundig, Mitsubishi, Philips, Sharp, Sony and Toshiba models are of this type. There are two main differences to be found in these models. Some, such as those from Grundig and Philips, have separate projection and screen units. The Japanese manufacturers on the other hand tend to favour integrated projection/screen models, with an extra mirror to deflect the output from the projectors up on to the screen, which is mounted above. As industry watchers would expect, Sony do it somewhat differently from everyone else – they project two light beams on to the screen, one a combined red/blue picture, the other the green one. The red and blue pictures are combined, using a dichroic lens system, before being projected.

The differing complexity of these systems is reflected in their prices. The Panasonic projection system with its lightguide c.r.t.s and folded light path comes at the top end of the range. In the middle come folded light path models using a refractive lens projection system. At the lower end of the price range come the relatively simple two-unit models with refractive lenses. Folded light path models tend to be more expensive due to the additional mirror, more complex cabinet and the need for extra electronic raster correction. Whilst the Schmidt system is inherently more efficient than a single lens arrangement, the difference in light outputs is in practice not great with current techniques. To obtain a brighter picture, all these models use a directional, aluminised screen – this provides a gain of about ten compared to an equivalent flat matt screen.

Mullard Empress III System

In fairly recent times a Mullard group set about the task of investigating how a low-cost projection system giving superior performance in terms of brightness and overall focus quality could be achieved. The result is the Mullard Empress III projection system, which reverts to the use of the basic Schmidt optical technique. The group investigated all possible projection methods, and came to the conclusion that a Schmidt package offered the best solution. The use of a lightguide tube, and techniques in which dichroic lenses are used to combine the primary-colour pictures before projection, were rejected on the basis (mainly) of complexity and manufacturing cost. Lightguide tubes could also be a deterrent to users because of the cost of replacements.

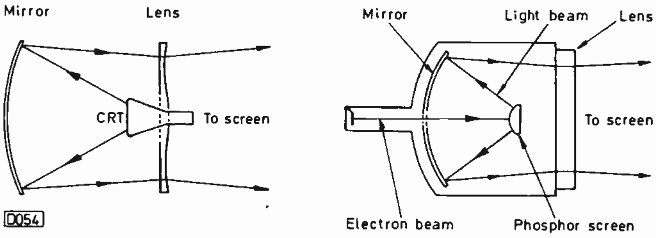


Fig. 1 (left): The basic Schmidt optical system.
Fig. 2 (right): The integrated Schmidt lightguide tube.

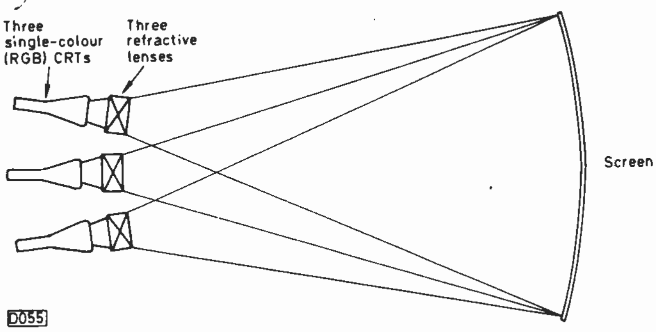


Fig. 3: Use of three tubes with refractive lenses.

Refractive lens systems were rejected on the basis that they introduce an unnecessary optical limitation to the system's performance. The Mullard group point out that earlier work, in producing the Pye Mammoth projection system for professional use, led to the development of advanced optical replication techniques, making it possible to produce a high-quality correction lens, with good overall focusing, at low cost. The optical system used in the Empress III can resolve 1,000 TV lines over most of the viewing area, with a minimum resolution of 600 TV lines at the extreme corners of the screen. This is better than the system's overall resolution (500 lines).

The three tubes used in the Empress III projection system are the P8-110GK, P8-110BF and P8-110YA, for green, red and blue respectively. They have conventional 6·3V, 0·3A heaters, and operate at 30kV – just 5kV higher than the $2\frac{1}{2}$in. MW6-2 tube used in the original Mullard monochrome projection system. The beam current is typically 100μA, giving a screen dissipation of 3W. The focusing electrode requires 7-9kV, with 1kV on the first anode.

Two models, with different screen sizes, are envisaged by the Mullard designers – one with a 4ft. diagonal screen and a projection distance of 6ft., the other with a 6ft. screen and a 10ft. projection distance. The only change, apart from the screen, would be the need for a different correction lens. The three projectors are mounted in-line horizontally, with their axes converging on a single point at the centre of the screen: the angle from one axis to the adjacent one should be 7°. Included with the deflection yoke are two centre-tapped convergence coils for vertical and horizontal adjustment.

It will be interesting to see whether setmakers take up the Empress III system. ■

Letter from America

Jim Edwards

A POST in the New World, primarily promoting the sales of European consumer i.c.s to the colonials, was recently offered to me, so I thought why not? That's how I came to board a 747 at Heathrow one Monday morning, and was then subjected to one of the bumpiest Atlantic crossings so far. I'm sure that any TV set on board would have disintegrated, but thank God and Boeing they don't build avionics that way.

Eleven hours later I checked in at my hotel and turned on the customary TV set. Not much happened. Turn off and on again, still nothing other than a silly lamp telling me which channel I was supposed to be tuned to. Think that maybe I'm not doing things properly, so change channels and turn up the volume. Still bugger all. Resort to first principles and thump set. Again no effect, so turn off and take shower. Return to set twenty minutes later and turn on again. Sound of degaussing circuit doing its thing, but everything otherwise dead. Decide h.t. supply has failed, so search back of set for cut-out button. None to be found, so take easy way out – write note of complaint and head for bar. Set fixed and working again next day, so suspect a dead fuse.

During next three weeks, find that all TV sets in hotel rooms at least produce a picture first time, though on one the scan yoke was about 15° off angle (not easy with a PIL tube!), giving the most amazing convergence etc. Write another letter of complaint. Don't nowadays carry a screwdriver with me, otherwise I might have been tempted. Many of the sets here have hex-headed screws, à la Rediffusion, to stop unofficial tinkering.

And so I got over the initial pains. What's American TV like nowadays? Well, it's on for 24 hours a day, and some of the material (mainly imported from the UK – Dr. Who every night of the week!) is worth watching. Not all sets produce terrible pictures – only most of them, because they're misadjusted. The NTSC colour system doesn't seem to produce quite such bad results as I'd been led to expect, only a very little adjustment to the hue control being required (for those not familiar with the NTSC colour system, the hue control adjusts the phasing of the colour demodulators, and is set for optimum flesh tones).

Once you've adjusted the hue control, the only other adjustment I've found necessary is to the channel – and thereby hangs a problem. There are so many to choose from, even though most of what's available is not worth watching. Where I am at the moment, I have signals on channels 2, 4, 5, 7, 9, 10, 11 and 12 (v.h.f.), and 24, 38, 44 and 56 (u.h.f.). There's some duplication, due to networking, but there's still a choice of some eight programmes most of the time.

Now these signals account for only the off-air transmissions. Being connected to a cable network would give me a choice of up to 32 (at present) stations, piped in from other areas, also locally generated items such as stock exchange figures. With that sort of selection, by the time you decide what to watch it's all over.

One of the main advantages of the cable systems is that they put on new movies long before these get to be shown by the networks. You have to pay for the privilege of course, but since it's about the same as a UK TV monthly rental it's reasonable enough. In fact the cable TV business is the fastest growing segment of the US consumer electronics market at present. The colour TV set market itself is around ten million sets a year, growing at a rate of about 2% a year.

The first TV manufacturer I visited was Zenith which, unlike other companies in the field, is concerned with consumer electronics only. The company produces some two million colour sets a year, and I'd say its R and D operation compares with the whole of European Philips TV. The Japanese setmakers are well established here – familiar names like Toshiba, Matsushita, Sony and Sanyo, all with local factories. In fact it reminds me quite a bit of the UK!

When I've had a chance to nose around the manufacturers a bit more, to examine the products and designs, I'll be reporting back further.

VCR Clinic

Steve Beeching, T.Eng. (C.E.I.)

The play key of a JVC HR4100 portable VCR ejected almost as quickly as it was pressed. If it was held down the recorder would play, though for only a short while. The cause of the trouble was failure of the cassette compartment lamp.

A similar problem occured on another of these machines, but this time was more intermittent. There are several safety circuits that will cause unthreading, so each has to be monitored. Is the capstan motor running? If so, is the head drum revolving, and are both spools rotating *and* driving the tape counter? Each of these points may need to be checked, visual inspection usually being adequate. With this particular machine we noticed that when the problem occurred the head drum was not revolving, the cause being a faulty drum motor.

Ferguson Videostar

A reader of *Television* came along with his Ferguson Videostar VCR, the problem being intermittent unthreading, creating problems with timer recordings some twenty-forty minutes into the programme. We found that after such a period of time the take-up spool would start to revolve erratically, the take-up tension being low. The trouble was overcome by cleaning all the surfaces with AF spray and adjusting the forward tension.

Apologies Department

I received a number of complaints about being too hard on Grundig following the notes on the 2 × 4 machine in the March issue. So I checked up on the situation in this area, and discovered that dealers had sold some 75-100 machines that had no faults at all, only some five having come to me for attention. I must also mention that I sell the 2 × 4 plus machine myself, and have had little to complain about. So don't take everything too much to heart, and remember that the faults sent to me to put right are usually the ones that others won't touch – a sort of "the buck stops here!".

Also Fig. 1 in the March issue is inaccurate – it was "got at" by the editor. (Fig. 1 this month shows the luminance playback/drop-out compensation system accurately.)

Wobble

The problem with a couple of VCRs that came along recently was picture wobble. The first was a JVC HR3660, and a replacement head drum motor soon put matters right – after setting up the servo of course. The second machine was, dare I say it, a Grundig 2 × 4!

The wobble occurred about three-quarters of the way through the tape, and after some checking I noticed that the tension arm was then vibrating. This could be felt with one's finger: a bit of finger pressure either way and it stopped. Fortunately Peter (he who knows Grundigs better than I do) arrived on a flying visit. A short time later, after changing the sequence module which contains the tension electronics, we concluded that the fault was due to one of the tape drive motors. That's to say, I said I thought it was a motor going lumpy, Peter thought it was a sensor optocoupler. We'd no proof of either diagnosis, except that there was an a.c. waveform on top of the d.c. motor supply. I sent for a motor and changed it, which is no mean feat and decidedly not advisable without the correct equipment. Anyway, the fault was still present, so I changed the optocoupler. Peter, being a smarty pants, was proved right. Motto: change the easier bits, even if it's more difficult to do it another way. Or something like that.

New Audio Head

The new audio head for a Grundig 2 × 4 plus machine – see the April *VCR Clinic* – duly arrived and was fitted with very little trouble. The ceramic parts of the head assembly

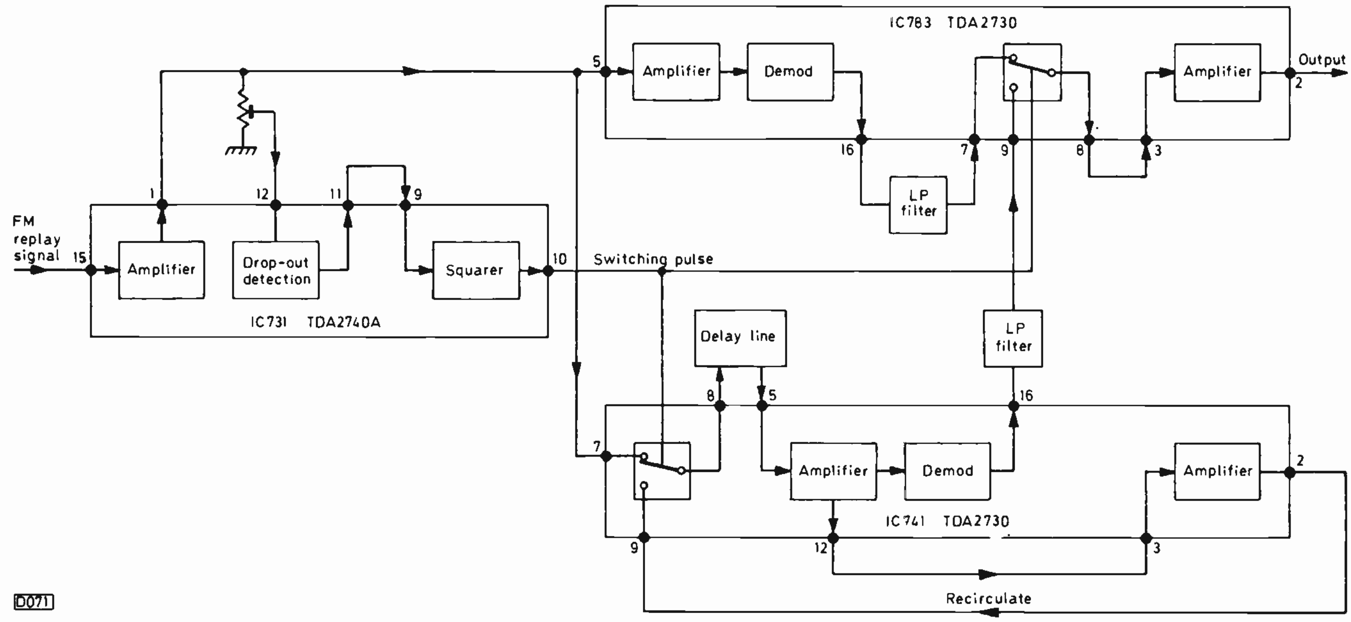


Fig. 1: The luminance playback/drop-out compensation system used in the Grundig 2 × 4 VCR. When a drop-out occurs, the f.m. playback signal envelope collapses. This is detected by IC731, which produces a switching signal at pin 10 to operate the electronic switches in IC783 and IC741. As a result, the signal is obtained from the 64µ sec delay line. In the event of a sustained drop-out (longer than one line), the signal is recirculated via pins 12, 3, 2, 9 and 8 of IC741.

are tape exit guides. I found it reasonably easy to carry out alignment for a symmetrical f.m. replay, with the head actuator disconnected of course. Only the audio bias signal needed altering, in accordance with the markings on the head – coloured blobs.

No Signals

A new, stock JVC HR3320 came in with no E to E video – that's to say, there seemed to be no output from the tuner. This was rather strange, as faults in this area have been few. With a cassette inserted and the record button pressed, there was indeed no output. An oscilloscope check showed that there was no signal at TP72, i.e. at the video output from the tuner/i.f. panel. There was a signal at TP12, i.e. at the input to the video i.c. – IC201, type AN345 – but nothing at its output (TP41). A replacement AN 345 i.c. put that right.

Spotty Picture

Finally this month an HR4100 that led us a bit of a dance. The customer had complained of spots on the picture, and the dealer had diagnosed the need to clean the static discharge brushes. This had made no difference. The "noise" consisted of fine black spots around areas of the picture with the sharpest focus or h.f. transients. Now this pointed to a number of possibilities – say the replay limiters and carrier balance. Adjustments here made the flecks worse, not better, but before changing the limiter i.c.s one has to consider other possibilities. The record carrier frequency and deviation for a start, in case there was over recording. The f.m. record and replay levels were all right, and the problem was still with us. Next try adjusting the replay preamplifier equalisation – and find that one of the damping controls, R33, was slightly out. Correct adjustment of this with a test tape cured the problem: this fault took a fair while to sort out, but I've never said that servicing VCRs is an easy task.

There was an editorial slip in our note on the Sanyo VTC9300 VCR last month – the zener diode (D712) in the 12V regulator circuit is a 6·2V type, not 10V (beware – the circuit in the manual shows a reading of 10·6V across the diode . . .).

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a 75p postal order (made out to IPC Magazines Ltd.), the query coupon from page 435 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

LUXOR 2621

The fault with this set is field jitter when the height is increased or on channel change. The boost voltage is correct at 700V: when this is reduced, the field jitter stops but there's lack of width. We've tried replacing the field timebase valves (PC92 blocking oscillator and PL508 output), and have also changed the electrolytics in the PL508's cathode circuit and carried out a suggested modification in the field oscillator circuit (adding a 390kΩ, ½W resistor and 1µF capacitor in series between the anode and chassis, readjusting the height and linearity controls), but the fault remains.

The link between the field and line timebases is the fact that the field charging circuit is fed from the boost rail, as is usual in hybrid sets. The problem you describe is very common on this chassis, and is due to instability in the line drive circuit.It should show up only when the height or the boost voltage is excessive. Unfortunately however the component tolerances on some sets are such that jitter occurs at normal settings. If the filter network modification in the field oscillator circuit has not cured the fault, try the following: add a 220kΩ, 1W resistor and 50µF, 50V capacitor in parallel between the collector of the line driver transistor Q751 and chassis, and a 50µF, 25V electrolytic from the cathode (pin 7) of the PL508 to chassis.

PYE 697 CHASSIS

For some weeks the colour has been coming and going, but recently it's been very weak when present. The colour can be restored by overriding the colour killer – but goes negative when changing channels!

The trouble could be due to the reference oscillator preset control RV10 being out of adjustment, but more likely the tuning of the ident coil L27 has become capacitive – a half turn clockwise should remedy this.

BUSH TV161 SERIES

The problem on this set affects the lower v.h.f. channels. With the contrast set at minimum, two or more vertical white lines are present – usually two on the left and one at the centre of the screen. When the setting of the contrast control is advanced, the interference spreads right across the screen. The line timebase valves have been replaced without improving matters.

Make sure that plug/socket 6/2 and the line output transformer frame are firmly earthed, ensure that the line output transformer screening can is present, and check that the aerial input lead is not routed past the back of the receiver. If these measures fail to provide a cure, fit a capacitor of not more than 10pF and not less than 8kV rating between the top cap of the PL504 line output valve and chassis. This capacitor can be made from a section of "figure eight" mains lead, with the conductors left parallel for about four inches.

THORN 1500 CHASSIS

When the brightness is turned up to nearly maximum, everything white appears very white – as if over-contrasted. The picture is only fairly good with the brightness set at a lower level.

The video output transistor VT9 (suitable types BF178, BF257A or BF336) could be defective, but it's far more likely that one or other of its two series-connected collector load resistors R40 and R41 has increased in value. Also check the video ouput transistor's base coupling capacitor C37 (64µF), and C38 (12µF) which smooths the h.t. supply to the video output stage.

PYE 569 CHASSIS

The trouble with this set is loss of field sync – the field can be locked for a few seconds by adjusting the hold control, but then slips. Several transistors (sync separator VT11, field sync pulse clipper VT12, and field oscillator VT6) look as though they could be responsible, but replacing them has made no difference.

VT6 is only half the field oscillator stage in this chassis, the triode section of the PCL805 field timebase valve forming the other half. A new valve may well cure the fault, but first check the value of R108 (1·5MΩ) which is in series with the field hold control – it often changes value on these sets. If the fault persists, check the value of the sync separator's base bias resistor R125 (4·7MΩ), then check the 330pF capacitors C87/C89 in the filter circuit between VT11 and VT12.

THORN 9000 CHASSIS

There's a good picture on this set, but on dark scenes field flyback lines are present. Removing the aerial makes no difference, and the lines cannot be tuned out.

It seems that the field flyback blanking system is not operating properly. The best thing to do would be to check with a scope that field flyback blanking pulses are passing from the collector of VT401 in the field oscillator stage via plug/socket 22/1 and 4/6, then R172, to pin 6 of the SN76227N chroma demodulator and luminance/chroma matrixing i.c. If they are, the chip itself is suspect.

RIGONDA VL100

All the transistors in this set are strange Russian types. I'm having difficulty with replacement timebase transistors. Any suggestions?

There are no recommended alternatives unfortunately, so substitutes must be tried on a trial and error basis. We've found that a couple of AC188 transistors can be used in the field output stage, though heatsinks may have to be added. An AU110 will work in the line output stage, though it may be necessary to adjust the values of the flyback tuning capacitors C81/2 to get the width right. Most of the other transistors used in the timebases are types MN38A, MN40, MN41, and KT315. The KT315 can be replaced with a BC107/8, an AC187 will replace the MN38A, while the MN40 and MN41 can be replaced with an AC188. A BF337 can be used to replace the KT601A video output transistor if necessary.

PHILIPS TS7 CHASSIS

The trouble with this portable (Pye T175) is lack of brightness. With the brightness control turned to maximum the picture becomes brighter but is still too dark.

The first thing to check is the voltages in the video output stage – there should be 3·9V at the emitter, 4·1V at the base and some 65V at the collector of TS20. Last time we had this problem it was due to a changed value resistor, and TS20 (BF337) had to be replaced as well. In this connection note that the emitter of TS20 is biased from the 10·8V rail via R190. If all is well here, make sure that the beam limiter diode D18 (V06C or BY206) is not open-circuit, then if necessary check the brightness control potentiometer, its series resistor R195 (820kΩ), and the first anode supply circuit, which includes the brightness preset R200.

THORN 9000 CHASSIS

The problem is field collapse. When this first happened, the field output transistors VT406/7 were changed, restoring the picture – but for only a couple of minutes or so.

The simplest course would be to change the two driver transistors VT405/8, the output transistors VT406/7, the diodes W406/7/8 in the output stage bias network and check the associated resistor R405 (4·7Ω). Check that the output stage mid-point voltage is 10·9V, and ensure that the c.r.t. Aquadag coating is earthed to the c.r.t. base panel.

GEC 3135

There's a strange fault with this portable. The set is dead until I parallel a 140µF electrolytic across C405. It then starts up. C405 has been renewed, but I still have to connect a capacitor across it to get the set to start.

C405 is one half of a capacitive potential divider which provides a kick-start voltage. The other components in the start-up circuit should all be checked therefore – C404 (680µF), R403/4, 2·7kΩ and 150kΩ respectively, and D403 (1N4004). If everything is in order here, it could be that the SN76544N/07 sync/timebase oscillator i.c. IC251 is reluctant to start working.

KÖRTING SOLID-STATE COLOUR CHASSIS

This set would blow the mains fuse, then work o.k. for a few weeks with a new fuse. On the last occasion however R1019 burnt out when a new fuse was fitted and the set was switched on, and D1011 was found to be short-circuit.

D1011 produces the 220V supply (U3) for the RGB output stages, by rectifying the positive-going flyback pulses at tap h on the line output transformer. R1019 is the associated 2·7Ω surge limiter resistor. The most likely cause of the trouble is that the reservoir capacitor C1030 (2·2µF), or maybe the decoupler C1032 (0·15µF), is short-circuit or leaky. If these capacitors are o.k., we suggest you disconnect the U3 supply and try again. "Possibles" further along the line are C606c (100µF) and C251 (0·1µF).

ITT VC200 CHASSIS

The line hold is very unstable, though lock can be obtained by adjusting the line oscillator coil L56. Unfortunately lock is lost when the channel is changed. The picture will also drift from left to right. The PCF802 line oscillator valve has been replaced, and the flywheel sync discriminator diodes D7/8 have been checked.

Start by shunting a 33µF or 25µF electrolytic capacitor across the line oscillator h.t. supply (HT5) in case the smoothing electrolytic C87 is open-circuit. If the fault remains, check R146 (150kΩ) which biases the cathode of the triode section of the valve, then check the 47kΩ resistors R139 and R142 which provide pulse coupling/integration in the discriminator circuit. If you have a scope, confirm the presence of a sawtooth waveform at the anode of each discriminator diode, and that line sync pulses are arriving at both cathodes via C115. If the fault is stubborn, check the value of the discriminator load resistors R143/4 (2·2MΩ).

DECCA 100 CHASSIS

The fault with this set is that all of a sudden the picture will bow in at the sides, i.e. the width will reduce by about three inches at either side of the centre line, the width at the top and bottom being nearly correct. There's also a vertical line about an inch from the left – this is normally present at switch on, but disappears after a few seconds. The fault is temperature sensitive, i.e. switch off for a while and normal results are restored, operate the set with the back off and the picture is perfect for hours.

This is not uncommon on these sets, and is usually due to dry-joints on the line output panel – at the EW modulator transformer T402 or sometimes at the filter coil L401 or the associated plug pins where they solder to the print on the panel.

THORN 1613 CHASSIS

There's an odd audio fault on this set – weak sound, which fades completely when the volume control is moved to increase it! The voltages in the audio circuit seem to be o.k., the volume control itself is all right, and the voltage across it rises and falls as the slider is moved.

The volume control acts on pin 5 of the TBA120C intercarrier sound i.c. This pin is decoupled by C47 (2·2µF). If the voltage across C47 is about 2·5V at maximum volume, touch either side of the audio coupling electrolytic C58 (0·22µF) with your finger. If a rasping buzz is heard, suspect the TBA120C i.c. and its l.t. supply feed resistor R32 (680Ω). If not, the TAA611/B12 audio output i.c. is probably responsible for the fault.

RANK A816 CHASSIS

The picture collapsed to a 4in. band across the centre of the screen, with foldover at the top and a bright white line at the bottom. The picture was restored by replacing the lower field output transistor 3VT14 (BC323), but on two further occasions it's gone again. All the voltages in the field timebase are normal when the set is working, so I'm a bit puzzled.

3VT14 seems to be vulnerable in this chassis – 3C32 was changed from 1µF to 1·5µF to provide increased protection, and it's recommended that this capacitor should always be replaced at the same time when 3VT14 has to be replaced. If further difficulty is experienced, replace both field output transistors, using a BC287 if possible in the 3VT13 position, the field coupling capacitor 3C31 (1,000µF) and the flyback diode 3D7.

TELEFUNKEN 711 CHASSIS

The trouble with this set is bad raster distortion – apparently something is wrong with the NS correction circuitry. Any stock troubles here?

Check the NS driver and output transistors T501 (BC327) and T503 (BD177) – they are inclined to go short-circuit base-to-emitter. Also check for dry-joints on the NS phase coil L501.

THORN 1600 CHASSIS

The trouble with this set is that the field output i.c. burns up. This has happened twice so far, and I suspect that the replacement i.c. may have been defective. Most of the components around the i.c. have been checked.

It's important to ensure that the supply to the i.c. is not excessive – it should be 28V at pin 10. If it's high, the shunt regulator may be inoperative due to R157 (39Ω) being open-circuit. Things to check if necessary in the field output stage are the coupling capacitor C99 (1,000μF), C91 (0·001μF) in the stabilising network, and the feedback resistor R103 (22kΩ). We assume that the replacement i.c. was of the fully winged type.

KUBA FLORENCE

When a tape is being played back through this set from a Sony SL8000UB VCR, the top of the picture is distorted, with vertical lines curling around to an almost horizontal position.

As with other sets using a TBA920 sync/line oscillator i.c., pin 10 of the i.c. should be connected to chassis for VCR use. If off-air reception is affected when this is done, add a switch to short out the components connected to pin 10.

TEST CASE

222

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.

TV sets are not all pictures and colours, as we discovered this month. Among the queue of sets awaiting attention in the workshop we found a monochrome table model fitted with the Philips E2 chassis. The job card said "weak sound", and as we'd been battling with intermittent faults and horribly complicated circuits all day we turned to this set for some light relief – and to restore our faith in the triumph of logic over obscurity! On test, the sound was indeed weak, but with a degree of hum and background noise way above the normal level. With the volume control turned to maximum, the sound level was rather less than what would be the normal listening level.

The arrangements used in the sound channel in this chassis are quite conventional, consisting in the main of two chips – a TBA120AS intercarrier sound i.c. and a TDA2611AQ audio amplifier/output i.c. The only feature that's a bit unusual is the use of a BC636 transistor (TS425) as a simple emitter-follower shunt stabiliser for the 23V supply to the audio chip. Our first suspicion was naturally that the supply voltage to this chip was incorrect, due maybe to TS425 or the decoupling electrolytic C425 (470μF). The voltage at pin 1 was correct however. Back to the intercarrier sound chip then.

Voltage checks on all pins were made with the multimeter, but all were within 10% of those shown on the circuit diagram. We concluded therefore that the chip itself was innocent, which seemed to be born out by the "lively" response at the various pins. Adjustment of the quadrature coil S401 was next tried, but no improvement was obtained – in fact adjusting the coil produced little effect. Attention was next turned to the 6MHz input to the chip. This comes from a tuned circuit at the output of the TDA2541 i.f. amplifier/demodulator i.c. The tuning of this circuit was found to be spot on, and in fact the full output was being passed to the intercarrier sound chip.

Capacitor trouble maybe? The TBA120AS's supply decoupling electrolytic C409 (220μF), and C406 (1μF) which couples its output to the volume control, were next checked. Both proved to be in order! What had we overlooked? See next month for the answer, and for another item in the series.

ANSWER TO TEST CASE 221
– page 382 last month –

Our Sony KV1822UB last month was suffering from the no signal condition, because virtually no tuning voltage was reaching the u.h.f. tuner. As the circuit we showed made clear, the sliders of the tuning potentiometers RV151-8 are each linked to the base of the output emitter-follower transistor Q155 via a diode. These diodes are included to isolate the unselected potentiometers, preventing them from upsetting the tuning voltage obtained from the selected potentiometer.

Now in circuits of this type these diodes sometimes become faulty, causing tuning problems. None of them had become leaky or short-circuit however, as we first suspected. Apart from this, the diode associated with the selected potentiometer has to be switched on somehow to get the required voltage at the base of Q155. In this circuit R168 (8·2MΩ) is included for the purpose – and was found to be completely open-circuit, leaving the diodes "wagging their tails in the air" as our engineer put it.

When making tests in this and similar circuits, it's important to bear in mind that the source impedance of the tuning voltage at the base of Q155 is very high. Thus application of an ordinary multimeter here will vastly alter the tuning voltage.

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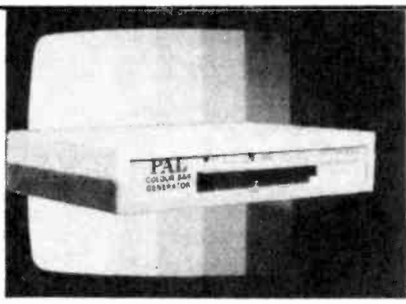

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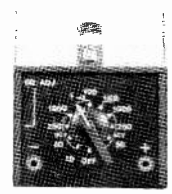

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