TELEVISION

25p

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

DECEMBER 1974

Get the best from your Aerial

with this SIGNAL STRENGTH METER

PART 1

ALSO:

DECODER FAULT-FINDING

SELF-CONVERGING COLOUR CRTs

SERVICING THE BAIRD 660/670/680 CHASSIS

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.35
AC117	0.24
AC126	0.25
AC127	0.25
AC128	0.25
AC141	0.26
AC141K	0.27
AC142K	0.19
AC151	0.24
AC152	0.25
AC153K	0.28
AC154	0.20
AC176	0.25
AC187	0.25
AC187K	0.25
AC188	0.25
AC188K	0.26
AC193K	0.30
AC194K	0.32
ACY28	0.25
ACY39	0.68
AD140	0.50
AD142	0.52
AD143	0.51
AD149	0.50
AD161	0.48
AD162	0.48
AF114	0.25
AF115	0.25
AF116	0.25
AF117	0.20
AF118	0.50
AF121	0.30
AF124	0.25
AF125	0.20
AF126	0.20
AF127	0.20
AF139	0.35
AF147	0.35
AF149	0.45
AF178	0.55
AF179	0.60
AF180	0.55
AF181	0.50
AF186	0.40
AF239	0.40
AF279	0.84
AL100	1.10
AL102	1.10
AL103	1.10
AL113	0.95
AU103	1.40
AU110	1.10
AU113	1.70
BC107	0.12
BC107A	0.13
BC107B	0.14
BC108	0.12
BC108B	0.13
BC109	0.13
BC109C	0.14
BC113	0.13
BC114	0.20
BC115	0.20
BC116	0.20
BC117	0.20
BC119	0.29
BC125	0.22
BC125B	0.25
BC126	0.20
BC132	0.15
BC134	0.20
BC135	0.15
BC136	0.20
BC137	0.20
BC138	0.20
BC142	0.30
BC143	0.35
BC147B	0.13
BC148	0.12
BC149	0.14
BC152	0.25
BC153	0.20
BC154	0.20
BC157	0.15
BC158	0.13
BC159	0.15
BC161	0.48
BC167B	0.15
BC168B	0.13
BC169C	0.13
BC170	0.15
BC171	0.15
BC172	0.14
BC173	0.20
BC176	0.22

Type	Price (£)
BC177	0.20
BC178	0.22
BC178B	0.22
BC179	0.20
BC179B	0.21
BC182L	0.11
BC183	0.11
BC183K	0.12
BC183L	0.11
BC184L	0.13
BC186	0.25
BC187	0.25
BC208	0.12
BC212L	0.12
BC213L	0.12
BC214L	0.15
BC238	0.10
BC261A	0.28
BC262A	0.18
BC263B	0.25
BC267	0.16
BC268C	0.14
BC294	0.27
BC300	0.58
BC301	0.35
BC303	0.60
BC307B	0.12
BC308A	0.10
BC309	0.15
BC323	0.38
BC377	0.22
BC441	1.10
BC461	1.58
BCY33	0.36
BCY42	0.16
BCY71	0.22
BCY88	2.42
BD115	0.65
BD123	0.98
BD124	0.80
BD130Y	1.42
BD131	0.45
BD132	0.50
BD135	0.40
BD136	0.46
BD137	0.48
BD138	0.50
BD139	0.55
BD140	0.62
BD144	2.19
BD145	0.75
BD163	0.67
BD183	0.56
BD234	0.75
BD519	0.76
BD520	0.76
BDX18	1,45
BDX32	2.55
BDY16A	0.38
BDY18	1.78
BDY20	0.99
BF115	0.20
BF117	0.45
BF120	0.55
BF121	0.25
BF123	0.28
BF125	0.25
BF127	0.30
BF158	0.25
BF159	0.27
BF160	0.22
BF161	0.45
BF162	0.45
BF163	0.45
BF167	0.25
BF173	0.25
BF177	0.30
BF178	0.33
BF179	0.33
BF180	0.35
BF181	0.33
BF182	0.44
BF183	0.44
BF184	0.26
BF185	0.26
BF194	0.15
BF195	0.15
BF196	0.15
BF197	0.17
BF198	0.20
BF199	0.25
BF200	0.35
BF218	0.35
BF222	1.08
BF224J	0.15
BF240	0.20

All items advertised ex-stock on magazine copy date. All prices subject to availability.

Type	Price (£)
BF241	0.20
BF244	0.18
BF254	0.45
BF255	0.45
BF256	0.45
BF257	0.49
BF258	0.66
BF259	0.93
BF262	0.70
BF263	0.70
BF273	0.16
BF336	0.35
BF337	0.35
BF458	0.46
BF459	0.57
BF596	0.70
BF597	0.15
BFR41	0.30
BFR61	0.30
BFT43	0.55
BFW10	0.55
BFW11	0.55
BFW16A	1.70
BFW30	1.38
BFW59	0.19
BFW60	0.20
BFW90	0.28
BFX16	2.25
BFX29	0.30
BFX30	0.35
BFX84	0.25
BFX85	0.26
BFX86	0.26
BFX87	0.28
BFX88	0.24
BFY18	0.53
BFY40	0.40
BFY41	0.43
BFY50	0.25
BFY51	0.23
BFY52	0.23
BFY57	0.32
BFY64	0.42
BFY72	0.31
BFY90	0.70
BLY15A	0.79
BPX25	1.65
BPX29	1.60
BPX52	1.90
BRC4443	0.60
BRY39	0.42
BR101	0.35
BSW64	0.38
BSX19	0.13
BSX20	0.19
BSX76	0.15
BSX82	0.52
BSY19	0.52
BSY41	0.22
BSY54	0.50
BSY56	0.80
BSY65	0.15
BSY78	0.40
BSY91	0.28
BT101/	
300	1.05
/500	1.15
BT102/	
300	1.02
/500	1.12
BT106	1.18
BU105/02	1.95
BU108	3.25
BU126	1.93
BU204	1.98
BU205	1.98
BU207	3.00
BU208	3.15
BU209	2.55
BUY77	2.50
BUY78	2.55
BUY79	2.85
C106F	0.43
C111E	0.56
CRS1/40	0.45
CRS3/40	0.55
D40W1	0.45
E1222	0.55
E5024	0.20
ME6001	0.16
ME6002	0.17
ME8001	0.18
MJE340	0.68
MJE341	0.72
MJE370	0.65
MJE520	0.85
MJE521	0.95
MJE2955	1.20

Type	Price (£)
MJE3055	0.74
MM721	0.70
MPF102	0.40
MPS6566	0.21
MPSA05	0.47
MPSA55	0.50
MPSU05	0.66
MPSU06	0.76
MPSU55	1.26
OC26	0.38
OC28	0.65
OC35	0.50
OC36	0.55
OC42	0.35
OC44	0.15
OC45	0.15
OC70	0.15
OC71	0.15
OC72	0.15
OC73	0.51
OC75	0.25
OC81	0.25
OC81D	0.30
OC139	0.28
OC140	0.30
OC170	0.25
OC171	0.30
OCP71	0.43
ON188	2.19
ON236A	0.65
ORP12	0.55
R2008B	2.05
R2010B	2.10
TAG3/	
400	1.54
TIC44	0.29
TIC46	0.44
TIC47	0.58
TIP29A	0.49
TIP30A	0.58
TIP31A	0.65
TIP32A	0.67
TIP33A	0.99
TIP34A	1.73
TIP41A	0.80
TIP42A	0.91
TIS43	0.30
TIS73	1.36
ZTX109	0.12
ZTX300	0.16
ZTX304	0.22
ZTX310	0.10
ZTX313	0.12
ZTX500	0.17
ZTX502	0.17
ZTX504	0.42
ZTX602	0.24
2N525	0.86
2N696	0.23
2N697	0.15
2N706	0.12
2N706A	0.15
2N708	0.35
2N744	0.30
2N914	0.19
2N916	0.20
2N918	0.42
2N930	0.35
2N1304	0.21
2N1305	0.21
2N1306	0.31
2N1307	0.22
2N1308	0.26
2N1309	0.36
2N1613	0.34
2N1711	0.45
2N1890	0.45
2N1893	0.48
2N2102	0.31
2N2217	0.36
2N2218	0.60
2N2219	0.50
2N2221A	0.41
2N2222A	0.50
2N2369A	0.42
2N2401	0.60
2N2484	0.41
2N2570	0.18
2N2646	0.53
2N2712	0.12
2N2904	0.22
2N2904A	0.26
2N2905	0.72
2N2905A	0.73
2N2926G	0.13
2N2926Y	0.12
2N2926O	0.12
2N3019	0.75

Tel: Stoke Climsland (05797) 439
Telex: 45457 (A/B Mercury Calgton)

Type	Price (£)
2N3053	0.21
2N3054	0.55
2N3055	0.60
2N3133	0.54
2N3134	0.60
2N3232	1.32
2N3235	1.10
2N3254	0.28
2N3323	0.48
2N3391A	0.23
2N3702	0.13
2N3703	0.15
2N3704	0.15
2N3705	0.11
2N3706	0.10
2N3707	0.13
2N3715	2.30
2N3724	0.72
2N3739	1.18
2N3771	1.70
2N3772	1.90
2N3773	2.90
2N3790	4.15
2N3794	0.20
2N3819	0.35
2N3820	0.49
2N3823	1.45
2N3866	1.70
2N3877	0.25
2N3904	0.16
2N3905	0.18
2N3906	0.15
2N4032	0.31
2N4036	0.52
2N4046	0.35
2N4058	0.17
2N4123	0.13
2N4124	0.15
2N4126	0.20
2N4236	1.90
2N4248	0.12
2N4284	0.19
2N4286	0.19
2N4288	0.13
2N4289	0.20
2N4290	0.14
2N4291	0.18
2N4292	0.20
2N4871	0.24
2N4902	1.30
2N5042	1.05
2N5060	0.32
2N5061	0.35
2N5064	0.45
2N5087	0.32
2M5294	0.35
2N5296	0.37
2N5298	0.38
2N5322	0.85
2N5449	1.90
2N5457	0.30
2N5458	0.35
2N5494	1.85
2N5496	2.05
2N6027	0.65
2N6178	0.71
2N6180	0.78
2SC643A	1.36
2SC1172Y	2.80
3N140	1.21
40250	0.60
40327	0.67
40361	0.48
40362	0.50
40429	0.80
40439	2.67

MATCHED PAIRS

Type	Price (£)
AC128/AC176	0.52
AC141K/AC142K	0.56
AC187/AC188	0.60
AC187/AC188K	0.61
AC193K/AC194K	0.71
AD161/AD162	0.95
BC142/BC143	0.70

Any other transistors can be matched at a supplement of 20p per pair.

DIODES

Type	Price (£)
AA113	0.15
AA119	0.09
AA129	0.20
AA143	0.10
AAZ13	0.30
BA100	0.15
BA102	0.25
BA110U	0.30
BA115	0.12
BA141	0.17
BA145	0.17
BA148	0.17
BA154	0.13
BA155	0.16
BA156	0.15
BA157	0.25
BAX13	0.06
BAX16	0.07
BB103	0.25
BB104	0.45
BB105B	0.45
BB105G	0.35
BR100	0.50
BY100	0.15
BY103	0.22
BY126	0.16
BY127	0.17
BY133	0.23
BY140	1.40
BY164	0.55
BY176	1.00
BY179	0.70
BY206	0.31
BYX10	0.15
BYZ12	0.30
FSY41A	0.40
OA10	0.20
OA47	0.07
OA81	0.12
OA90	0.08
OA91	0.07
OA95	0.07
OA200	0.10
OA202	0.10
OA210	0.29
OAZ237	0.78
S2M1	0.22
TV20	1.20
IN914	0.07
IN914E	0.06
IN916	0.10
IN4001	0.05
IN4002	0.06
IN4003	0.07
IN4004	0.08
IN4005	0.09
IN4006	0.11
IN4007	0.14
IN4148	0.05
IN4448	0.10
IN5400	0.15
IN5401	0.17
IN5402	0.20
IN5403	0.22
IN5404	0.25
IN5405	0.27
IN5406	0.30
IN5407	0.34
IS44	0.07
IS310	0.45
IS920	0.07
IS923	0.12

Diodes can be supplied balanced at a supplement of 5p per device—e.g. four balanced OA91 would be £0.48 per set.

Variable capacitance diodes can be supplied matched at a supplement of 3p per device.

LINEAR INTEGRATED CIRCUITS

Type	Price (£)
CA3046	0.70
CA3065	1.90
MC1307P	1.19
MC1310P	2.94
MC1327PQ	1.01
MC1330P	0.76
MC1351P	0.75
MC1352P	0.72
MC1358PQ	1.85
MC1496L	0.87
MC3051P	0.58
MFC4000B	0.43
MFC4060A	0.70
MFC6040	0.91
PA263	1.90
SL414A	1.91
SL901A	2.60
SL917B	3.80
SN76003N	2.92
SN76013N	1.95
SN76013ND	1.72
SN76023N	1.95
SN76023ND	1.72
SN76033N	2.92
TAA300	1.46
TAA320	0.94
TAA350	1.54
TAA435	0.85
TAA450	1.85
TAA550	0.49
TAA570	1.39
TAA611	1.73
TAA630Q	3.29
TAA630S	3.29
TAA700	3.30
TAA840	1.64
TAA861A	0.49
TAA100	1.42
TBA120	0.68
TBA120S	0.99
TBA240A	1.10
TBA480Q	1.24
TBA500	1.99
TBA500Q	2.00
TBA510	1.99
TBA520Q	2.72
TBA530	1.98
TBA530Q	1.99
TBA540	2.20
TBA540Q	2.21
TBA550Q	3.29
TBA560C	2.71
TBA560CQ	2.72
TBA570	1.17
TBA641	0.76
TBA673	1.80
TBA700	1.90
TBA720Q	2.20
TBA750Q	1.54
TBA800	1.75
TBA810AS	1.75
TBA920Q	3.29
TBA990	3.29
TBA990Q	3.29
TCA270Q	3.30
ZN414	1.25
µ6A995-159	2.25
709:	
TO99	0.45
DIL8	0.45
DIL14	0.47
710:	
DIL14	0.50
711:	
DIL14	0.62
723:	
TO100	0.95
DIL14	0.95
741:	
TO99	0.48
DIL8	0.50
DIL14	0.55
748:	
DIL8	0.52

DIGITAL INTEGRATED CIRCUITS

Type	Price (£)
7400	0.20
7401	0.20
7402	0.20
7404	0.24
7406	0.45
7408	0.25
7410	0.20
7411	0.25
7412	0.28
7413	0.50
7416	0.45
7417	0.30
7420	0.20
7430	0.20
7440	0.20
7441	0.85
7447	1.30
7450	0.20
7451	0.20
7454	0.20
7460	0.20
7470	0.33
7472	0.38
7473	0.44
7474	0.48
7475	0.59
7490	0.65
7491	1.10
7492	0.75
7493	0.65
7494	0.85
7495	0.85
7496	1.00
74100	2.16
74121	0.60
74122	0.80
74150	1.44
74151	1.15
74154	1.66
74164	2.01
74192	2.05
74193	2.30

HARDWARE BASES

Type	Price (£)
DIL8	0.16
DIL14	0.16
DIL16	0.18

PADS

TO-5	½p
TO-18	½p

MOUNTING KITS

TO-3	0.06
TO-66	0.06

VALVES

Type	Price (£)
DY87	0.39
EB91	0.30
ECC82	0.41
EF80	0.41
EF183	0.53
EF184	0.53
EH90	0.55
PC86	0.67
PC88	0.76
PCC89	0.58
PCF80	0.47
PCF86	0.58
PCF801	0.58
PCF802	0.63
PCL82	0.50
PCL84	0.54
PCL805/85	0.58
PCL86	0.58
PFL200	0.74
PL36	0.80
PL84	0.61
PL504	0.80
PL508	0.95
PL509	1.44
PY81/800	0.45
PY88	0.52

ZENER DIODES

400mW 3.0-33V **12p each**
1W 3.3-68V **18p each**

MINIATURE BRIDGES

2A Plastic Encapsulated

N6001	50V PIV	**35p each**
N6002	100V PIV	**38p each**
N6003	200V PIV	**41p each**
N6004	400V PIV	**45p each**
N6005	600V PIV	**50p each**
N6006	700V PIV	**59p each**
N6007	800V PIV	**68p each**

VDR'S, PTC & NTC RESISTORS

Type	Price (p)	Type	Price (p)
E295ZZ/01	12	E299DD/P116-P354	all 7
E295ZZ/02	12	VA1015	20
E298CD/A258	6	VA1026	17
E298ED/A258	5	VA1033	7
/A260	5	VA1034	7
/A262	5	VA1040	7
/A265	5	VA1053	7
/P268	5	VA1055S	9
E298ZZ/05	6	VA1077	10
/06	5	VA1104	27
		VA8650	85

RESISTORS

Carbon Film (5%)
¼W 5.6 Ω-330k Ω (E12) **1p ea**
⅓W 10 Ω-10M Ω (E24) **1p ea**
1W 10 Ω-10M Ω (E12) **2p ea**
2W 10 Ω-10M Ω (E12) **3p ea**

WIREWOUND (5%)
2½W 0.22 Ω-270 Ω **15p ea**
5W 10 Ω-8.2k Ω **12p ea**
10W 10 Ω-25k Ω **15p ea**

CAPACITORS

Full range of C280, C296, tubular ceramic, pin-up ceramic, miniature electrolytics, mica, mixed dielectric and TV electrolytics stocked.—Please see catalogue.

MASTHEAD AMPLIFIERS

Labgear type CM6000 complete with mains power unit CM6001/PU.
Groups A, B, or C/D **£9.87**

PATTERN GENERATORS

Labgear CM6004/PG giving crosshatch dots, greyscale and blank raster on 625-lines. Tuning can be preset for anywhere in Bands IV and V as well as Band III (for relays). **£45.39**

COLOUR-BAR GENERATORS

Labgear CM6037/DB: Dual standard bar generator gives standard 8 band colour bars + greyscale step wedge + red raster + centre cross + centre dot + crosshatch + dot pattern + blank raster. Sync output also provided **£101.31**

VHF/UHF CONVERTERS

Labgear "Televertas" for DX-ing or single-standard receiver use on relay systems.
Type 6018/RC **£10.00**
Type 6022/RA (with pre-amp gain control) **£12.27**

AERIALS, ETC.

Please see catalogue.

OUR NEW CATALOGUE IS NOW AVAILABLE AT 30p (refundable).

P. & p.: UK £0.08 per order
Overseas: At cost

Please Add 8% for V.A.T.

EAST CORNWALL COMPONENTS

CALLINGTON - CORNWALL

"I MADE IT MYSELF"

Imagine the thrill you'll feel! Imagine how impressed people will be when they're hearing a programme on a modern radio you made yourself.

Now! Learn the secrets of radio and electronics by building your own modern transistor radio!

Practical lessons teach you sooner than you would dream possible.

What a wonderful way to learn – and help qualify yourself for a new, better-paid career! No dreary ploughing through page after page of dull facts and figures. With this fascinating Technatron Course, you learn by building!

You build a modern Transistor Radio . . . a Burglar Alarm. You learn Radio and Electronics by doing *actual projects you enjoy* – making things with your own hands that you'll be proud to own! No wonder it's so fast and easy to learn this way. Because learning becomes a hobby! And what a profitable hobby. Because opportunities in the field of Radio and Electronics are growing faster than they can find people to fill the jobs!

No mathematics, no soldering – yet you learn faster than you ever dreamed possible.

Yes! Faster than you can imagine, you pick up the technical know how you need. Specially prepared step-by-step lessons show you how to: read circuits – assemble components – build things – experiment. You enjoy every minute of it!

You get everything you need. Tools. Components. Even a versatile Multimeter that we teach you how to use. All included in the course AT NO EXTRA CHARGE! And this is a course anyone can afford. You can even pay for it in easy payments – in fact you could make extra cash from spare-time work when you've turned yourself into a qualified man through B.I.E.T. training.

So fast, so easy, this personalised course will teach you even if you don't know a thing today!

No matter how little you know now, no matter what your background or education, we'll teach you. Step by step, in simple easy-to-understand language, you pick up the secrets of radio and electronics.

You become a man who *makes* things, not just another of the millions who don't understand. And you could pave the way to a great new career, to add to the thrill and pride you receive when you look at what you have achieved. Within weeks you could hold in your hand your own powerful radio. And after the course you can go on to acquire high-powered technical qualifications, because B.I.E.T.'s famous courses go right up to City & Guilds levels.

Send now for FREE 76 page book – see how easy it is – read what others say!

Find out more now! This is the gateway to a thrilling new career, or a wonderful hobby you'll enjoy for years. Send the coupon now. There's no obligation.

POST TODAY FOR FREE BOOK

To: BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY
Aldermaston Court, Reading RG7 4PF

BTV85

QH

Yes, I'd like to know more about your course. Please send me free details—plus your big, 76-page book that tells about all your courses.

NAME ....

ADDRESS ....

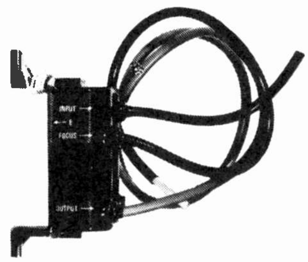
....

....

BIET

HOME OF BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

COLOUR 25 KV TRIPLERS



£1.70+13p V.A.T.

REPLACEMENT TRIPLERS

PYE CT72 SERIES 691, 693, EKCO CT103, CT120, CT105, CT125, CT121, CT122. GEC 2028, 2029, 2030 SOBELL 1028, 1029, TS25, 11TAZ	£3.00+24p V.A.T.
DECCA CS1730	£1.00+8p V.A.T.
E.H.T. RECTIFIER STICKS X80/150D	10p+1p V.A.T.
PYE TRANSISTOR TUNER UNITS VHF, UHF. *No* push button assembly	£1.50+12p V.A.T.
PHILIPS UHF UNIT	£1.50+12p V.A.T.
6 OR 4 PUSH-BUTTON UHF TUNER UNIT PYE	£3.00+24p V.A.T.
UHF AERIAL ISOLATING CO-AX SOCKETS & LEAD	30p+2p V.A.T.
22 MFD, 315V/W Condensers 25 MFD, 300V/W, 470MFD 35 V/W 10 MFD, 250 V/W, 2.20 MFD 63 V/W 1000 PF 8Kv	10p+1p V.A.T.
200+100 MFD, 325 V/W	30p+2p V.A.T.
200+200+100, 325 V/W	40p+3p V.A.T.
200+100+50+100	40p+3p V.A.T.
300+200+100 MFD, 350 V/W	50p+4p V.A.T.
200+200+100 MFD, 350 V/W	50p+4p V.A.T.
100 W/W Resistor	£1.00+8p V.A.T.
300 Mixed Condensers	£1.00+8p V.A.T.
350 Mixed Resistors	£1.00+8p V.A.T.
40 Mixed Pots	£1.00+8p V.A.T.

COLOUR T/V COMPONENTS
MANUFACTURERS DISCARDED MATERIALS

VHF or UHF Varicap Tuners	£1.20+9p V.A.T.
Line o.p. Panels	£1.20+9p V.A.T.
Decoder Panels	£1.00+8p V.A.T.
G8 Type Yoke	50p+4p V.A.T.

Money returned if not completely satisfied

SENDZ COMPONENTS

2 WOODGRANGE CLOSE
THORPE BAY, ESSEX

P.P. PAID U.K. ONLY

Reg Office Only—No Personal Callers Please

TELEVISION

VOL 25 No 2
ISSUE 290

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS DECEMBER 1974

RELIABILITY PROBLEMS

Since the UK has been in the business of quantity TV set production longer than anyone else, since 1937 in fact, you might suppose that we know how to make them. Reliably, that is. So what do we find 37 years later? Here are some recent examples, all modern colour sets. In the field sync coupling circuit of one set a 220kΩ resistor was found fitted in place of a 3.3MΩ resistor. Since the resistor concerned is in a network connected to the field linearity feedback loop the result was cramping at the centre of the screen. Noticeable on test you might think. In another set the audio output pentode screen grid feed resistor was found to be 220kΩ instead of 100Ω. Audible that one you might suppose. In yet another the field scan was intermittent due to a dry-joint resulting from a wire link on the power board being cut too short. You'd think a soak test would have shown that one up. These three examples come from different manufacturers incidentally.

While this sort of thing goes on the UK setmaking industry is being constantly compared with the extraordinary reputation for reliability of the Japanese setmaking industry. Not just the fact that their sets work properly the first time—straight from the carton—but continued reliability over a long period of time.

Now that more than ever before our TV industry—along with the rest—must establish an internationally viable position problems such as those above are a matter of urgency. Just why is it possible for brand new sets to be faulty?

Is it because mechanical engineers, those who work out the assembly and testing arrangements, are insufficiently in touch with their electronics counterparts and vice versa? It seems on the cards, though hard to understand since they have been working together for so long. As to set reliability over the longer term, surely in these days of BEAB testing when almost every conceivable combination of component failures and the likely consequences have to be taken into account chassis which provide reliable performance should be rolling off the production lines.

Or is the basic problem the overall way in which our industry is organised? If you're simply out for the quick buck, short cuts in production are likely to be considered unimportant. If however the establishment of a viable industry from the long term point of view is the aim, as it should be, good all round engineering is essential. Also the co-ordination of production, sales and servicing activities so that there is a feedback of information and an understanding of market requirements in their entirety.

The UK TV industry has always had its problems. Originally the 405-line system, which meant that domestic production was isolated from export activities. And at present the gap between inexpensive 90° colour receivers—the norm in the UK—and the elaborate (they have to be) 110° chassis which seem to be the requirement in most export markets.

Nevertheless one can say the following about the UK TV industry: the knowhow is certainly there, and the ability to produce sets at a highly competitive price. This should add up to sure-fire success, both domestically and internationally. If it doesn't, and all those production sillies and failures to design chassis with built-in reliability continue, it will all be part of our miserable inability to organise ourselves and seize the opportunities that are there right now to bootstrap ourselves out of our economic malaise.

L. E. HOWES—*Editor.*

THIS MONTH

THE NEXT ISSUE DATED JANUARY IS DUE FOR PUBLICATION ON DECEMBER 16

TELETOPICS

VIDEODISCS IN THREE YEARS?

Philips of Eindhoven has signed an agreement with MCA of Los Angeles on the marketing of videodisc players using optoelectronic scanning techniques—the Philips system was described in detail in our June 1974 issue. Both companies have been working on optoelectronic systems for some years and have now established a licensing organisation. Philips is to manufacture the players.

Under the agreement MCA (Music Corporation of America) will make and market the videodisc programmes. MCA is understood to have a wide selection of material available for this purpose, including the United Pictures film library. The successful launch of videodiscs on the domestic consumer electronics market depends of course not only on suitable playing equipment being available at an acceptable price but also on the availability of programme material for the recordings.

Philips has indicated that it expects to have its videodisc players on sale in the UK in about three years' time.

GO AHEAD FOR CEEFAX AND ORACLE

The Home Office has approved the introduction for a two year experimental period of regular Ceefax/Oracle TV data transmissions. These will provide a live news/information service for those with receivers able to decode the data signals transmitted during the field blanking period. The purpose of the experiment is to assess the demand for the service, to determine the form it should take and the scope for manufacturing the equipment required. It is expected that the results will be considered by the Annan Committee on the Future of Broadcasting. The UK is at present the world leader in the techniques and hardware for such transmissions.

Whilst warmly welcoming this government encouragement of what should be a very worthwhile addition to the broadcasting services we are somewhat puzzled as to how an experimental period will be able to give any indications about future demand. Present decoders are prototypes and very few in number: in consequence they are relatively expensive. It will not be until sets incorporating decoders—or alternatively set adaptors—are in large scale production that the cost will come down to the level at which the public is likely to show interest. It would be better to give wholehearted support to the service—which will cost the broadcasters very little to install and operate—right now.

There have been many references to Ceefax and Oracle in this column since we first mentioned in January 1973 the development by the BBC of its Ceefax system. We have not however shown readers what the information looks like on a TV receiver screen. The accompanying off-air photographs remedy this omission. They were taken by our editor at a recent demonstration of Oracle at the IBA's new engineering headquarters at Crawley Court, Sussex when news flashes from ITN with on-air editing were shown: direct feeds from ITN, the Meterological Office and the AA provided up-to-date information for the Oracle transmissions from the Crystal Palace mast. The transmitting centre uses a small general purpose computer to generate the data messages and allow rapid insertion of new information via a keyboard. Graphics, for example simple, still pictures such as weather maps, were also transmitted.

The BBC's experimental Ceefax service is now in operation on the BBC-1 u.h.f. network and is available throughout normal programme hours. Material initially being transmitted includes news headlines, weather forecasts, sports results, radio and television programme schedules and other items.

PHONE YOUR TV SET!

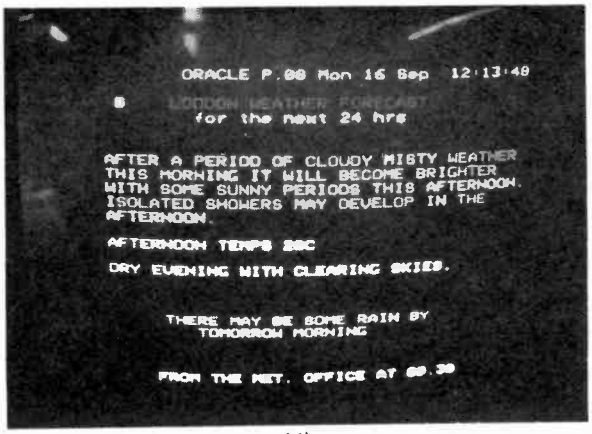
A data terminal called Datacom has been developed by GEC. In addition to providing messages via a normal telephone handset, messages received can be printed out. GEC anticipate that it will be possible to operate the terminal in conjunction with a Ceefax/Oracle decoder, enabling messages to be displayed on a TV screen. When this happens you'll be able to phone your TV set.

IC SYMPOSIUM

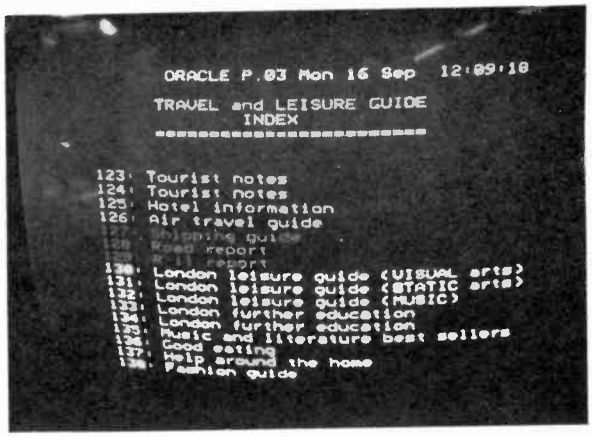
Delegates from eleven UK radio, audio and TV setmakers recently attended, at Mullard's invitation, an international i.c. symposium at Eindhoven, Holland. A new generation of linear i.c.s to meet the requirements of setmakers in the late 1970s was described there. Mullard contributions to the new range include colour decoder circuits, a class D field deflection circuit and i.c.s for TV information systems—e.g. Ceefax/Oracle. Work on these is being carried out at Mullard's Central Application Laboratory.

TV GAMES

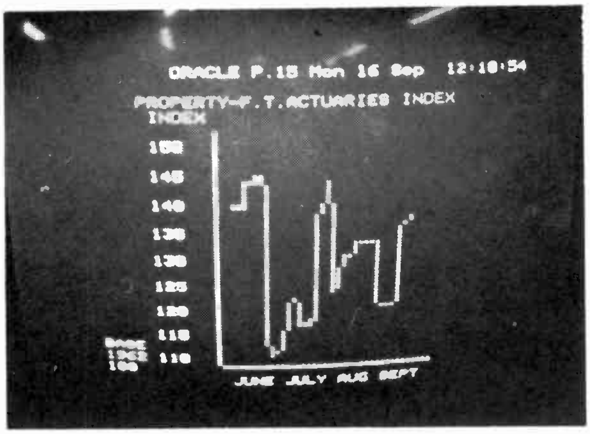
Something of a price war in TV games seems to be breaking out. Forward Retailing are to market the US-built Magnavox-Odyssey TV game unit which offers twelve different games including table tennis, roulette, ski-race, analogic and haunted house at a recommended retail price of just under £60. The unit comes with



(1)



(2)



(3)

(4)

Photographs of off-air Oracle transmissions from the Crystal Palace transmitter taken at a recent demonstration of Oracle at the IBA's Crawley Court, Sussex engineering headquarters. (1) An Oracle page giving the weather forecast from the Meteorological Office. (2) An Oracle page with some lines displayed in colour. (3) Graph transmitted by Oracle. (4) Weather forecast map transmitted by Oracle. The decoder used in (1)-(3) was of Mullard design with the display on a Prowest monitor. The decoder and set used in (4) are from the GEC research laboratory.

screen overlays, paper money and gambling chips. It is battery operated and has a master control plus two player controls. Different games are selected by placing different printed circuit boards in the master control, and the ball speed is adjustable. The overlays are suitable for use on sets with screen sizes from 19in. upwards and the input to the receiver is via the aerial socket. A mains converter is available as an optional extra, also an electronic rifle which converts the TV screen into a shooting gallery with a selection of moving targets. The rifle has a recommended retail price of £15·50. Some 200,000 Odyssey games have been sold in the US. The address of Forward Retailing, which is part of the Telesurance Group, is 47 Chase Side, Southgate, London N14.

2·2kV LINE OUTPUT TRANSISTOR

Nothing ever seems to stand still very long nowadays. No sooner have we dealt with modern TV power supply circuitry (see recent articles) taking into account the present voltage limitation—of the order of 1·5kV—of transistors suitable for use as line output devices than along comes Texas with a 2·2kV, 1·5A transistor (type BUY71) for use as the line output transistor in monochrome receivers. This makes possible a very economical set design. The transistor is suitable for use with a 200-210V h.t. rail, which simplifies the power supplies and neatly matches the requirements of the video output stage. Texas suggest that future developments based on the charactertistics of the BUY71 could include a self-regulating and self-oscillating (thus eliminating the line driver transformer) line output stage. The current handling capability restricts the device to monochrome set use of course but once any "barrier" in semiconductor technology has been breached the question of what is possible becomes wide open.

RECENT PROJECTS

Readers making the touch tuner unit described in our October issue should note the following comment from George Boyce of Rank Radio International: "May I

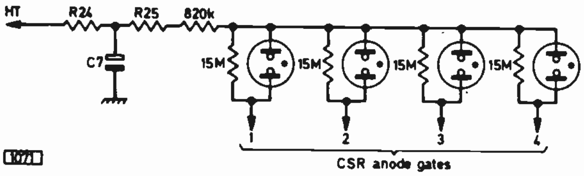


Fig. 1: Modification to the digital touch tuner unit where miniature neons are to be used instead of a numicator tube.

from experience of touch tuners warn constructors to mount their units as far away from the c.r.t. inside the cabinet as they can—the static e.h.t. from around the c.r.t. can play havoc with touch tuners." Thanks George for that helpful tip. The author adds the following point: "Dress all leads particularly those to the numicator cathodes around the outside of the cabinet to avoid picking up pulses which can interfere with the unit. The circuit shown in Fig. 1 can be adopted by those wishing to use miniature neon indicators instead of a numicator tube."

Last month's black-level clamp was for use with valved video output stages where a.c. coupling is employed in the video channel. Most transistor video output stages are d.c. coupled to the c.r.t., some (i.e. RRI and Pye group chassis) via a beam limiting diode: the black level should be stable with these sets. Where an a.c. coupled transistor video output stage is employed, e.g. in the BRC 1500 chassis, the d.c. restorer circuit designed by Keith Cummins and described in our July 1973 issue can be used to stabilise the black level. In colour sets the video signals have to be clamped in the original designs of course to prevent them drifting with respect to each other and thus producing colour casts.

TRANSISTOR FAULTS

It used to be said that transistors were go/no-go devices and seldom went wrong if operated under the correct conditions. Not like valves which can do all sorts of funny things. But that was the story put around in the early days, when nearly all transistors were small-signal devices. We know nowadays that junction resistances can change, and that with driver and output transistors leakage currents can increase leading to various forms of distortion. Recently we were told of a rather unusual fault in a colour set where the frequency response of one of RGB output transistors was found to have fallen drastically (to 1MHz). In another, one of the RGB output transistors was found to be *unstable*! And then there was the case of the Philips set with the G8 chassis where a picture of sorts was obtained with only one line output transistor functioning. So it seems that transistors do have their peculiar habits: in particular they are sometimes sensitive to operating temperature in practical circuits. Perhaps some semiconductor manufacturer would care to throw some light on all this for us.

TRANSMITTER OPENINGS

The following relay station transmitters are now in operation:

Blaina (South Wales) BBC-Wales channel 40, BBC-2 channel 46. Receiving aerial group B.
Clyro (Mid Wales) ITV (HTV Wales programmes) channel 41. Receiving aerial group B.
Congleton (Cheshire) ITV (Granada programmes) channel 41. Receiving aerial group B.
Gilfach Goch (South Wales) BBC Wales channel 21, ITV (HTV Wales programmes) channel 24, BBC-2 channel 27. Receiving aerial group A.
Heyshaw (North Yorkshire) BBC-1 channel 57, BBC-2 channel 63. Receiving aerial group C/D.
Llangeinor (South Wales) BBC Wales channel 55, BBC-2 channel 62. Receiving aerial group C/D.
Llanhilleth (South Wales) BBC Wales channel 39, BBC-2 channel 45, ITV (HTV Wales programmes) channel 49. Receiving aerial group B.
Ogmore Vale (South Wales) BBC Wales channel 57, BBC-2 channel 63. Receiving aerial group C/D.
Oxenhope (West Yorkshire) ITV (Yorkshire Television programmes) channel 25. Receiving aerial group A.
Sedbergh (Cumbria) ITV (Granada programmes) channel 43. Receiving aerial group B.
Stanton Moor (Derbyshire) ITV (ATV programmes) channel 59. Receiving aerial group C/D.
Taffs Well (South Wales) BBC Wales channel 55, BBC-2 channel 62. Receiving aerial group C/D.

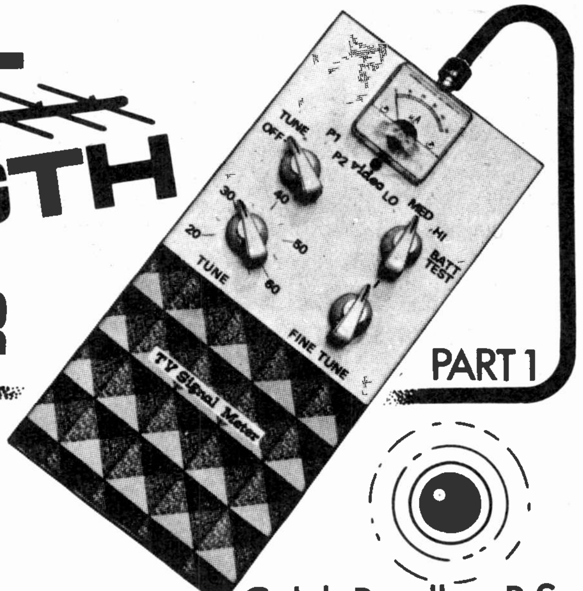
All these relay transmissions are vertically polarised.

RECEPTION PROBLEMS

In spite of all the efforts that the broadcasting authorities are putting into providing a good signal over as wide an area as possible one wonders to what extent the public is getting the full benefit. Speaking to the *Royal Television Society* recently C. B. B. Wood, head of the BBC's Engineering Information Department, commented: "We have met dealers who were unconvinced about polar diagrams and even some who were unsure in which direction the main beam would be. As for getting an aerial in the right group of frequencies, in some places that's altogether too much of a good thing. The importance of the correct aerial, designed for the frequencies it is to cover, and properly installed, is something that we find very difficult to emphasise sufficiently."

Writing in *Electrical and Electronic Trader* recently Peter Jones, Technical Manager of Aerialite, emphasised that coaxial feeder should be handled with care. Excessive tension, for example from a sudden jerk, can result in the inner conductor being stretched beyond its elastic limit so that it kinks: the damage may not be visible but can result in a short-circuit or mismatch depending on the degree of kinking. Water in some forms of coaxial cable can dramatically increase signal attenuation, especially at the higher frequencies. The coaxial downlead needs to be secured to prevent damage as a result of abrasion but it is equally important that when staples are used they should not be driven in so that the cable is deformed and thus possibly damaged internally. Signal reflections due to cable impedance irregularities resulting from such damage are more noticeable at u.h.f., and a serious form of reflective attenuation can occur where the spacing of staples over a length of 15 feet or more is exactly the same and corresponds to a half wavelength of one of the channels being received. This is a point to be remembered in cases where a marked difference in the signal strength of one of the local channels with respect to the others is experienced. Sharp bends in a coaxial downlead must be avoided—the minimum radius of any bend should be not less than five times the diameter of the cable.

TV SIGNAL STRENGTH METER



PART 1

Caleb Bradley B Sc

THE u.h.f. signal coverage of the UK by the BBC and IBA transmitters is among the best in the world and this advantage, combined with the ability of modern receivers to give viewable pictures with only microvolts of signal input, often allows fairly casual erection of domestic aerials. There are many aerial riggers about who align an aerial by compass, or merely set it parallel to the one on the house next door!

Simply adjusting an aerial for the best picture on the receiver is a poor method for two reasons: (a) Two people are needed, one to watch the set while the other turns the aerial on the roof, and communication is generally in vague shouts of "left a bit—right a bit". (b) TV sets incorporate automatic gain control which almost completely hides variations in signal strength: for this reason there is often no obviously correct aerial heading when this method is used.

It is necessary in fact to use a signal strength meter to be certain of the best signal from an aerial. In the primary service area of a transmitter where few element aerials are adequate it is quite possible to align an aerial mistakenly so that it is receiving on a spurious lobe of its pickup pattern: only a signal strength meter can eliminate this possibility. In fringe areas where high-gain multielement aerials are used a signal strength meter is essential since the positioning of these highly directional aerials is critical.

It is highly desirable to have the aerial aligned for the best signal possible—even when close to the transmitter—since this is the only way to obtain the ideal of a bright, sharp picture, free from any blurring due to multipath reception, stably synchronized, and with accurate grain-free colour. Whenever possible the signal strength should be considerably greater than the receiver's minimum input requirement since this will give a margin that allows for the inevitable long-term deterioration of the aerial and receiver.

Receivers near a transmitter may suffer from over-modulation, usually showing as sound-on-vision and vision-on-sound interference. In extreme cases the picture from one channel drifts across the picture of another channel. Even in this situation the aerial should be directed for the strongest signal, and then proper, matched attenuators fitted in the aerial lead.

Ghosting

It is sometimes said that the usefulness of a signal strength meter is limited because it cannot reveal the presence of ghosts (repeated hazy images to the right of the main picture, caused by the aerial receiving signals both directly from the transmitter and on slightly longer routes via reflecting landmarks). While it is true that ghost images can be detected only by viewing a receiver, in all but exceptional situations the best or near-best results are obtained by aligning the aerial for maximum signal. In the few situations of heavy ghosting where better results are obtained by positioning the aerial to receive an indirect signal instead of the direct signal, a signal strength meter can still be useful in showing a minor signal peak at this position.

Features of Meter

The portable signal strength meter to be described can be constructed without special equipment and enables any u.h.f. television aerial to be aligned for maximum signal strength. It is battery powered, tunable to any u.h.f. channel, and features three gain ranges to cope with most likely signal strengths. An exception might occur very close to a transmitter where the meter could be overloaded, but in this case the same attenuators necessary for the receiver can be used to reduce the sensitivity of the meter.

Since the unit is intended primarily to give *relative* readings of signal strength no plan for amplitude calibration is given. If desired the unit can be calibrated by comparison with a commercial instrument, e.g. the well known Labgear unit, but the lack of calibration is not likely to be a hindrance since one can establish at the first trial the only calibration point which really matters—the minimum deflection consistent with acceptable picture quality.

On the most sensitive range the unit can measure signals which are too weak to provide viewable pictures. This makes it a useful accessory for u.h.f. DX (long distance) enthusiasts.

Sound and Vision Carriers

A television transmission consists of radiation at two carrier frequencies on which are modulated the sound and vision information respectively. This is equally true for the 625 u.h.f. as for the old 405 v.h.f. transmission,

★ Components list

Resistors:

R1	3·3M Ω	R7	1·8k Ω	R13	470 Ω
R2	6·8k Ω	R8	1·2k Ω	R14	15k Ω
R3	560 Ω	R9	5·6k Ω	R15	120k Ω
R4	1M Ω	R10	1k Ω	R16	820 Ω
R5	100k Ω	R11	5·6k Ω	R17	330 Ω
R6	680 Ω	R12	1·3k Ω	All ¼W 10%	

Capacitors:
C1 0·47μF plastic
C2 47μF 30V (or larger) electrolytic
C3 100μF 12V (or larger) electrolytic
C4 0·1μF ceramic
C5 0·01 or 0·1μF ceramic
C6 0·47μF plastic
C7 0·47μF plastic
C8, C9, C10, C11 0·1μF ceramic

Controls:
VR1 100k Ω carbon potentiometer
VR2 100k Ω carbon potentiometer
VR3 100k Ω min. preset potentiometer
VR4 100k Ω min. preset potentiometer
VR5 10k Ω min. preset potentiometer
VR6 10k Ω min. preset potentiometer
VR7 10k Ω min. preset potentiometer

Semiconductor devices:
D1 Silicon diode, e.g. OA200/2, 1N914/6 or unmarked type
D2 Zener diode, 27 to 30V, 400mW
D3 As D1
D4 Economy red l.e.d. (e.g. Texas TIL209)
D5, D6, D7, D8, D9 As D1
Z1, Z2, Z3 741 type operational amplifier i.c.—for alternatives see text.

Hardware:
M 1mA moving-coil meter (SEW)
S1, S2 3-pole 4-way rotary switch (Lorlin)
Tuner—Mullard ELC1043, RIZ 243-619 (Guest), etc.
I.F. strip—surplus, e.g. Philips G8 (two boards, vision selectivity and gain)
Box—Norman AB17, 10x4½x3in.
Veroboard—3¾x5in., 0·1in. matrix plain.
Coaxial lead, four pointer knobs, nuts, bolts etc.

the main difference being that on 625 the sound carrier is frequency modulated instead of amplitude modulated. This allows it to be amplified by the same stages in the receiver as the amplitude modulated vision signal and then separated from the latter by the intercarrier-beat technique.

The receiver bandwidth is somewhat narrower than the separation of the two carriers and the optimum tuning point (good sound and vision, including colour) occurs when they lie at points on the opposite falling flanks of the receiver response. Since for convenience the signal strength meter has a similar bandwidth to a receiver, two signal peaks are seen as it is tuned across the two carriers of a transmission. If it was a receiver the optimum tuning point would be obvious. With only a meter indication however the existence of two peaks is confusing, especially when different transmissions are close together.

A novel arrangement has been included therefore to identify the two carriers. Believed unique, it consists of a circuit which drives a red light-emitting diode (l.e.d.) indicator when a vision carrier is tuned in (even if weak) but not when a sound carrier is tuned in. It works by sensing the 50Hz frequency component which is always present in a detected vision carrier due to the field sync pulses. A satisfactory way of using the signal strength meter is to tune for peak indication of the vision carrier (l.e.d. glowing) even though this differs from ideal receiver tuning.

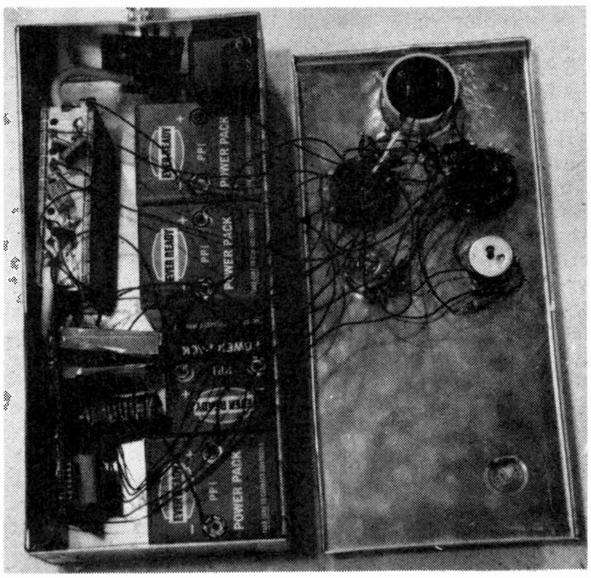
Variable and Preset Tuning

The unit uses a modern varicap u.h.f. tuner to allow voltage-controlled tuning over Bands IV and V (channels 21 to 68) by means of two potentiometers, "coarse" and "fine". This eliminates mechanical reduction drives which can be troublesome. Since the meter may be used for erecting aerials in the service areas of only one or two transmitters two preset tuning positions are also provided. These are preset to any desired channels by screw-adjust potentiometers inside the unit. The "fine" tuning control is still active when these two preset tuning controls are selected, but with only enough effect for minor trimming of the tuning.

Block Diagram

A block diagram of the signal strength meter is shown in Fig. 1. The varicap u.h.f. tuner and i.f. strip are preassembled units intended for use in receivers. Thus up to the vision detector the circuitry resembles a TV receiver except that a.g.c. (automatic gain control) is not provided since its inclusion would maintain a constant signal level at the detector and defeat the purpose of signal measurement. Instead, the voltage at the a.g.c. input of the i.f. amplifier is fixed by a preset potentiometer ("i.f. gain") while the tuner a.g.c. input is switched to one of three different voltages to provide high, medium or low sensitivity.

On 625 lines video detector diodes are normally connected to provide a negative-going output signal, i.e. negative-going sync pulses and positive-going video.



Arrangement of the interior of the Signal Strength Meter.

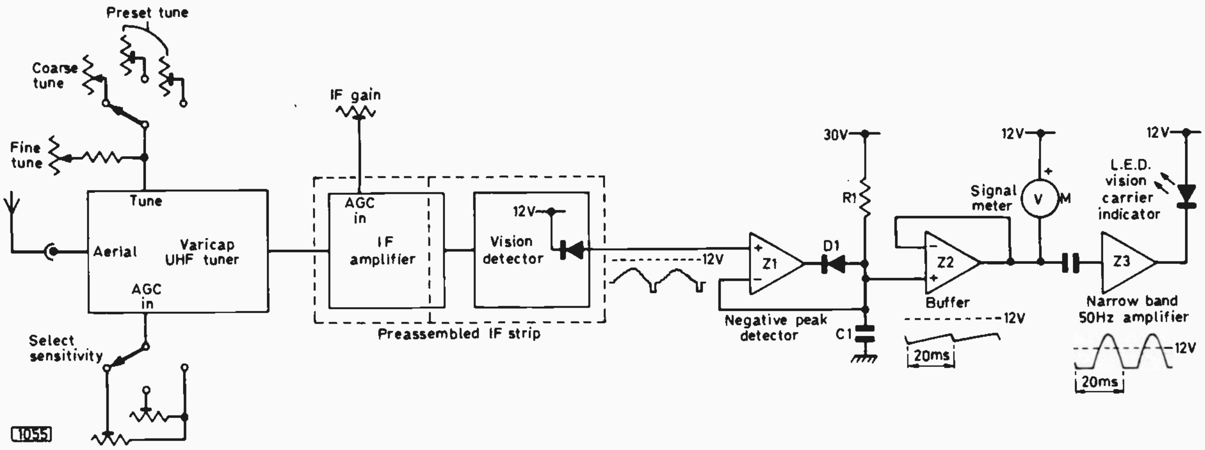


Fig. 1: Block diagram of the Signal Strength Meter.

This signal polarity convention is used in this unit but it is necessary to change the d.c. return voltage of the detector (i.e. the output voltage with no signal) from 0V to the i.f. strip supply rail voltage in order to suit the following stages. This is achieved by a simple modification to the commercial i.f. strip used.

Although the average level of the video from the detector diode varies continually as the picture content changes, the level of the sync pulses (peak r.f. strength) is constant and is proportional to the aerial signal strength since the gains of the tuner and i.f. stages are fixed. A negative-going peak detector stores the sync pulse amplitude to provide a near-constant voltage proportional to signal strength: this voltage is fed via a buffer amplifier to a voltmeter.

The peak detector consists of an operational amplifier (Z1) which on sync pulses charges a capacitor (C1) negatively via D1 until the two input voltages to the operational amplifier are equal. The operational amplifier is one of three economical "741" type integrated circuits used in the unit. These have the advantage over similar types—such as the "709"—of not needing any external components to ensure stability, even in unity-gain configurations as used here. At first sight the 741 may seem inadequate for Z1 since its frequency response and slew-rate (rate at which the output voltage can change when the inputs are fully driven) limitations prevent it amplifying video. The broad field sync pulses which occur in the video waveform every 20mS last for nearly three scanning lines however (i.e. for nearly 200µS)—ignoring the narrow separating pulses—and this is long enough for the output of Z1 to settle. Z1 is connected to give unity voltage gain by means of a feedback wire from C1 to the inverting (−) input. This is preferable to taking feedback directly from the output of Z1 since it avoids the small forward voltage drop across D1 modifying the peak value stored in C1.

The discharge path for C1 is via a very high value resistor (R1) to the 30V positive rail which also powers the 741s and provides the varicap tuner tuning voltage and oscillator supply. The long time-constant R1, C1 and the fact that negligible charging of C1 occurs during the narrow (4.7µS) line sync pulses means that the voltage on C1 is nearly constant but has a small 50Hz frequency component due to negative charging by the field pulses when video is being received.

Buffer amplifier Z2 is connected as a unity-gain follower and passes the voltage on C1 to the voltmeter comprising milliammeter M and a multiplier resistor. The meter is unaffected by the small 50Hz ripple and gives an indication in proportion to the signal strength. Buffer Z2 is necessary since connecting a moving-coil voltmeter directly to C1 would shorten the time-constant R1, C1. With the arrangement chosen R1 can be very large since it need supply only a tiny input bias current to Z2. Hence an adequate time-constant can be obtained with a relatively small value for C1.

Meter M is returned to the same 12V rail as the vision detector diode in the i.f. strip so that zero signal gives zero deflection.

LED Video Indicator

There is a 50Hz ripple on C1 only when a vision carrier is being received, since with an f.m. sound carrier C1 will be continually charged. The feedback components used around the a.c. amplifier Z3 have been chosen by a computer run to provide a compound high-pass/low-pass characteristic with a narrow band of peak gain around 50Hz. The performance obtained is similar to that of a tuned-circuit amplifier but without the expense of a large inductor, while the circuit uses fewer components than the parallel-T or Wein bridge arrangements usually used for active filters. Since the bandwidth of the circuit is narrow ($Q=$ approximately 10) the unloaded output when a vision carrier is being received is a fair 50Hz sinewave. The negative excursions of this sinewave drive the l.e.d. indicator which causes clipping of these excursions due to the finite output impedance of Z3. A resistor in the 0V supply to Z3 limits the peak current in the l.e.d. to extend battery life: if it is omitted the l.e.d. glows very brightly but battery life is short.

Full Circuit

A total of five batteries is used to provide the 12V and 33V supplies. The 12V supply is permanently connected to the circuit, the 0V and 33V supplies being disconnected when S1 (off/tune/preset-1/preset-2) is in the off position. In the other positions sections b and c of S1 connect these supplies to the circuit. The 33V supply is reduced to a stabilised 30V by R17 and zener

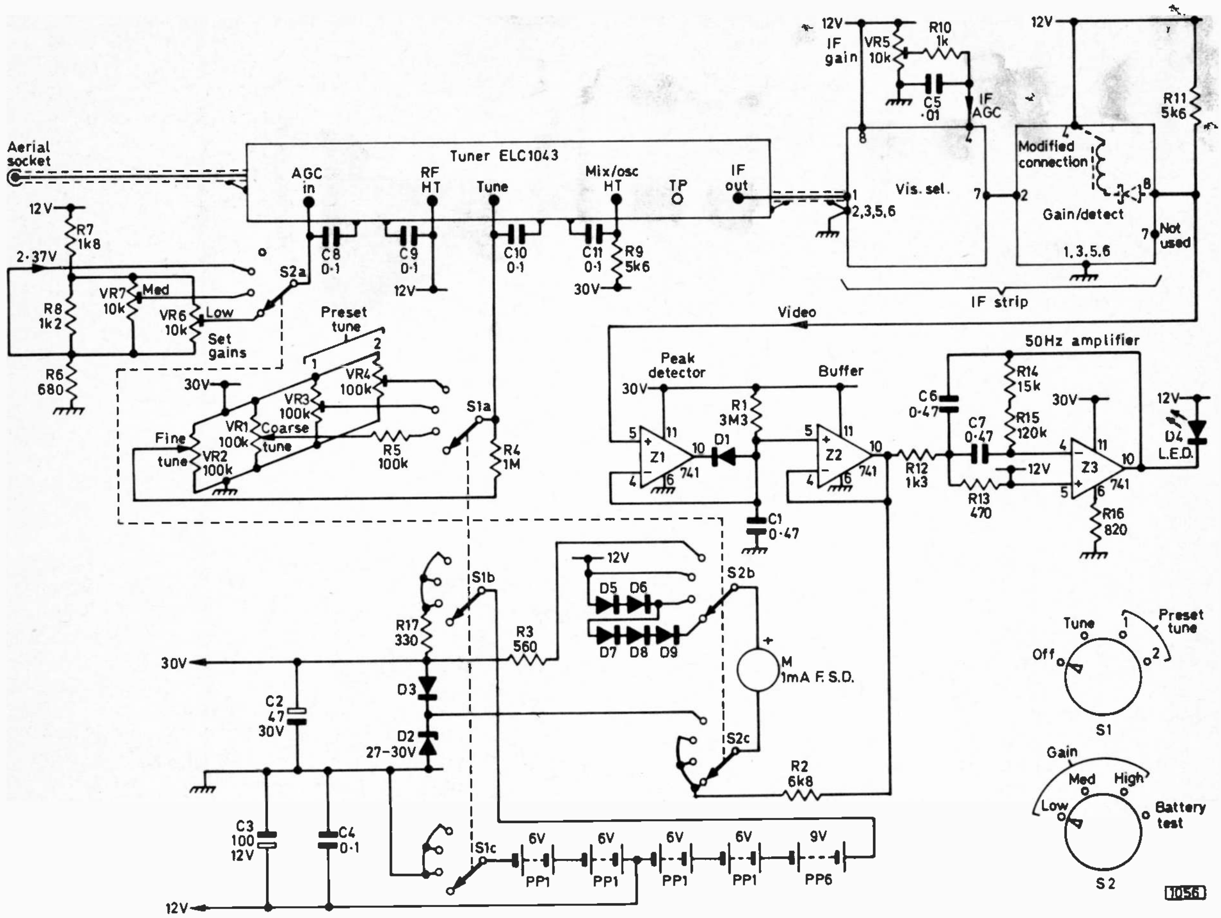


Fig. 2: Circuit diagram of the prototype meter using the Mullard ELC1043 u.h.f. tuner and Philips G8 i.f. strip. If other modules are used, the connections must, of course, be altered to suit.

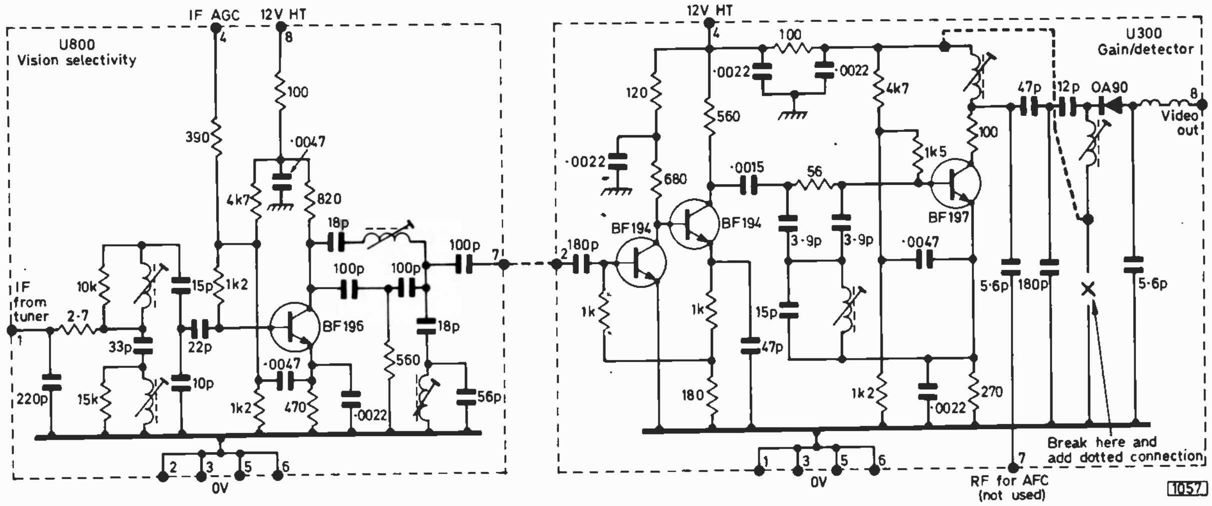
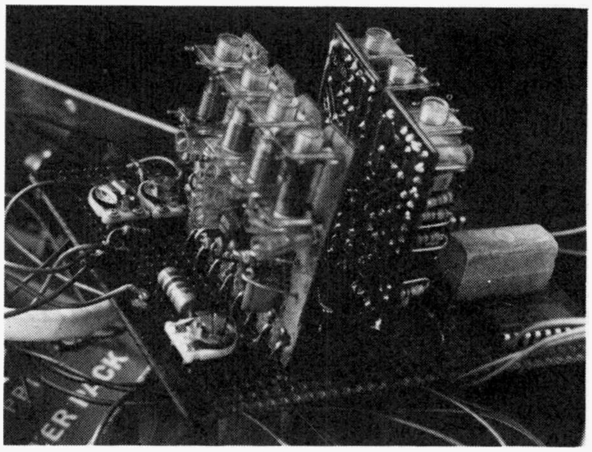


Fig. 3: Circuit of the Philips G8 i.f. strip showing the modification required to change the d.c. component of the output signal.

diode D2. This stabilisation is sufficient to reduce tuning drift—the higher performance obtained with an i.c. regulator as used in most varicap tuned receivers is not necessary for this application. The 12V rail is the positive supply for the i.f. strip and the centre reference voltage for the operational amplifier circuitry.

Section a of S2 (low/medium/high sensitivity and battery test) selects three degrees of gain by varying the a.g.c. supply to the tuner as previously described. Also on the medium and low gain positions section b places progressively more silicon diodes in series with meter M. Since these diodes pass little current until a voltage drop of approximately 0.6V occurs across each one their effect is to suppress weak readings on these two ranges so that small variations of strong singals can be seen better. The meter deflection is not linear however, being compressed at the low end. Multiplier R2 is chosen to give full-scale deflection when Z2 output falls below 12V by approximately 7V: therefore the meter movement cannot possibly be damaged by the maximum negative swing of Z2 to just over 0V.



The two i.f. modules are edge-mounted on the Veroboard.

In the battery test position of S2 meter M is disconnected from R2 and the 12V rail by sections b and c and instead connected (via multiplier R3) across diode D3 which is in series with zener diode D2. It deflects if the zener diode is passing current through D3 and this occurs only if the total battery voltage (nominally 6+6+6+6+9=33V) actually exceeds the zener voltage (plus approximately 0.6V for D3). Provided a visible meter deflection is obtained the batteries are considered usable.

Section a of S1 selects continuous tuning or either of the two preset tuned positions. In the tune position the desired channel is roughly selected by VR1 (coarse tune) which wipes from 0 to 30V (calibrated in u.h.f. channels 21 to 68) and then finely tuned by VR2 (fine tune) which has a vernier effect due to the ratio R4: R5. Presets VR3 and VR4 can be set to any two channels and due to their direct connection to S1 the preset positions are only slightly adjustable by VR2. In fact VR2 has hardly any effect at all with presettings to very high or low channels but in practice the arrangement is quite satisfactory.

CONCLUDED NEXT MONTH

LONG-DISTANCE TELEVISION

ROGER BUNNEY

DURING September there was a gradual decline into the quieter, minimum activity conditions we expect in winter. Fortunately however a number of events gave some light relief—Sporadic E (SpE), tropospherics (trops) and even evidence of an Aurora (AS). For part of the month your scribe was staying with our old friend Ian Beckett at Buckingham: Hugh Cocks took over the logging for this period (September 15-22nd inclusive).

During my stay with Ian we took the opportunity of visiting the new J Beam factory complex—they have moved from the previous address at Rothersthorpe Crescent, Northampton to the Moulton Park Industrial Estate, Moulton near Northampton. The Multibeam production lines have been increased, also the Parabeam assembly lines, and there are greatly increased storage facilities. The wideband Band III array—Astrabeam—is now being made available in stacked versions—a special matching/phasing harness is required for the stacking.

Research into SpE Openings

Towards the end of my stay at Buckingham Ken Edwards from Aberystwyth visited us. Ken has been very active with research into Sporadic E activity, using pen recordings taken at different locations throughout the UK on channels in Band I. Ken's researches over more than twenty years have reached a point where it is possible to forecast with some accuracy the trends of Sporadic E openings. The exact day and time cannot as yet be determined unfortunately but from graphs and tables it is possible to give an overall period and approximate time for the forthcoming expected winter-time activity in mid-December. For 1974 the period anticipated is during the 15th-25th December, possibly the 21st during the morning period from 0900 GMT. Looking back over the past few years the trend can be clearly seen: 1973, 31st December-January 1st and 5th (the last two dates actually in 1974); 1972, 23rd December; 1971, 22nd December ber; 1970, 15th December; 1969, 15th and 24th December; 1968, 25th December; 1967, 16th December. The trend can certainly be seen and although the above prediction for 1974 cannot be 100% certain it's a "good possible".

Multistandard Sony Receiver

James Burton-Stewart from Stowe School, Buckingham also visited us during my stay and was able to pass on valuable information about Tele Monte Carlo programme timings. Both James and Ian have recently invested in the multistandard Sony receiver. This has facilities for reception of the French 819-line transmissions (system E), the CCIR system B/G, the Belgian v.h.f. system (C) and the French u.h.f. system (L). The receiver worked very well indeed on the signals seen during my stay (it was unfortunately not too good a time for trops at Buckingham).

Log for the Month

The log for the period—a mixture of Hugh's (15/9/74-22/9/74) and yours truly—is as follows:

1/9/74 CST (Czechoslovakia) ch. R1; TVE (Spain) E2—both MS.

2/9/74 TVP (Poland) R1; ORF (Austria) E2a; SR (Sweden) E2; TVE E2, 4—all MS.

4/9/74 SR E2, 3; TVE E2—both MS.

5/9/74 RAI (Italy) IA, IB; TVE E4; SR E2; WG (West Germany) E2—all MS.

6/9/74 TSS (USSR) R1; YLE (Finland) E2—both SpE; TVP R1; RAI IB—both MS.

7/9/74 TSS R1—SpE; WG E2, 4; SR E2, 3; TVP R1—all MS.

8/9/74 CST R2—MS.

9/9/74 TVP R1; CST R1—both MS.

10/9/74 ORF E2a; RAI IB; TVE E2—all MS; also unidentified signal—see below.

12/9/74 TVE E2—SpE; Swiss E4; TVP R1; TVE E2; *WG E5*; all MS.

13/9/74 DR (Denmark) E3; SR E2, 3; TVP R1—all MS; also improved trops (to East).

15/9/74 RAI IA, IB—SpE; ORF E2a; RTB (Belgium) E3—both MS. At 1845 Auroral activity was noted over Band I, extending up to 78MHz. An E3 religious programme was noted with poor vision. Characteristic Auroral "noises" were noted until 2025, reappearing at 2100.

16/9/74 ORF E2a; RAI IB—both MS.

17/9/74 DFF (East Germany) E4; TVP R3; RTB E3; Swiss E3—all MS; also slight Auroral activity noted on ch. E4.

18/9/74 RTB E3—MS; also improved trops (to East).

19/9/74 TSS R1—SpE; CST R1; RAI IB—MS; also good trops from France and the South, with several new u.h.f. transmitters.

20/9/74 WG E4; DR E3; TVP R1—all MS. An excellent trop opening occurred, with signals into TVE. These included ch. E10 Tortosa; E11 Caceres; E22 Bilbao; E24 Madrid; E28 unknown. Signal strengths ranged from very poor to fair. ORTF was well received, being similar to the 19th.

21/9/74 RTB E3; DR E3—both MS; TSS R1, 2, 3; JRT E3 (Yugoslavia)—all SpE.

22/9/74 RTB E3—MS; MT (Hungary) R1; RAI IA, IB—both SpE.

23/9/74 TVE E2—SpE; ORF E2a—MS.

24/9/74 DFF E3; DR E3; SR E2; Swiss E2—all MS.

25/9/74 CST R1; WG E2—both MS.

26/9/74 TSS R1—SpE; DR E3—MS.

27/9/74 DFF E3; DR E3; TVP R1; CST R2; TVE E4—all MS.

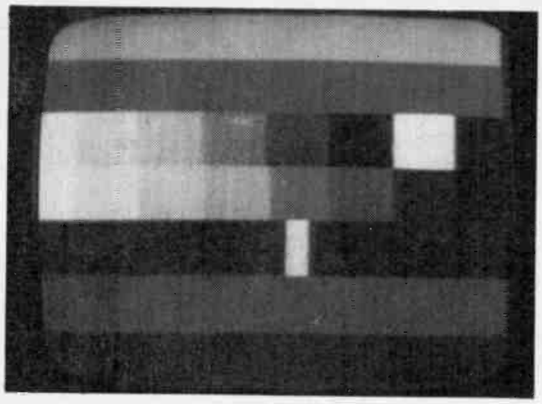
28/9/74 CST R1; RAI IB—both MS.

29/9/74 WG E2, 4—both MS.

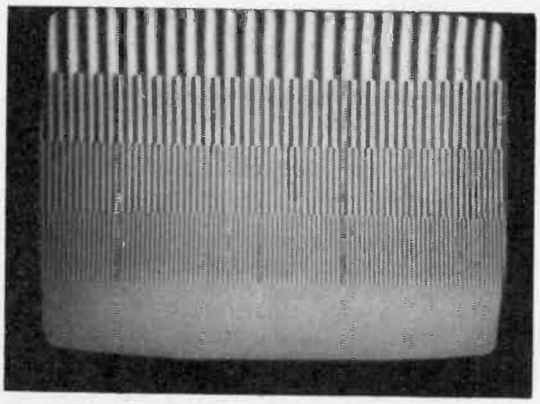
30/9/74 SR E2, 3; DR E3; CST R1—all MS.

Matters Arising

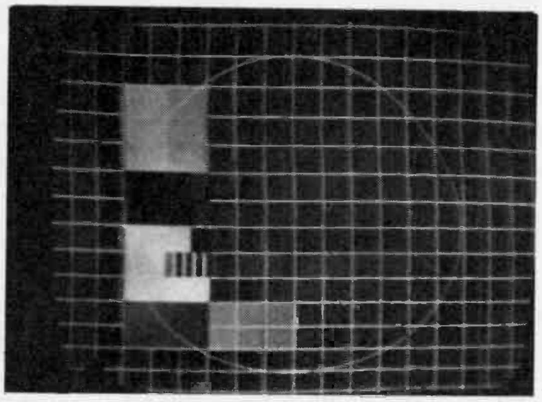
Several points arise. Grunten (Bayerischer Rundfunk, West Germany) is now radiating the Fubk test card with "Grunten" across the centre in bold white letters. The familiar CS U 01 pattern was noted on the 10th at 0810 on



New test pattern being used by the DFF (East Germany). Photo courtesy Clive Athowe.

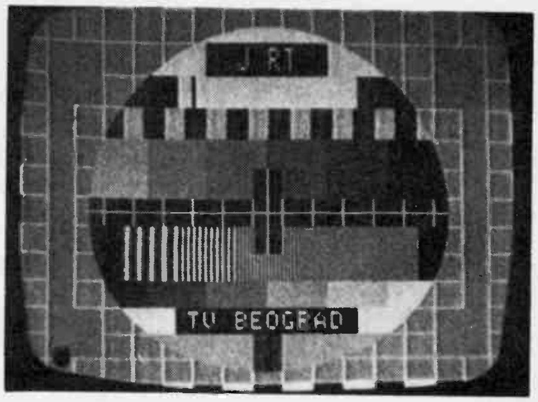


Test pattern consisting of frequency gratings (BBC). Photo courtesy Ian Beckett.

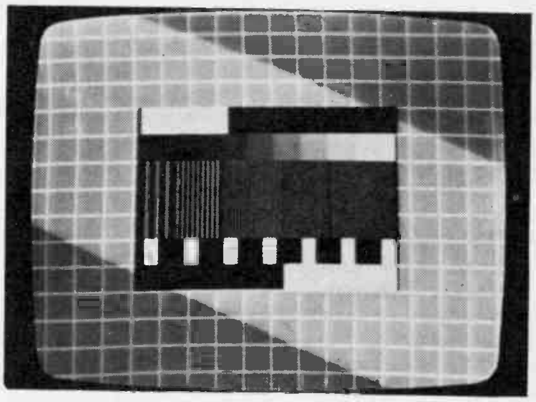


An unusual shot showing a faulty Fubk pattern generator on ZDF. Photograph courtesy of Ryn Muntjewerff.

ch. R1, changing to a caption with the figure "1". I suspect that this was from TVP (Poland). Ian Beckett noted SpE openings on the 23rd down to TVE/RTP (Portugal), with an interesting sighting of the conventional TVE test card but carrying the identification "Galicia"—the province in the North-West of Spain—possibly from the ch. E4 Bilbao transmitter. Another SpE signal from TVE was noted at lunchtime on the 25th.



The PM5544 test card as used by JRT (Yugoslavia). Photo courtesy Ryn Muntjewerff.



SFB Berlin ch. E7 test card, showing effect of a focal-plane shutter camera set at 1/15th second. Photo courtesy Dieter Scheiba.

CST has now been noted by several enthusiasts using the 5544 test card with the identifications "CST" at the top and "Bratislava" at the bottom. At times the side panels are deleted from the card.

Band III MS

A number of TV-DX operators have been spending time on Band III with some successes via MS. Keith Hamer and Garry Smith (Derby) have received a number of transmitters—the signals most in evidence seem to be from Denmark, Norway, Sweden and Poland. I strongly advise anyone with a sensitive receiver and good aerial system to spend some time at the lower end of Band III, though at least one DXer has received signals as high as ch.E10. The most profitable time for this appears to be around 1200-1400 when most transmitters are radiating test cards.

News Items

West Germany: The Benelux DX club reports that the Kreuzberg/Rhon ch. E3 transmitter is now using horizontal polarisation. Tests were carried out earlier this year with both polarisations.

Ghana: A second Band III transmitter has been ordered from Pye TVT by the Ghana Broadcasting Corporation for the Adjancote television transmitter.

Sierra Leone: A new 10kW Band III transmitter is to be built atop the summit of Leicester Peak (1950 asl). This will greatly increase the service area of Sierra Leone TV. The site is three miles from Freetown and the transmitter (feeding arrays on a 250ft self-supporting mast) is due for completion in mid-1975.

Zanzibar: Details of the first colour TV network to come into operation on the African continent have been received. A main studio centre has been constructed in Zanzibar City, with a 4kW u.h.f. transmitter some five miles out of the City. The 250ft self-supporting mast carries a directional aerial system. The signals from Zanzibar are picked up on the Southern side of Pemba island and sent via a microwave link to a 4kW v.h.f. transmitter at Chake Chake. This island also has a studio centre—somewhat smaller than the main one at Zanzibar.

New EBU listing: TVP (Poland) ch. R5 100kW horizontal at Suwalki (22E53 54N11).

Tele Monte Carlo: Typical programme timings (courtesy James Búrton-Stewart). Programmes commence at 1820 local time each evening. Programmes end at 2345 on Saturdays, 2320 on Sundays, 2255 on Mondays, 2250 on Tuesdays, 2240 on Wednesdays and Thursdays and 2345 on Fridays.

Off-screen Photography

We have commented from time to time on methods of taking photographs from the screen. The use of a camera using a focal-plane shutter has generally been avoided. Dieter Scheiba (Brussels) visited me recently at Romsey and this problem was discussed during the course of our conversations. It is recommended that a shutter speed of 1/8th or 1/5th is used as this avoids the shading experienced with faster speeds—e.g. 1/25th. The accompanying shot (actually from the SFB ch. E7 outlet, Berlin) clearly shows the shading that occurs when an incorrect shutter speed is used.

From our Correspondents . . .

I know that readers will be relieved to hear that our old friend A. Papaeftychiou of Palouriotisa, Cyprus is in good health following the military activities there. He saw the first phase of the invasion and fighting around the Nicosia area prior to being evacuated to the South. On returning subsequently to his house he found that it had escaped damage though his aerial rotor unit was destroyed by a bullet. We wish him well in these troubled times.

Dr. M. F. Baloch (Libya) has written telling us about the tropospheric ducting in his area during the summer months. In Benghazi it is possible to receive Malta, Tripoli, Tunis, Rome and Athens five nights out of seven. These signals disappear as soon as winter conditions arrive. Aerials generally used are stacked v.h.f. and u.h.f. arrays with amplifiers—usually Hirschmann or Philips—typical cost being £80.00.

John Ding (Watford) has written to say that on the same day the mysterious news announcer wearing a fez was received by yours truly (ch. E3, June 22nd at 1535) he received Arabic music on his Band II f.m. receiver (88.5—90·5MHz). After consulting the EBU list he concludes that this originated from Egypt! I am now thinking that the suspected defunct ch. E3 outlet at Port Said is in fact operational—as yet no reply from the authorities there!

G. Clement (Zambia) who was recently on holiday in the UK is becoming very interested in TV-DX—we look forward to hearing of his results back in Africa. He says that the Zambian TV Service suffers because of aged equipment, with frequent interruptions to the service. Transmissions are from 1700 to 2130 GMT, the test card being transmitted at various intervals during the morning and afternoon. The Indian Head card is used by Lusaka (ch. E3) and Kitwe (ch. E4).

Paul Duggan (Cork) has sent us a few lines to correct an error concerning the RTE colour transmissions. The test programmes are on the first Tuesday or Friday of each month. Discussions are at present being held with the BBC to use BBC-1 programming on RTE-2. Failing this RTE-2 will be set up using several hours of Irish material and for the rest excerpts from BBC-1, BBC-2 and IBA programmes. Colour programming on RTE is at present 60% of output.

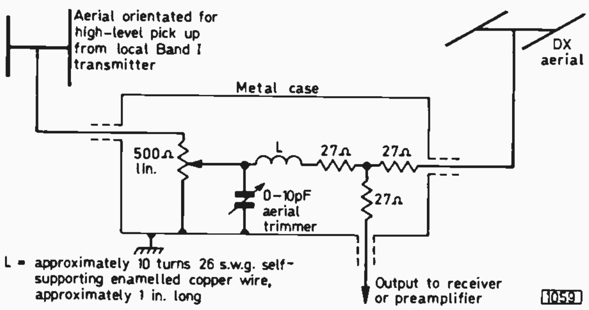


Fig. 1: Anti-phasing unit for reducing Ch. B2 interference.

Rejecting Interference from Locals

Last month we discussed the problem of receiving chs. E2/R1 when operating adjacent to a strong ch. B2 transmitter. A unit made some years ago for ch. E3 reception close to a ch. B3 transmitter could be used—the need for this type of filter in the case of ch. E3 reception has been made unnecessary since the advent of the sharp notch filter. Since the main problem under discussion however is the removal of ch. B2 audio (48·25MHz) from ch. E2 video (48·25MHz) and ch. R1 video (49·75MHz) this filter can be tried.

The basic idea is to combine two signals, one from the DX aerial containing the wanted signal plus an ample though unwanted ch. B2 signal and the other from an aerial oriented to pick up the unwanted ch. B2 signal (see Fig. 1). The signal received from the latter aerial is attenuated by means of the 500 Ω linear carbon potentiometer so that it is of the same level as the unwanted ch. B2 signal received via the DX aerial. The phase of the signal from the ch. B2 aerial is then shifted by means of the 0-10pF low-loss aerial trimmer capacitor until signal cancellation, leaving only the wanted DX signal, occurs. Complete cancellation is rarely achieved but a considerable drop in the level of the unwanted signal can be obtained.

It has to be admitted that the unit in its basic form is crude to say the least, and undoubtedly mismatching and other undesirable effects occur. Since the result is to get a signal which was previously something of a problem if not an impossibility however we cannot be too choosy about the means employed. Rotation of the DX aerial will result in different signal levels and phasing conditions in the system of course and adjustment of the two controls will then be necessary. With practice obtained under suitable conditions operation becomes quite easy however.

We would be pleased to hear from anyone who has coped successfully with this problem of ch. B2 "interference" so that we can pass on for the benefit of others details of the methods they have used.

Practical Decoder Fault-Finding

Michael Gladwell

THE majority of decoders used in present-day colour sets follow a similar basic pattern. Nearly all are fully transistorised, most now employing integrated circuits of one kind or another as well. All are of the PAL-D variety, and component accessibility is usually very good.

As with all fault finding the secret of success is to adopt a logical plan of action. In the case of a decoder faults can be simply located with the aid of a good oscilloscope, crocodile leads with a resistor or two and an Avo meter. Fig. 1 shows in block diagram form the essentials of a typical decoder—the output stages are assumed to be on a separate board. Fig. 2, based on this, shows which stages can cause the various basic fault conditions. In the latest generation of decoders many of the stages are incorporated in integrated circuit blocks of course. Nevertheless Fig. 2 will serve as a basic diagnostic tool and if followed will save many hours of circle chasing.

Reference Oscillator Faults

Faults in the reference oscillator circuit account for a high percentage of decoder troubles—either no colour ones or "rainbowing", i.e. unsynchronised colour. Tuning drift and loss of output signal amplitude are the main bugbears. Any cheap and nasty capacitors should be replaced. This applies particularly to oscillator tuning and coupling capacitors—good quality 1% silver mica types should be used for these purposes. Transistors can cause drift and must be replaced with the type specified by the manufacturer—this is especially so with the ITT CVC5–CVC8 series of chassis (transistor type BC172C is specified in this case). Carry out tuning using a good oscilloscope. A good final test of the oscillator's pull-in range is to remove the aerial plug and then—with a test card or something similar being received—reconnect and disconnect the plug to the socket about twenty-five times. If the colour content of the picture remains stable after this repeated interruption of the signal the oscillator can be assumed to be operating correctly. Some setmakers suggest using a test meter to tune the oscillator: an oscilloscope gives more reliable and exact readings however.

Ident Stage

The ident amplifier—which generates a 7·8kHz sinewave output—is another stage that can give a fair amount of trouble. The main faults are no output or low-amplitude output. No output usually means that the transistor—or i.c.—has failed. Low-amplitude output is usually the result of the 7·8kHz tuned circuit coil being off-tune or a faulty decoupling capacitor. The coil can be adjusted by the visual method—tune it for complete colour resolution over the entire screen. Alternatively use an oscilloscope, tuning for maximum amplitude output—this is undoubtedly the better method.

Chroma & Burst Channels

The stages in the chrominance and burst channels are pretty straightforward, faults being easily traced with an oscilloscope and the help of the abundant waveforms for these stages given in most service manuals. The tuning of the burst channel is critical however and again the use of 1% silver mica capacitors is recommended. Interstage supply rail decoupling capacitors can also cause trouble, the fault usually being colour patterning in the region of 1MHz all over the screen.

Delay Lines

The glass chrominance delay line is utterly reliable. The only problems likely to be encountered in this part of the circuit concern the tuning and setting of the balance/phasing control(s) in the associated matrixing circuit. These adjustments can be carried out visually, tuning for minimum Hanover bars on a test card—or better by using an oscilloscope and the waveforms given by the manufacturer.

The delay line in the luminance channel gives little trouble though there is a tendency for it to go open-circuit—easily recognisable of course since chrominance information only reaches the screen. Dry-joints here cause luminance ringing.

PAL Switch; RGB Channels

The faults in the bistable (PAL switch), preamplifier and output stages consist mainly of the failure of transistors and i.c.s. Straightforward voltage checks will soon locate the source of trouble therefore.

Repeated failure of RGB output and driver stages can be due to a faulty c.r.t., the reason of course being interelectrode flashovers in the tube and the d.c. coupling used between it and the RGB output transistors. Reduction of the c.r.t. first anode voltages can help, also the use of good quality spark gaps on the c.r.t. base panel. Regunned tubes have a habit of flashing over so it is well worthwhile watching out for this.

Wire-wound RGB output transistor load resistors also give problems, usually in the form of dry-joints which result in either red, green or blue colour streaking.

Beam current control is sometimes applied on the decoder panel: it is good practice to check the operation

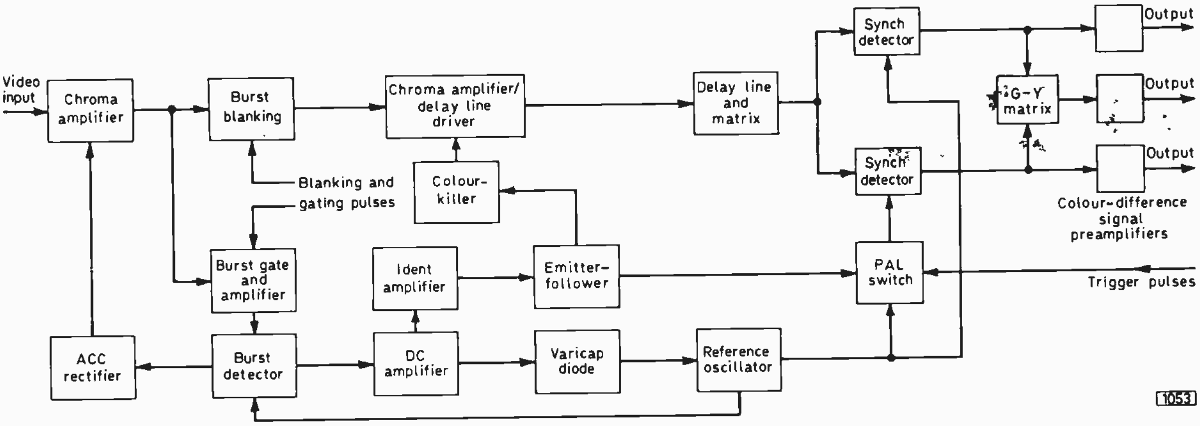


Fig. 1: Block diagram of a typical PAL-D decoder. The reference oscillator output is generally taken via an emitter-follower buffer stage (not shown above). The outputs from top to bottom are B – Y, G – Y and R – Y.

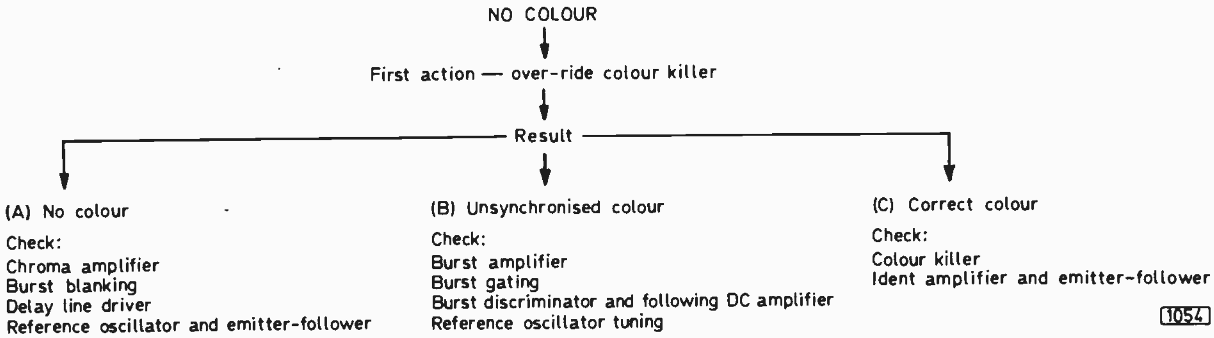


Fig. 2: Fault finding chart for the two basic decoding faults, no colour or unsynchronised colour.

Incorrect ident—the PAL switch operating in the wrong phase—gives the well known green faces symptom. If this is a permanent condition check the ident amplifier tuning. If the fault is sometimes present, sometimes not, check the ident amplifier output, the feed circuit to the PAL switch, and the setting up of the burst discriminator.

An inoperative PAL switch results in severe blinds across the picture, most noticeable where the R – Y component of the chrominance signal is of high amplitude. The usual cause of the fault is a defective transistor in the bistable circuit or a faulty i.c. (depending on the decoder design).

Absence of one of the colour-difference or RGB signals can be deduced from the colours displayed: voltage checks in the appropriate channel generally reveal the source of the fault.

Colour casts where not due to incorrect c.r.t. first anode supplies are generally caused by a faulty output transistor, a fault in one of the clamps in the output stages or a leaky electrolytic signal coupling capacitor (this can also result in colour streaking).

of this circuit and carry out adjustment in accordance with the instructions in the service manual.

Miscellaneous Troubles

Wiring harnesses, colour controls, plugs and sockets and cracked printed boards are other sources of trouble. Careful inspection and probing are required to deal with these.

The use of good quality instruments and tools together with a logical approach to faults makes decoder fault finding very much easier. ■

ORTF REORGANISED

The French broadcasting organisation ORTF is to be split up. According to plans recently announced the government will retain overall control of the broadcasting services but the three TV channels, radio and ancillary services (a production company serving all channels, a broadcasting network company and an audio-visual institute) will operate separately. The ORTF has been under criticism for many years, particularly because of its use by previous governments as a means of interfering with day-to-day broadcasting.

NEW COLOUR SETS

Toshiba have introduced a new 18in. 110° colour set—Model C800B—fitted with their "black-stripe" RIS tube. The recommended price is £275 including VAT. The c.r.t. has black stripes between the vertical colour phosphor stripes on the screen to reduce the brightness reduction and colour desaturation that occur due to reflection from the screen when a set is used in high ambient light conditions. Two new colour sets from **Decca**—the 22in. Model CV302 and 26in. model CZ304—are fitted with the Decca 30 series chassis.

SELF-CONVERGING

COLOUR CRTs

S.George

A number of successors to the conventional delta-gun shadowmask colour c.r.t. have been announced over the last couple of years. The main aim has been to reduce the amount of tube neck hardware required, simplify the associated circuitry and in consequence the setting up procedures. This cuts the initial set manufacturing and the subsequent installation and servicing costs. Improved performance is also claimed.

Tube Structure

By mounting the three guns in line instead of in the traditional delta formation convergence errors are confined to the horizontal plane. These can then be cancelled by using suitably predistorted deflection fields. Two features that go with the use of in-line guns are deposition of the phosphors on the tube screen in vertical stripes (instead of dot triads) and the use of a shadowmask with slots instead of holes (see Fig. 1). The use of a striped screen means that purity errors are also confined to the horizontal plane.

The first tube to adopt this basic pattern was the Sony Trinitron. In this the shadowmask slits go from the top to the bottom of the mask—in fact the mask consists of a fine metal grille held in a rigid frame. Because of the problems of keeping such a structure accurately positioned the mask and faceplate are not

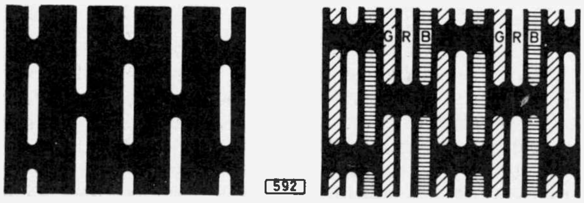


Fig. 1: Arrangement of the slits in the shadowmask (left); impression of a close-up view of the screen (right).

curved in the vertical plane. Subsequently the RCA/Mazda PIL tube and more recently the Mitsubishi "Diatron" SSS tube have come along. In these the tube faceplate has the normal vertical and horizontal curvature, crossties between the slots in the shadowmask holding it rigidly in position. Both these tubes are 90° types but with shorter necks than the conventional shadowmask tube because of the simplified gun structure used. A feature of both is that they come complete with a preadjusted deflection yoke which provides the deflection field distortion required to cancel out dynamic convergence errors in the horizontal plane. The tubes are very similar but the notes below are based on the Mitsubishi SSS (Self-converging; Striped screen; Short neck) range.

Other recently announced tubes that follow the in-line gun/striped screen/slotted shadowmask pattern include the Toshiba RIS and Mullard 20AX. These are 110° tubes which achieve the same general aims through somewhat different techniques—separate deflection yokes are used and the gun structure is not "unitised".

Mitsubishi SSS Range

The Mitsubishi SSS range of tubes come complete with a semi-toroidal deflection yoke and neck magnet assemblies. These are all factory preset. The need for any subsequent purity, static or dynamic convergence adjustments is thus eliminated.

Several features are used to achieve this "preset convergence". First, the use of unitised gun construction—most of the electrodes are common—ensures beam landing accuracy. The common grids also eliminate convergence drift due to thermal expansion. Secondly, the use of a striped phosphor screen. Thirdly, the use of magnetic shunts and enhancers (see Fig. 2). These slightly reduce—by "shunting" the deflection field—the rasters produced by the two outer (blue and green) guns while increasing—through field "enhancement"—the width of the raster produced by the centre (red) gun. This ensures that the centre beam lands centrally with respect to the other two beams, making precise convergence possible at all points on the screen. Any slight residual misconvergence is restricted to the blue and green rasters and does not show up to the extent that red misconvergence would. Fourthly, the use of a semi-toroidal—saddle-wound line scan coils and toroidal field scan coils—deflection yoke which provides deflection fields with the predistortion required to achieve dynamic convergence correction.

The inductance of the line coils is 8·4mH when series connected and 2·1mH when parallel connected, that of the field coils 90mH when series connected and 22·5mH when in parallel. These figures are somewhat higher than those quoted for the yoke used with the PIL tube and mean that the deflection power required is less.

Purity static and dynamic convergence are all preset on a factory test jig and then locked in position. Conventional magnetised rings are used for purity.

Convergence

Static convergence is set by means of four plastic rings which contain equidistant miniature permanent magnets (see Fig. 3). Two of the rings contain four magnets thus giving a four-pole field; the other two rings contain six magnets giving a six-pole field. The four-pole fields shift the outer (blue and green) beams in opposite directions to each other while the six pole

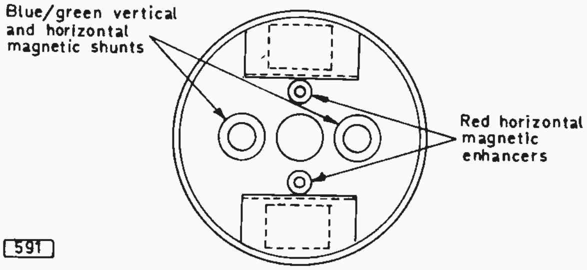


Fig. 2: Front view of the in-line electron gun assembly used in the Mitsubishi Diatron SSS range of tubes. The magnetic shunts reduce the rasters produced by the two outer beams while the enhancers increase the width of the raster produced by the centre beam.

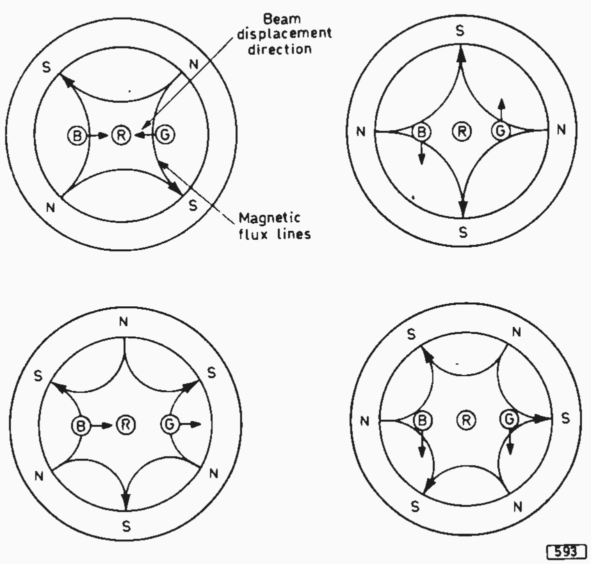


Fig. 3: Arrangement of magnets used to obtain static beam convergence—showing the beam displacements produced by the four- and six-pole fields.

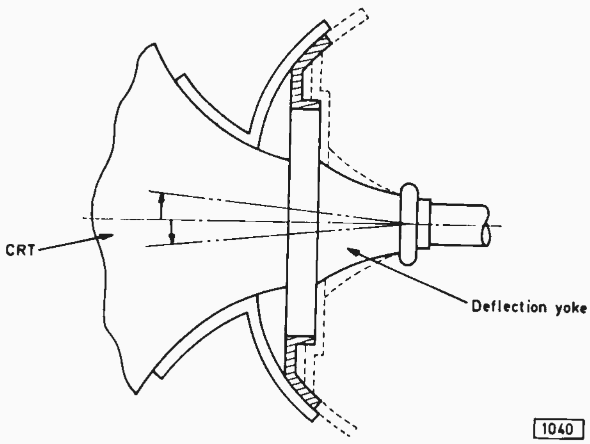


Fig. 4: Tilting the deflection yoke.

fields move these beams in the same directions.

Dynamic convergence is set by tilting the yoke

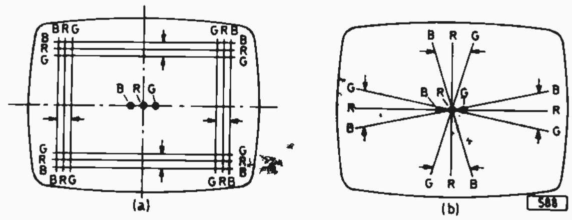


Fig. 5: Dynamic convergence is factory preset by tilting the deflection yoke: (a) if the yoke is tilted horizontally to the left the size of the green raster is increased (as indicated by the arrows) while that of the blue raster is decreased; (b) if the yoke is tilted vertically upwards the green raster is rotated in an anticlockwise direction while the blue raster is rotated in a clockwise direction.

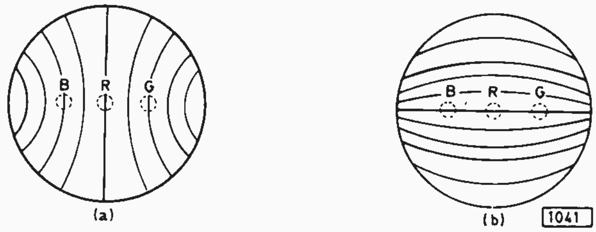


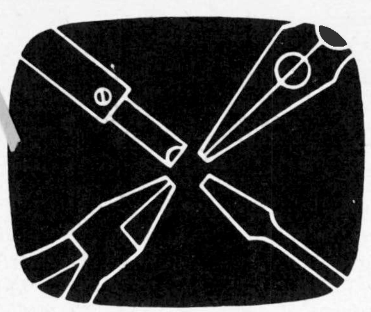
Fig. 6: The predistortion introduced by the horizontal scan coils is pincushion shaped (a), that introduced by the vertical scan coils is barrel shaped (b).

assembly (see Fig. 4) in the horizontal and vertical planes. The effects are shown in Fig. 5. When the yoke is tilted horizontally the size of the raster produced by one of the outer beams is increased while the size of the raster produced by the other outer beam is decreased. When the yoke is tilted vertically the raster produced by one outer beam is rotated in a clockwise direction while that of the other outer beam is rotated in an anticlockwise direction.

The deflection field predistortion introduced by the scan coils is shown in Fig. 6. The horizontal scan field is given a pincushion distortion while the vertical scan field is given barrel distortion. The result is that when the yoke is tilted by the right amount in each plane the superimposition of the three rasters is very accurate over the whole screen.

Advantages

The basic in-line gun/slotted mask/vertical phosphor striped screen arrangement confers several advantages. (1) There is increased light output since the phosphor stripes cover more of the screen than a dot pattern. (2) The centre-to-edge grading of the light output is improved since the beam to phosphor register at the edges of the screen is better. (3) The standard of colour purity/white uniformity over the screen area is higher. Since the use of horizontally mounted in-line guns restricts beam-phosphor misregistration to the horizontal plane the lens used to print the phosphor stripes on the screen can be optimised to give best horizontal registration. Also the effect of the earth's magnetic field is reduced since the component of the field parallel to the horizontal axis causes no purity problem. (4) Finally the large pitch of the vertical slots eliminates the moiré patterning inherent in the conventional shadowmask tube. ■



SERVICING television receivers

L. LAWRY-JOHNS

BAIRD 660/670/680 SERIES

THE Baird/Radio Rentals 660, 670 and 680 series of receivers were widely distributed through rental and retail outlets so that large numbers are available for repair or reconditioning. There were many variations—some had v.h.f. radio circuitry, some transistorised i.f. strips—and to cast as wide a net as possible without getting too bogged down in involved circuit detail we must allow some lesser fish to pass through without comment. Readers who possess the 1969-70 volume of *Radio and Television Servicing* will find very detailed drawings and data on the various models which for reasons of space cannot be included in this article. From a general servicing viewpoint only two basic chassis need be considered: the early version with a valved i.f. panel and a PCL84 video amplifier and the later transistorised version with a PFL200 video stage.

The right side timebase panel and the centre line output section are common to all models: it is in these areas of course that the majority of faults occur.

Lack of Height

The PCL85 field timebase valve is used in a fairly conventional circuit though with one or two pitfalls for the unwary. Probably the first place one looks for a lack of height fault for example is in the height control circuit where it is usual to find that a resistor in series with the control has changed value. Working along these lines one might suspect the 1MΩ resistor R144. Whilst this could be at fault in fact it rarely is. It is far more likely that the trouble will be found just below the PCL85 at the focus control. Of the two slider controls, the focus control is the right-side one, the left-hand one being the vertical hold control which in this set is a preset rather than a user control—just to be quite clear when we say the right-side control we mean of the two under the PCL85, not the control at the extreme right side which is the width control.

The point here is that the type of slider control used does tend to change value (going down). The effect of the focus control falling in value is to reduce the boost line voltage supply to the tube first anode and to the PCL85 triode anode via R155 (820kΩ). When confronted with a picture which is lacking in height it pays to spend a few moments checking the true value of the focus control therefore. If it has dropped in value to about 1MΩ it is quite in order to lift the earthy end and insert a 1MΩ resistor in series. This restores the original total resistance value and stops any further value change. The control can be removed and another fitted of course if this makes anyone feel better and/or if appearances are important.

All this is not to say that the PCL85 cannot be responsible for lack of height. It often is: but as it is more obvious it cannot come under the heading of a pitfall! The field charging capacitor is C176 which we have not to date had cause to change but which we have often suspected when the PCL85 pin 1 voltage has been found low.

Bottom Cramping

Bottom compression is a common fault on these models. Whilst a new PCL85 may solve the problem it is often the case that a more careful check is necessary to reveal the source of the trouble which can by caused by several defects. The first step is to examine the general condition and appearance of the cathode bias resistors R131 and R132. If either or both appear discoloured it is likely that the PCL85 has passed too much current in which case the 390Ω resistor R132 is likely to have changed value. Ensure that both resistors are of the correct value, and check the associated decoupling electrolytics C164 and C169. Then check C172 and if necessary C163.

Field Sync Problems

It is rarely necessary to adjust the preset field hold control. If it is however the chances are that further adjustment will be needed. A lot of time can be saved by not moving it in the first place: changing the PCL85 will probably restore correct field hold. If the valve is not at fault check C168 by replacement and ensure that the vertical hold control is of the correct value (200kΩ).

If the field sync is weak suspect the M3 interlace diode X11 which may have a poor internal connection: squeezing the body with a pair of pliers can improve connection and avoid replacement. If the diode is in order, with low forward and high reverse resistance, check the high-value resistors R117 and R122.

Poor field sync need not originate in the filter network however. Indeed as time goes by the trouble is just as likely to be found in the video amplifier or sync separator stages. Whilst the EF80 sync separator stage is the same in both the earlier and later versions of these chassis the video stages differ considerably. In both versions check the EF80 screen grid feed resistor R115 (100kΩ) and the decoupler C152 (8μF or near)—the resistor tends to go high while the capacitor tends to dry up.

Models using a PCL84 video valve have a cathode decoupler (C124) which should not be overlooked. Later models using a PFL200 video valve do not have a

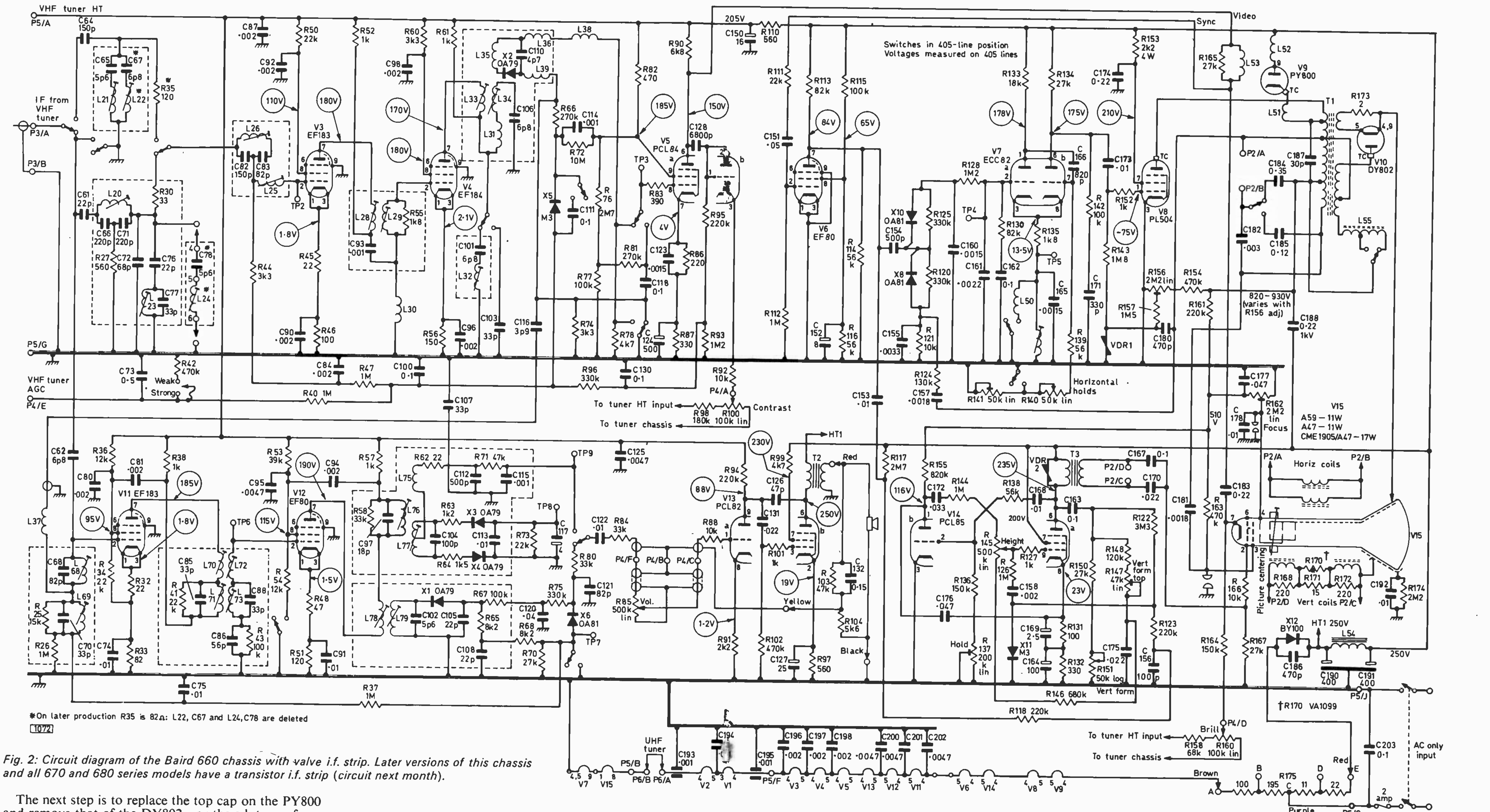


Fig. 2: Circuit diagram of the Baird 660 chassis with valve i.f. strip. Later versions of this chassis and all 670 and 680 series models have a transistor i.f. strip (circuit next month).

The next step is to replace the top cap on the PY800 and remove that of the DY802—or the e.h.t. cap from the side of the tube. If this restores vigorous life the DY802 has an internal short. If there is still no change, check the valves by replacement and then suspect the line output transformer. If this has to be replaced note the code printed on it and order accordingly. Whilst the scan coils can give trouble this is not common.

If on the other hand the PL504 is quite cool and the voltage (though not pulsed) present at its top cap is well over 200V the chances are that its screen grid feed resistor R153 is open-circuit. A standard 2·2kΩ 5W type does quite nicely in this position.

Audio Circuit

The other valved section which is common to both versions is the audio channel. The valve is a PCL82. Whilst the output stage is the same in both the triode section differs for one particular reason. With valved i.f. stages the triode's anode load resistor is 220kΩ and its cathode resistor 2·2kΩ. Where the i.f. stages use transistors however the triode stage uses different components in order to produce the "turn on" bias voltage for the first sound i.f. stage Tr6: the voltage is developed across the 1kΩ cathode resistor and in this case decoupling is of course necessary. This is provided by C72 (25μF). The anode load resistor is reduced to 47kΩ and the coupling capacitor is changed to 0·1μF.

CONTINUED NEXT MONTH

MILLER'S Miscellany

Chas. E. MILLER

I was called out recently to attend to a model in the GEC 2000 range. The complaint, that on 405 lines the picture and sound faded out, sounded to me just like a tuner fault—except that a factory rebuilt v.h.f. tuner to special order had been fitted only weeks before, the set owner living in a flat with no facilities for u.h.f. reception. For once I actually saw the fault condition in the house, and checked the tuner and first i.f. valves by substitution without success. I then brought the set into the workshop where, predictably, it worked for over a week without flinching. When it did pack up—just before lunchtime—I found I had a classic intermittent fault on my hands.

Checking voltages almost anywhere on the tuner and i.f. strip restored the vision and sound, as did judicious tapping. Eventually I found a voltage check point where there was no effect—at the control grid of the first i.f. valve there was a slightly different reading from that at the other end of the input coil, which read open-circuit when checked on the meter. On opening up the i.f. transformer I found that the grid end of the winding had never been soldered—a quick blob put everything to rights. It's remarkable how a set will work perfectly for years—this one dated from about 1964—before a fault like this shows up.

A Christmas Trip . . .

While preparing this article I was reminded of an incident that occurred one Christmas some years ago. My assistant Dennis and I were delivering repaired TVs late on Christmas Eve. We had reached almost the end of our round at a house where an Ekco table model was to be returned. Dennis picked up the set from the back of the van leaving me to close the doors. I heard the garden gate open and turning to follow Dennis was amazed to see him literally sprinting up the path towards the house! Granted he might be anxious to finish work for the night, but this burst of speed was still inexplicable. What I didn't know was that he had tripped over a low step just inside the gate and was running in a desperate attempt to regain balance. What I did know however was that if he didn't moderate his pace he would never be able to negotiate the right-angle bend at the end of the path. Facing the bend was a side entry door which was latched shut: it was upon this that Dennis's head impinged. The latch failed to take the strain and the door flew open, scattering milk bottles far and wide. Dennis sank gracefully to the ground, with the set on top of him. By this time, sympathetic soul that I am, I was draped over the fence helpless with laughter. Lights sprang up all over the house and the occupants crowded out through the front door, eager to see if there had been an invasion by a foreign power or something more mundane such as a thunderbolt striking the premises.

Both Dennis and I were unable to explain the shambles—we were, for different reasons, temporarily speechless. The gentlemen of the house lifted the set from Dennis's chest while I composed myself sufficiently to help him to his feet and into the house. To his credit he was far more concerned with the state of the set than with his own injuries. The set had escaped remarkably lightly—one valve broken and the screen scratched—as indeed had Dennis. Curiously enough the owner of the house was an osteopath, and I received the impression that he was rather disappointed to find that he was not to be called upon professionally.

Vintage Spot: EMI—1

In 1930 the recently formed Electrical and Musical Industries (EMI) entered the field of television research in opposition to J. L. Baird who was currently receiving considerable publicity for his 30-line mechanical TV system. Under Isaac Schoenberg the EMI design team went for an all-electronic system which by 1936 had developed into the 405-line system still in use today. In that year the BBC tested both the EMI system and the improved Baird 240-line mechanical one. Just over 37 years ago—on February 8th, 1937—use of the Baird system was discontinued and the EMI system was established on its long and successful run.

A Rare Find

On the receiving side EMI produced some interesting sets under its HMV and Marconiphone trade marks. Amongst these was a 5in. combined radio and TV table model which bore the model numbers 904 under its HMV guise and 706 under its Marconiphone label. Some years ago one of these sets found its way into my workshops in a job lot of otherwise modern receivers bought from a bankrupt radio store in Newcastle-under-Lyme. What the set was doing in a place 100 miles outside the Alexandra Palace service area is anyone's guess: my own is that it was installed long ago for experimental or publicity purposes. With it was a length of prehistoric low-loss cable—thick as a garden hose, it contained five smaller rubber tubes which acted as semi-air spacing!

As soon as I realised what I'd got I put the old set on the bench for examination and test. My first surprise was to find a superhet vision and sound strip since this was by no means universal practice even fifteen years after the 904 was built. Closer examination revealed that the r.f. amplifier, frequency changer, first i.f. amplifier and sound detector and amplifier stages were common to both radio and TV—they closely resembled in fact the standard EMI mains radio of the period, with the addition of an extra wavechange switch position for the fixed tuned TV band. The c.r.t. and the valves used solely for TV were powered by a second mains

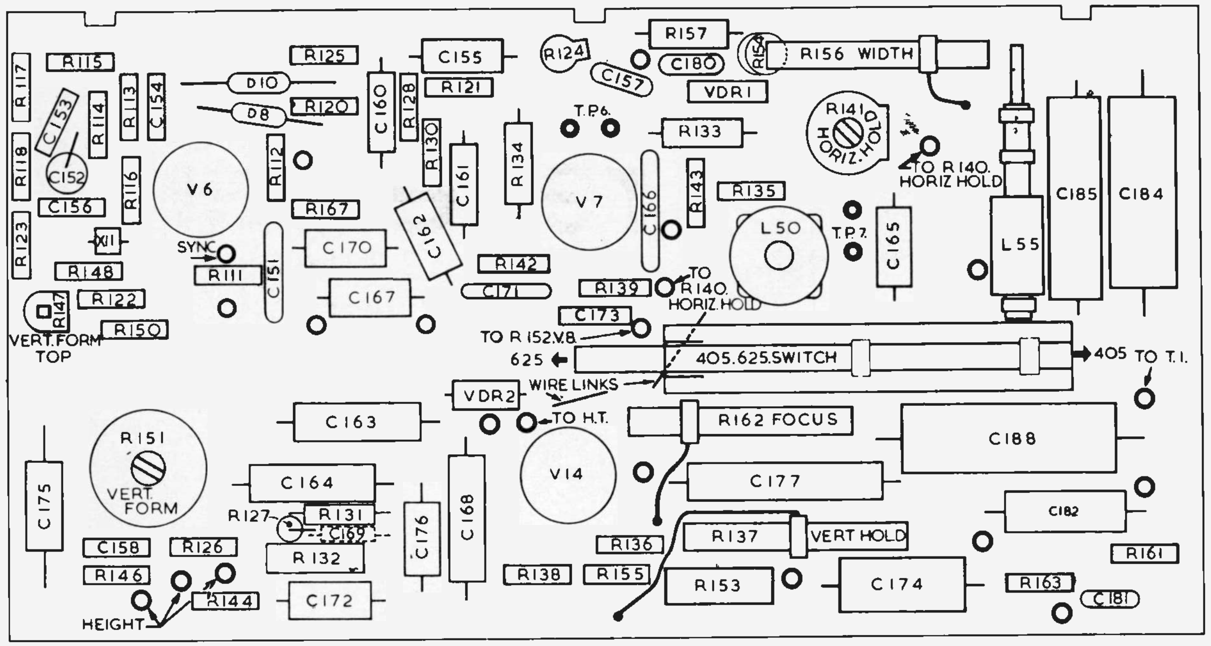


Fig. 1: Layout of the timebase printed panel, viewed from the component side.

cathode electrolytic but there is a 4μF screen grid decoupling capacitor (C143) which may require attention (particularly when line pulling is taking place).

Line Timebase

The line timebase is quite nice (at least as far as the oscillator is concerned). Sync pulses are fed to the centre of a pair of discriminator diodes whilst a reference pulse is fed back from the line output transformer via C157 and R124. This latter resistor can suffer two fates: going high to produce a no line sync condition tending to call attention to the sync feed; or going low first to push the line hold control toward the end of its travel and then to stop the line oscillator completely, tending to bring the ECC82 under suspicion.

To be fair however the ECC82 is responsible for most line oscillator failures—where the line output stage overheats through lack of line drive and the PY800 signals its protest in various ways, sometimes just sitting there glowering away in sympathy with its brother (the more robust PL504) or producing a few sparks of rage before rising to a fever pitch when it lights up bright to blow its heater or the fuse or both. If the heater chain is open-circuit and the dropper is intact the PY800 should be the first suspect. Reverting to the line oscillator however, the ECC82 is used in a simple multivibrator circuit which is relatively trouble free. Most oscillator faults are caused by the valve itself but resistors R133 and R134 can change value and are not above suspicion therefore.

Width Troubles

Most line timebase troubles do not concern the oscillator however. The trouble spot is the width circuit where the width control falls in value thus taking R154 nearer earth and increasing the current through it. This can result in a burn up which can look far worse than it is. A good clean up and replacement of the control and R154 restores normal operation if the surrounding components have not been damaged. These remarks also apply to the focus circuit previously mentioned, though in this case the increasing lack of height draws attention to the problem before real trouble develops.

VDR1 is very very rarely in need of replacement—despite what some readers seem to think—and its appearance does not justify its replacement. Resistors R143 and R157 are far more likely to go high and cause width troubles in cases where the control and its feed resistor R154 are in order.

Width (lacking or varying with brilliance) problems are often due to no more than a low-emission valve, usually the PL504, sometimes the PY800 or the ECC82. The poor old e.h.t. rectifier (DY802) is often blamed where advancing the brilliance results in the picture expanding and fading out. If the picture is of full width at low brightness the DY802 is very likely to be at fault. All too often however the picture at low brightness is well in from the sides indicating inadequate scan power. The DY802 is therefore under-run and cannot work properly. Too obvious to merit comment? Apparently not.

Line Scan Failure

The other common line timebase trouble of course is complete failure (no e.h.t., no picture). The action one should take depends upon the visible symptoms. If there is some degree of overheating of the PL504, not as severe as when its drive is removed, the first step is to remove the top cap of the PY800. If this restores some degree of timebase working the suspect is C188 which is the 0·22μF 1kV boost reservoir capacitor. If all is well this will be the thing that is at fault. If all is not well the only effect of removing the top cap will be to cool off the PL504 and heat up its screen grid feed resistor R153.

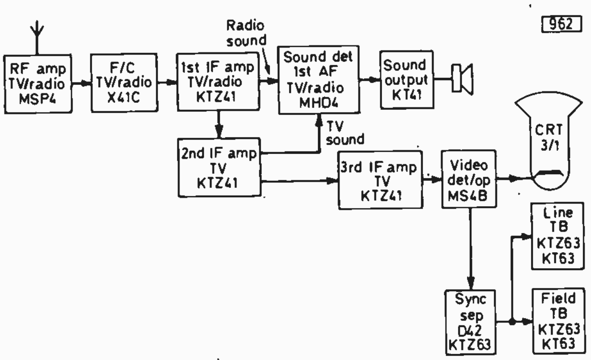


Fig. 1: Block diagram of the HMV Model 904.

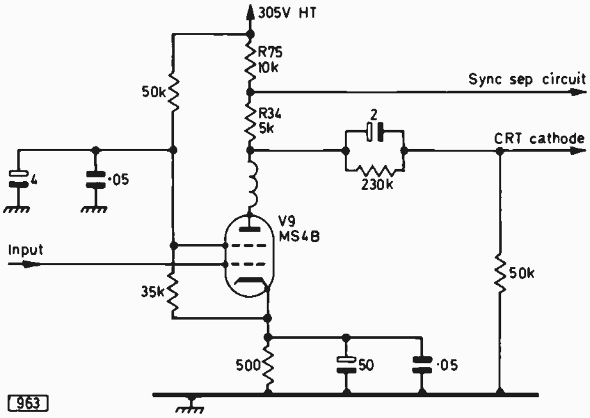


Fig. 2: The video circuit used in Model 904. The MS4B acted as vision detector and output stage. R34 was the load during the picture portion of the waveform, R75 being brought into circuit when the sync pulses arrived (see Fig. 3).

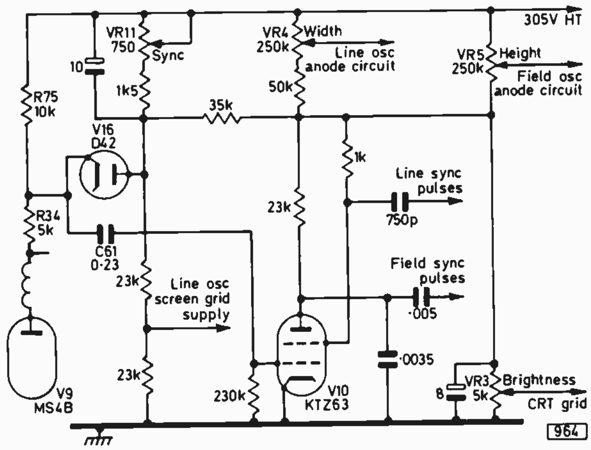


Fig. 3: The complex sync circuit used in Model 904—who thought up that lot? Blocking oscillators were used in both the field and line timebases, with the line output stage transformer coupled and the field output stage RC coupled to the deflection coils.

transformer which was switched in by contacts on the wavechange switch. This was long before the days of flyback e.h.t., so a 1·8kV winding on this transformer was used to provide nearly 2·5kV at the c.r.t. final anode after rectification.

I plugged the old set in and to my delight was rewarded with a good raster. It didn't take long to replace the original oscillator coil with a 4 channel type to suit our local transmitter and then retune the r.f. coils with brass cores. The gain of the MSP4 r.f. amplifier valve (yes grand-dad, an MSP4!) must have been pretty low at 45MHz and at 60MHz was less than unity. I had to sort out an old preamplifier from the junkbox to get a locked picture. Although the brightness level was low the definition on the small screen was excellent and the sound quality all that one had come to expect from EMI.

The set was used intermittently for some months and then left idle for a number of years until it was hauled out of retirement again at the request of a friend in the trade who wanted to use it in a colour TV exhibition. By this time unfortunately damp had penetrated the line output transformer and the e.h.t. winding, causing them to fail. Spares have been impossible to find so far but I have not altogether given up hope that the set may work again for the fortieth anniversary of its manufacture.

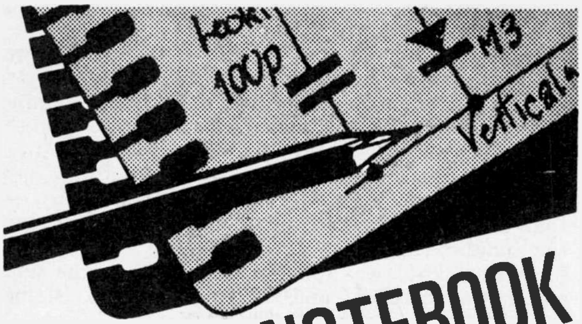
Circuit Features

Figs. 1—3 show some interesting features—I am grateful to EMI who managed to find a contemporary service manual.

Apart from the curious resistor values the video amplifier shown in Fig. 2 is not unfamiliar. Note however that there was no separate detector diode, the MS4B tetrode (V9) being operated in the anode-bend mode. The simplicity of this stage was amply made up for in the sync separator stage (Fig. 3) however. Briefly the idea here was that while the negative-going picture signal was present at the anode of the MS4B (V9) diode V16 was biased into conduction, short-circuiting R75. When the positive-going sync pulse arrived it cut V16 off and was coupled by C61 to V10 which acted as a sync clipper, providing field sync pulses at its anode and line sync pulses at its screen grid. VR11 could be varied to alter the bias on V16 anode in cases where it was difficult to get the picture to lock using the hold controls, but excessive adjustment would interfere with the correct picture contrast.

SOME CORRECTIONS:

Some errors in past issues of *Television* have come to light recently: readers with the issues concerned might like to note them. (1) In the circuit diagram of the STC/ITT/KB VC51 chassis given in the August 1970 issue the video amplifier (V7) screen grid decoupling capacitor C61 (220pF) was unfortunately omitted. (2) In the circuit of the line timebase used in the Thorn/BRC 960 chassis given in the April 1974 issue the capacitor (C102) which provides an r.f. bypass at the anode of the PY81 efficiency diode was shown as 0.22μF instead of 200pF. (3) In the c.r.t. rejuvenator circuit given in our May 1974 issue a 3.6kΩ 1W resistor is shown across the reservoir capacitors. The value of this is non-critical since it is there simply to provide a discharge path for the electrolytics. A 1W resistor of the value shown will burn out however. We suggest the use of a 330kΩ 1W resistor.



SERVICE NOTEBOOK

G. R. WILDING

Weak Field Sync

We have come across many instances over the years of weak field lock but normal or good line lock as a result of faults in parts of the receiver other than the sync separator or field oscillator. Examples are an over-biased video output valve on 405 lines cramping the sync pulses; impaired h.t. rail smoothing; an open-circuit video amplifier screen grid or cathode decoupling capacitor reducing the l.f. gain of the stage; i.f. drift narrowing the overall bandwidth so that the pulses are mis-shaped; over-advanced preset sensitivity controls; a soft EF183 affecting the field sync on 625 lines; and in the first Bush/Murphy single-standard colour models inadequate a.g.c. smoothing.

In a recent case a Bush Model TV135 had good line and field lock on 405 lines and good line hold on 625 lines but the field lock on this system was poor. Everything around the PCF80 sync separator/half field oscillator was o.k. and there were no faults in the other half of the field multivibrator (PCL85 triode). All voltages were spot on, there were no discoloured resistors to be seen and the interlace diodes had good forward/reverse resistance ratios. The electrolytics and decouplers were all up to standard.

It was then noticed that on test card reception the resolution of the higher gratings was not too good. These models don't usually drift however and the slugs had clearly not been touched. It was thought therefore that perhaps an emitter or collector circuit decoupler in the three-stage vision i.f. strip was open-circuit or dry-jointed. Checks proved that all were in order but while working in the area of the input circuit to the final i.f. stage we found that panel pressure suddenly locked what had been a picture which tended to roll at every scene change. After further probing and prodding the cause was found to be a dry-jointed 22pF tuning capacitor (2C22) in the 625-line inter-stage coupling circuit. On resoldering this, good field lock was restored and the 625-line resolution improved—though it must be said that even with the capacitor dry-jointed most viewers would have found the definition acceptable.

BRC 1400 Chassis

A set fitted with this chassis came in with the complaint of insufficient height. A new PCL805 field timebase valve failed to improve matters so the next check was to measure the voltage at the triode anode of this valve —insufficient voltage here due to an increased value feed resistor is a very common cause of inadequate height where the linearity is not too bad. The triode anode voltage was found to be just over 110V with the height control at maximum, against the correct voltage of 140/150V, so we were clearly on the right track. The anode feed circuit checked out o.k. however and although as expected disconnecting the stabilising v.d.r. increased the height it was still inadequate. The field charging capacitor which is connected between the anode and cathode was then disconnected in case it was leaky but this made no difference to the anode voltage. A leak in the coupler to the pentode section was ruled out since this would have resulted in bad cramping at the bottom of the raster and there was no sign of this. Attention was turned therefore to the triode's grid circuit since a leaky capacitor here would reduce the negative grid bias developed and thus reduce the anode voltage as a result of the above normal anode current. This proved to be the case, the 0·022μF grid coupling capacitor (C87) being the defective component.

In another of these receivers it was impossible to lock the field oscillator and although the valve heaters didn't seem unduly bright the cause was found to be a short-circuit heater circuit rectifier—in this chassis the bias for the field output pentode is obtained from the heater chain via a filter and applied to the grid circuit. Always check the heater rectifier first therefore when this fault arises in these sets. The heater rectifier (W10) is the very small and easily overlooked BY130 (replaced by a BY126 in later production) mounted just under the left-hand side of the main dropper resistors at the top of the swing-out chassis.

Basically this is a good chassis but it is worth mentioning some faults we often encounter.

First, if you get troublesome sound-on-vision which increases as the volume control is advanced it pays to carry out the maker's recommended modification. This is to change the value of the resistor (R97) which feeds the 30PL1 audio amplifier and output valve anode circuits from 470 Ω to 1k Ω (2W) and feed it in turn from C122 instead of C124. The improved filtering completely removes the symptoms.

Secondly, caption buzz in these receivers can be overcome by changing the video amplifier screen grid feed resistor (R36) from 3k Ω to 8.2k Ω. This increases the valve's working anode voltage, taking it further from saturation during captions.

Finally if sensitivity seems poor on one or both systems advance the contrast controls to maximum and short the a.g.c. rail to chassis near the a.g.c. clamp diode (W1). If the gain increases markedly you will almost certainly find that the resistors in series with the sliders of these controls have increased in value (R4 on v.h.f., R7 on u.h.f.). They often go high-resistance after some years' service, preventing the negative a.g.c. potential derived from the sync separator control grid circuit being fully offset when the contrast control(s) are fully advanced.

Trouble with a PL509

Sound but no raster was the fault on a colour set fitted with the Pye 691 single-standard chassis. Only the slightest suggestion of a spark could be obtained from the anode of the PL509 line output valve which was running very cool. This symptom usually indicates that its screen grid feed resistor is open-circuit so to check this without removing the line timebase chassis we unplugged the valve to enable us to check the voltage at pin 6 (see Fig. 1) and switched on again (since the PL509 is the first valve in the heater chain in these receivers removing it did not impose heater-cathode strain on any of the other valves). With the valve removed the voltage at pin 6 should have been the h.t. rail voltage if the feed resistor (R231) was intact since the current taken by the meter would produce negligible voltage across this resistor. Removing this valve would also result in most of the voltages applied to the other valves being near the h.t. rail potential but as this occurs whenever the set is switched on from cold—the h.t. supply being provided by a silicon rectifier—the working voltages of all the decoupling capacitors are well in excess of the h.t. voltage.

Following switch on there was a momentary swing of the needle when pin 6 was contacted, due to a slight charge on the 0·1μF decoupler C220, but the reading rapidly fell to a constant small deflection (even when a wire-wound resistor develops a break there is usually a measurable high resistance across its terminals). The screen feed resistor was clearly open-circuit and on replacing it and checking that there was no internal short-circuit in the PL509 between the screen grid and any other electrode the valve was plugged back in and the set switched on again. A raster appeared but with a gap of almost an inch at each side and before further tests could be made the raster disappeared and a cloud of smoke arose from the line output stage chassis.

On laying the chassis on its side no sign of any damage could be seen but on making tests the PL509's cathode resistor R226 which is used to de-

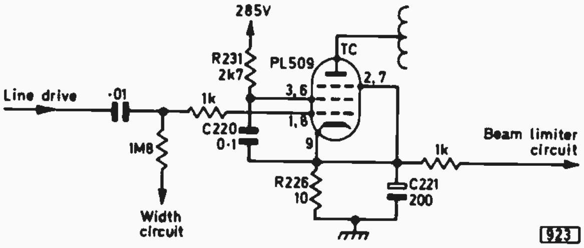


Fig. 1: Screen grid and cathode circuits of the PL509 line output stage used in the Pye group 691 chassis.

velop the potential to operate the beam limiter transistor was found to be open-circuit while the associated decoupling electrolytic C221 (rated at 50V) had clearly been subject to excessive voltage resulting in the smoke noted. Replacement of the PL509 and its cathode components restored a normal raster. The original PL509 clearly had an intermittent interelectrode short—probably from the screen to the suppressor grid since the components in the control grid circuit were unmarked and proved to be in order on test—that did not show up when the valve was tested cold. Incidentally although not always shown on circuit diagrams it is worth noting that the screen grid of a PL509 is connected to pin 3 as well as to pin 6.

Disappearing Picture

About twenty minutes after switching on the screen of a dual-standard Pye receiver would black out, the

—continued on page 79

PUZZLE CORNER

Set by H. K. Hills

It can truly be said that when you can estimate the capacitor and resistor values required for the wide variety of purposes these components serve in TV circuits and know the reasons for these component values you have really got to grips with the subject. We are going a stage further in this puzzle by giving a list of components—all of which have to be used—and asking you to use them in the design of a single-standard monochrome receiver detector circuit and subsequent emitter-follower video stage. The component values given are such that to work effectively they can be used only as in the original circuit which it is the object to duplicate.

Fig. 1 shows where your circuit is required—between the final i.f. transformer and the base of the video emitter-follower, also the emitter circuit components required in this latter stage. There are four outputs from the emitter-follower. First the 6MHz intercarrier sound signal which as shown is taken from a tuned circuit in its collector lead. Secondly a capacitively coupled output to the base of the video output transistor which as usual drives the cathode of the c.r.t. from its collector. Thirdly a capacitively coupled output to the sync separator. And fourthly an adjustable output to the a.g.c. circuit. From these facts you must also deduce the polarity of the detector diode.

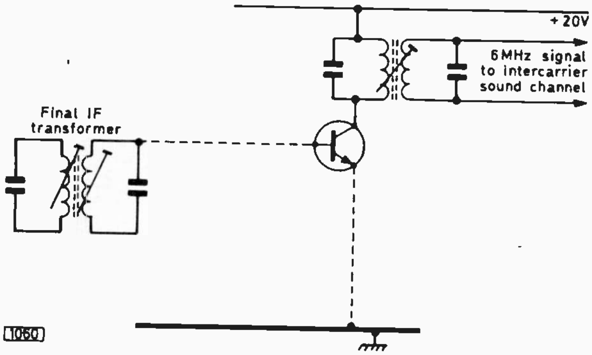


Fig. 1: Using all the components listed alongside, complete this circuit to produce a single-standard monochrome receiver detector and emitter-follower stage.

The components to be used are as follows:

C1	6·8pF	C5	1μF	R3	8·2kΩ		
C2	6·8pF	C6	50μF	VR1	1kΩ		
C3	0·001μF	R1	2·2kΩ	L1	R.F. choke		
C4	1μF	R2	3·9kΩ	D1	Detector diode		

A series acceptor wavetrap tuned to 6MHz is also to be used—to remove this signal from the feed to the video output stage.

ANSWER NEXT MONTH

Workshop HINTS

by VIVIAN CAPEL

One of the problems of a television service engineer's life is trying to see round corners. Centring the picture and adjusting the height, width and linearity controls all have to be done from the back of the set while at the same time viewing the effects on the screen. It can be done of course with a modern slim-line set, given a long and mobile arm and if one is prepared for burnt fingers! Most workshop benches are equipped with mirrors however to enable adjustments to be made from the rear without such contortions.

It is in outside servicing that the difficulties can crop up. A small portable mirror features in most outside engineers' kits but the snag is keeping it at the right angle and finding a support at the right height. A table is often too high and a chair seat too low, and when a perch on some article of furniture is finally found the angle is usually so far from the vertical that the mirror slides and falls over, often with no good effect on the furniture surface!

Mirror for Field Servicing

What is needed is a simple method of supporting a mirror at any angle, something not needing fiddling adjustments and taking up very little extra room in the kitbag. Some years ago I made up such a device (see Fig. 1) which has proved invaluable and satisfied all these requirements. The basic mirror is a cheap rectangular unit of about 9 x 5in. with a wooden back which is secured to it by metal corner pieces. A wooden base slightly wider than the mirror and about 4in. deep was first made. A pair of metal supports were then prepared—consisting of a couple of angle-pieces with a hole drilled in each part. These were screwed to the base board and the mirror mounted between by means of a woodscrew which passes through the hole in the angle-piece into the wood at the back of the mirror. A spring-washer (not a locking washer) and an ordinary washer are fitted between the mirror backing and the angle-piece (see Fig. 2) on both sides, the screws being screwed up fairly tightly but not too tight. Mount the angle-pieces towards the front of the base board rather than in the centre or towards the rear—in use the mirror will generally be tilted backwards and the larger amount of base at the rear will give it greater stability.

The mirror can be positioned on any convenient perch and angled as required. The spring-washers ensure that it remains in the position set. Over a period of use the screws may work loose so that the mirror does not maintain its position however. Tightening will soon put matters right but alternatively a locking washer can be included between the screw head and the angle-piece (not between the angle-piece and the mirror backing). A further ordinary washer will then be needed between the locking one and the angle piece.

To avoid damage to polished surfaces fit rubber feet on the bottom of the base board or glue on some felt pads. In transit the mirror can be folded back against the base so that it takes up very little room.

Difficult Valve Replacements

Valve replacement in modern sets is much easier than it used to be. The engineer still meets a goodly portion of older sets however in which changing a valve can be like doing a Chinese puzzle, with the valveholder concealed behind a screening can in a dark recess at the front of the chassis. A small mirror can often help and for this purpose a dental mirror is ideal. The problem is where to get one. The yellow pages in the telephone directory will usually provide the address of a dental supplier but as an alternative a substitute can be made using one of the small circular mirrors sometimes fitted to bird cages. These are usually backed with a plastic material to which the support will have to be fixed. A strong workshop adhesive could be used for this purpose. Some of these mirrors also have a small plastic ring which can be used for fixing purposes though the result may be rather fragile.

Adhesives

Mention of workshop adhesives brings us to the matter of their setting times. Many adhesives are fairly quick setting so that items being glued need be held together in a vice or by other means for only a short time before they can be put back into use. Impact adhesives are even quicker, surfaces being united as soon as they are brought together. Remember that with these the bond strengthens with time, so load or strain should not be applied immediately.

All these adhesives have particular applications, some being more suitable for one purpose than

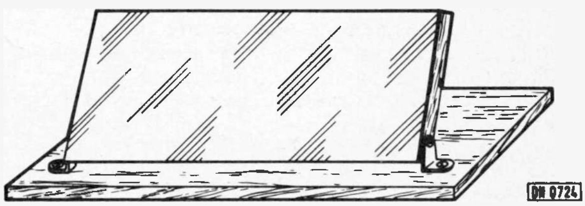


Fig. 1: (above) Portable screen viewing mirror which can be tilted to any angle.

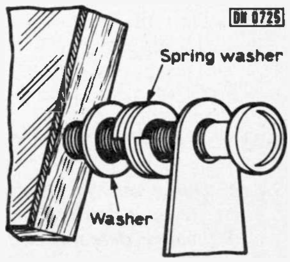


Fig. 2 (right): Detail of the assembly, showing the correct positions for the flat and spring washers.

another. Impact adhesives for example need the two surfaces to be well mated so that there is the maximum area of contact. Also they tend to soften with heat and a build-up of adhesive around the point will do nothing to increase its strength. For an instantaneous bond where it is inconvenient to hold the parts together for any time they are however ideal.

Then there are lighter adhesives—such as the clear ones—which have less strength but make a clean job of securing coil windings and other tasks where there is no great strain involved. These usually set fairly quickly.

Strong Bond

For a really strong bond one of the epoxy resins is most suitable. These are supplied in two tubes, one containing the hardener. They have to be mixed, usually in equal proportions, whereupon hardening commences. In addition to uniting the surfaces the adhesive can be built up around the point to give extra strength—since it dries to a hard, solid substance that reinforces the bond. This is useful for repairing broken plastic cabinets where the mating areas are very small. The joints can be built up at the back where the repair will not be noticed.

Unfortunately the setting times at normal workshop temperature (usually considerably less than "room" temperature) can be quite protracted—up to several days in fact. The time can be greatly reduced by the application of heat and as a bonus the joint will be much stronger. As most jobs will be physically small (except perhaps for plastic cabinets) what is needed is a means of applying localised heat at the bench.

One of the easiest ways of doing this is by making use of the bench lamp. Mains lamps generate a considerable amount of heat (very little heat is generated by the low-voltage type so these are not so effective for this purpose) which is concentrated by the lamp reflector. Thus heat can be applied simply by placing the job on the bench and bringing the lamp down over it as close as possible. The first reaction to heat of epoxy resin adhesives is to become less viscous and thick and to run. This is an advantage as minute cracks and crannies will be filled while the surface of any built up parts will become smooth.

After this initial stage the material becomes thicker and starts to harden at a rate dependent on the temperature—the higher the temperature the faster the setting. A couple of hours under the lamp will be sufficient for most small parts. Larger parts may take longer, especially if made of metal which will conduct the heat away.

Warnings

Two points of warning here. First, some plastic materials will not bond to epoxy resins. There is no way of telling in advance which ones will not; one can only try and hope for the best. As with other types of adhesives a clean surface is required—otherwise the adhesive will only bond to the dirt. Bonding will be improved if there is a "key" to the surface—a perfectly smooth surface can be keyed with a file or screwdriver.

The other point to watch is whether the part being repaired will stand up to the high temperature under the lamp, Many plastics are thermosetting which means that they will melt if subjected to excessive heat. It can be frustrating to say the least to lift the lamp after a couple of hours and find that one has a perfect joint between two drooping, mis-shapen masses of plastic!

The thermal properties of the plastic can be easily tested by touching the end of the soldering iron bit on a point that will not show. If it does prove to be sensitive to heat the joint can still be warmed but the heat should be moderated by not putting the lamp right over the work: leave it a few inches away and check from time to time that the plastic is not becoming soft.

Tracing Printed Circuits

When servicing printed circuits it is often difficult to trace from the component side where the print paths are going. Conversely it can be difficult when viewing a board from the print side to identify which components are connected to a particular portion of print. With a crowded board the difficulty increases.

If the board is viewed from the component side and a strong lamp is placed close to the print side the outline of the print can be observed. To identify any particular part use a pointer such as a screwdriver blade which can also be seen through the board if placed close enough. The print can then be identified by turning the panel around to see where the pointer is resting. Using a lamp in this way is especially helpful when dealing with those nightmare boards with print on both sides used by the GEC group.

SERVICE NOTEBOOK

—continued from page 77

sound continuing normally. A screwdriver blade applied to the anode of the PL504 line output valve when the fault was present produced no sign of a spark and no spark could be obtained after removing the top cap of the boost rectifier, proving that the boost capacitor was not going short-circuit. A new PL504 restored the picture, but it faded out again within minutes. It was then apparent that the valve was not running at nearly the normal temperature. This immediately suggested an open-circuit screen grid feed resistor since without screen grid volts a pentode passes very little anode current. A check at the screen grid pin revealed an above normal voltage however while even more surprisingly there was no negative voltage on the control grid. Lack of negative control grid bias implies loss of drive from the line oscillator and if the screen grid and anode voltages are present results in an over-run output valve. The cool running with zero grid bias and the screen grid and anode voltages present could only indicate one thing however—an open-circuit connection to the cathode. (The negative grid bias is developed as a result of the grid and cathode acting as a diode to charge the coupling capacitor.) An ohmmeter check showed that the printed circuit connection from chassis to the PL504 cathode pin was intact but when checked from the actual valveholder pin on the other side there was no reading. Resoldering the connection between the valveholder pin and the printed wiring restored constant operation. Clearly the dry-joint, usually making when cold, opened up as the heat from the valve affected the panel.

CCTV

PART 9

Peter Graves

THE camera tube's electron beam must be deflected to scan the target layer. The vast majority of vidicon tubes (and Plumbicon tubes which we have not yet covered but which are similar in most respects) use magnetic deflection with external scan coils—like the cathode-ray tube in a domestic receiver. A few types use electrostatic deflection, in the same manner as oscilloscope tubes, but these are generally special purpose types: only magnetic deflection will be dealt with in this series of articles therefore.

CRT & Vidicon Scanning

There are a number of important differences between a domestic c.r.t. and a vidicon tube. First, the amount of energy needed for scanning. The vidicon's electron beam is operated at low velocity and the tube is much smaller than a c.r.t. Thus the camera scan circuits require much less current under less stress. An e.h.t. supply is not needed for a vidicon, so the entire flyback e.h.t. system with its attendant troubles is eliminated. Then the vidicon is scanned orthogonally (see Fig. 1). This means that correction for pincushion and barrel distortion which are inherent in the non-orthogonally scanned c.r.t. is not needed.

There are disadvantages as well. Any distortion (e.g. non-linearity) in the camera is transferred to the rest of the system. Thus the accuracy of the scanning must be of a high order calling for high standards of manufacture and design. Another disadvantage is that the target layer of a vidicon is easily and permanently damaged by a scan failure. In consequence all but the cheapest cameras incorporate scan protection circuits to prevent this.

Largely because of their low energy requirements modern CCTV cameras use completely transistorised scan circuits.

Basic Requirements

Let's review the basic requirements of a magnetically scanned system with particular reference to the vidicon. Without any form of deflection the beam will take up a central position on the target. To scan the target in a standard, rectangular, raster pattern two sets of coils must be used, one to deflect the beam horizontally (the line coils) and the other to deflect the beam vertically (the field coils). When current is passed through these sets of coils the beam will take up a position on the target, the exact position depending on the magnitude and direction of the current flowing in the coils, i.e. the position of the beam is the resultant of the magnetic fields acting on it. By manipulation of the currents we can drive the beam to any position we want. For standard scanning we want the spot to move linearly (i.e. to move equal distances in equal times) during the working period of the scan and then to fly rapidly back into position for the next scan.

To achieve linear horizontal scanning the magnetic field produced by the current in the line scan coils must change linearly, implying that the current through the coils must also change linearly. This is not the same as saying that the voltage across the coils must be linear, as we shall see later. The current must increase from some negative value when the beam is at one side of the target, through zero with beam central, to a positive value when the beam is at the other side of the target. The current must then reverse rapidly to its maximum negative value (flyback), the beam being cut off during this period by a blanking pulse applied to the vidicon cathode or grid. Whilst scanning the target horizontally the electron beam will also be under the influence of the field coils. These also carry a linearly changing current, but at a much lower frequency. Thus while the electron beam is being scanned across the target by the line coils it is also being deflected downwards. Thus the next line starts a little below its predecessor—in fact the lines slope slightly downwards under the influence of the field scan. When all the lines have been scanned field flyback takes place in the same manner as the line flyback, the beam returning to the top of the target (ignoring the fact that the lens may invert the image on the target's front face). If either scanning current waveform is plotted as a function of time (Fig. 2) it will resemble the teeth of a saw—hence "sawtooth waveform".

In practice things are not as simple as this. The scan coils and the scan circuits are not perfect and the scan is not perfectly linear. In particular in addition to their inductance the coils have an inherent resistance. As a

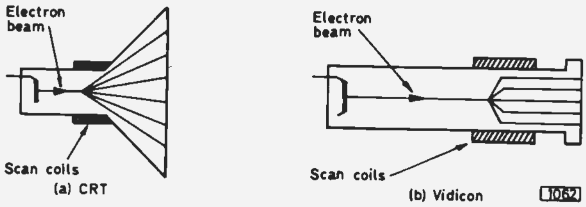


Fig. 1: Comparison between conventional c.r.t. scanning and the orthogonal scanning used with a vidicon tube.

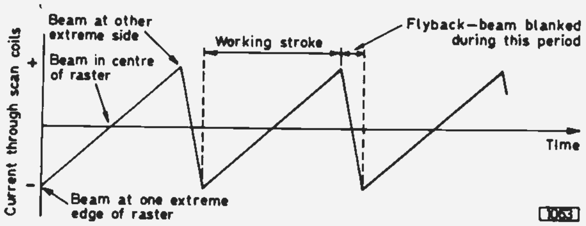


Fig. 2: The basic scanning current waveform.

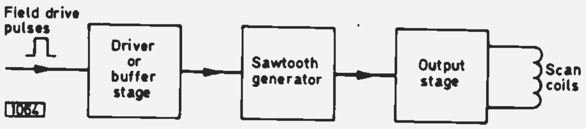


Fig. 3: Block diagram of the vidicon field scan circuit.

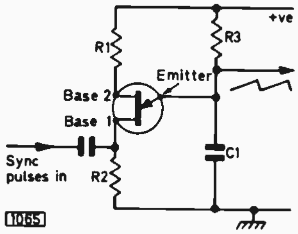


Fig. 4: The unijunction transistor sawtooth generator. This free-running oscillator can be synchronised by applying negative - going sync pulses to the transistor's base 1 connection.

result it is not possible to apply a simple voltage waveform across a coil in order to produce a sawtooth current in it. It is possible to calculate the shape the applied waveform should be for a given set of coils. We will tackle the problem from a practical point of view however. Some of the waveforms may look a bit odd, bearing in mind the shape of the resultant current waveform, but they are fully justified by theory.

Field Scanning

Let's look first at the field scan circuit. At field frequencies the inductive reactance of the field scan coils is very low, the coils' resistance predominating. To obtain a sawtooth current through a pure resistance a sawtooth voltage must be applied across it. We can deduce therefore that in the case of the field scan coils the applied voltage must be of almost sawtooth form. The heart of the field scan circuit (see block diagram, Fig. 3) is the sawtooth generator circuit. Unfortunately each manufacturer seems to have his own favourite circuit so that it is hard to generalise! Basically however there are two types of sawtooth generator, those that normally run free and can be synchronised by external pulses, and those that give no output unless they are driven by a continuous train of pulses (which also synchronise them).

Unijunction Oscillator

Typical of the first type of circuit is the unijunction transistor oscillator (Fig. 4). The unijunction transistor has two base connections and a single base-emitter junction. It is formed from a silicon (say n type) bar with a p-type emitter region near the centre. The ends of the bar are the two base connections. In the circuit shown capacitor C1 will at switch on be uncharged and will start charging through R3. A small current will flow between the transistor's base 1 and base 2 connections, through R1 and R2. In consequence there is a voltage drop across these resistors. Suppose the voltage drop across R2 is 1V. As C1 charges the voltage across it will increase until the voltage at the junction of R3, C1 is also 1V. The emitter-base 1 junction will then be forward biased (up to this point it is reverse biased and hence a high resistance) and the junction will conduct. The increased current which flows through the transistor lowers its effective resistance and in consequence the capacitor is rapidly discharged. When the voltage across the junction is too low for it to remain forward biased the transistor switches off. The capacitor then starts to charge again until the voltage at the emitter is about a volt, when the process repeats.

The circuit can be synchronised by tripping the base 1-emitter junction before it is tripped through C1 charging. This can be done by applying a negative-going pulse to the base 1 connection. This forward

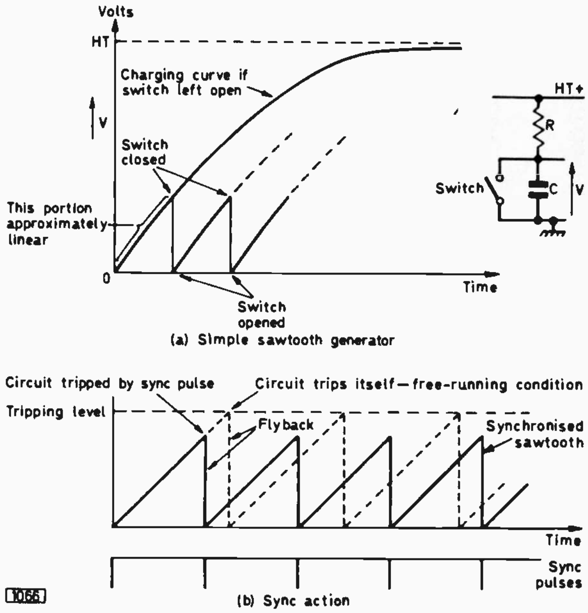


Fig. 5: Sawtooth generator waveforms. Whether the sync pulses are negative- or positive-going depends on the circuit being synchronised: they are shown negative-going here to meet the requirements of the circuit just shown (Fig. 4).

biases the junction and initiates discharge of the capacitor (see Fig. 5).

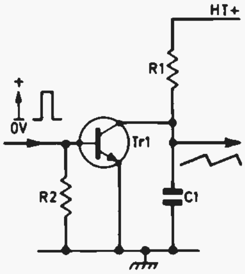
The output waveform obtained across C1 is not the linear ramp we want but increases exponentially (the standard case when a capacitor charges through a resistor). There are two main ways of dealing with this type of non-linearity. The circuit can be biased so that the capacitor never charges to a voltage anywhere near that of the supply rail, charging to say 10% of the rail voltage. The "bottom end" of a capacitor's charging curve is almost linear, as required. Alternatively feedback can be used to linearise the output as we shall see.

Driven Sawtooth Generator

A simple circuit of the driven type, again using the charging of a capacitor to generate the sawtooth, is shown in Fig. 6. Here again the transistor is used as a switch to discharge the capacitor. In the absence of a positive-going pulse at its base the transistor is cut off and capacitor C1 charges through R1. When a positive-going pulse appears at Tr1 base the transistor turns on and conducts, the capacitor discharging via the transistor. Again the output is exponential and in the interests of linearity only a small part of the charge cycle can be used. The circuit must be continually supplied with suitable rectangular pulses from a driver stage: in most cases the driver is a monostable multivibrator (see last month) which is itself driven by the field drive pulses from the sync pulse generator.

Bootstrap Circuit

A more sophisticated form of driven circuit is the "bootstrap circuit", so called because its action is analogous to a man raising himself to the ceiling by pulling on his own boot laces! The circuit is shown in



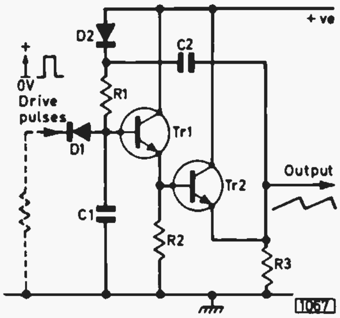


Fig. 6 (left): Driven sawtooth generator using an npn bipolar transistor as the switch.

Fig. 7 (right): The bootstrap sawtooth generator circuit.

Fig. 7 and uses feedback to linearise the output, thus overcoming the drawbacks of the simpler circuits. Like the multivibrator family of circuits the bootstrap circuit action is complicated by the use of feedback from the output to the input: so if this is new to you, take care!

When there is no drive pulse the input terminal will be at earth potential. D1 will be forward biased, effectively short-circuiting C1 to earth. D1 is biased on by R1. The base of Tr1 will also be at earth potential, so Tr1 will be cut off, and with no current flowing through R2 the base of Tr2 will also be at earth potential and Tr2 will be cut off as well. When a positive-going pulse is applied to the input D1 will be reverse biased and will turn off. With its short-circuit removed C1 will then start to charge through R1 as in the other circuits (D2 is forward biased at this stage). In the case of a simple series *RC* circuit, as the voltage across the capacitor increases the voltage across the resistor decreases. But in this circuit as the voltage across C1 rises Tr1 turns further and further on, more current flows through R2, the voltage across it rises and Tr2 also turns further on: the increasing voltage across R3 is fed back to the junction of R1 and D2 via C2, thus keeping the voltage across R1 constant and linearising the sawtooth developed by C1. The feedback is positive and since Tr1 and Tr2 are emitter-followers the sawtooth output developed across R3 is in phase with that developed across C1. When the positive drive pulse ends the input again returns to earth potential, D1 is forward biased and C1 rapidly discharges through it turning Tr1 and Tr2 off. If the voltage across R1 is to remain constant the voltage at the junction of D2 and R1 must not rise above the supply rail voltage. Diode D2 prevents this by becoming reverse biased should the voltage at the junction of R1, D2 approach that of the supply rail: with D2 reverse biased the supply to the charging circuit is effectively disconnected. Since the feedback via C2 is positive the voltage applied to the charging circuit R1, C1 increases as C1 charges—hence the "bootstrap" analogy.

Modifying the Sawtooth

These are typical of the circuits in common use and there are many variations on them. Note that they are straightforward sawtooth generators with varying degrees of non-linearity in their outputs. Since the field coils are slightly inductive however a sawtooth voltage waveform with a small rectangular step (Fig. 8) is

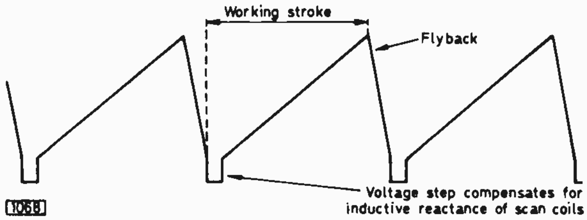
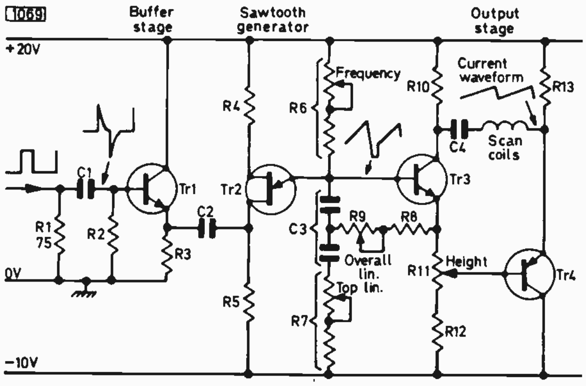


Fig. 8: Practical field scan **voltage** *waveform.*



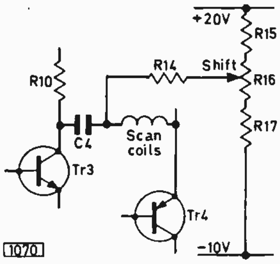


Fig. 9 (above): Practical field scan circuit.

Fig. 10 (left): Method of adding a shift control to the circuit shown in Fig. 9.

required. Also the working stroke must in practice be as linear as possible. So let's finally look at a complete though simplified practical field scan circuit, based on a commercial design, to see how these modifications to the basic sawtooth waveform are carried out.

Linearisation is achieved by using feedback circuits. This tends to make practical circuits look rather complicated. It is helpful to find out first what kind of sawtooth generator is being used: the additional feedback loops then become quickly apparent. Practical circuits must also include a height control and some means of varying the frequency where a free-running oscillator is used so that it can be adjusted for solid locking (c.f. the field hold control in a domestic receiver). Provision must also be made to shift the entire raster up and down (carried out by magnetised rings on the tube neck in a domestic monochrome receiver). When a driven oscillator is used the width of the pulse from the monostable driver stage must be adjustable to ensure correct operation.

Practical Field Scan Circuit

A complete field scan circuit, based on commercial practice, is shown in Fig. 9. Tr1 and its associated circuitry act as a buffer stage to isolate the field scan circuit from the external driving circuits. The values of C1 and R2 are chosen to differentiate the incoming rectangular pulse to provide a sharp synchronising pulse for the unijunction sawtooth generator (Tr2). R1 is a terminating resistor required for correct matching to the external field drive source (the sync pulse generator). If the field drive pulse is generated internally (say for random interlace operation) a higher value resistor may be substituted—typically 22k Ω. Care must be taken to ensure that the correct resistor for the correct mode is used. If the camera is often used in different modes it is convenient to mount R1 (and its corresponding resistor in the line scan circuit) on stand-off insulators to prevent damage to printed circuit boards with constant changing.

Tr2 is an elaborated version of the unijunction transistor oscillator described earlier (Fig. 4). C2 and R5 differentiate the pulse developed across R3, Tr2 triggering on the negative spike. The frequency determining components (corresponding to R3, C1 in Fig. 4) are R6 and C3. Part of R6 is made adjustable to provide fine frequency control: for a 50Hz field rate the total value of R6 is about 30k Ω. C3 consists of two separate components each with a value (again for a 50Hz field) of between 2 and 2.5μF. The junction is fed from one of the linearising feedback loops, of which more later. An additional resistor R7 (total value a few hundred ohms) is connected in series with C3 to prevent C3 fully discharging: this produces the step in the waveform (see Fig. 8) necessary to compensate for the inductive reactance of the scan coils. Part of this resistor is sometimes made variable—as shown—giving some control over the linearity of the first few hundred microseconds of the picture by varying the amplitude of the step.

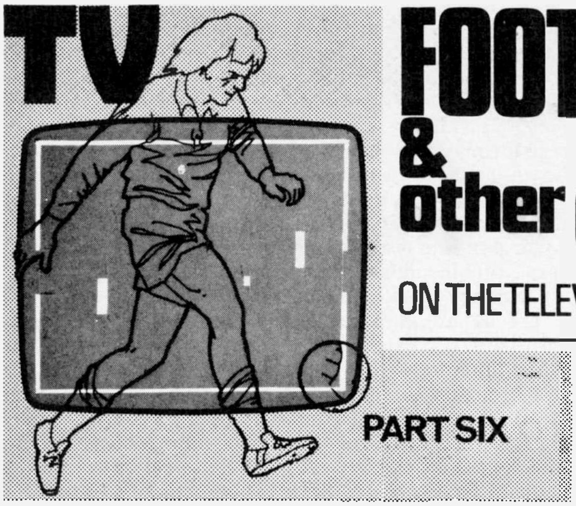
The output transistor Tr4 is driven by the emitter-follower Tr3, provision being made (R11) to adjust the amplitude of the input signal to Tr4. This provides height adjustment since R11 controls the amplitude of the scan current in the coils. The other end of the coils is returned to Tr3 collector via C4 which provides d.c. isolation between Tr3 and Tr4 but which, having a high enough capacitance (typically 500μF), is a pretty good dead short at field frequencies. This manner of connection forms one of the feedback loops: non-linearity in the scan current appears as a voltage across R10 in such a direction as to constitute negative feedback which corrects the current through Tr3 and hence the output to the coils.

The other feedback loop is from the emitter of Tr3 via R8 and R9 to the centre of C3. Since Tr3 is an emitter-follower the signal at its emitter will be in phase with the signal at its base: a proportion of the signal at its emitter is fed back to vary the charge on C3 by adding to it, thus linearising the otherwise exponential capacitor charging curve.

No provision has been made in this circuit for shifting the entire scan up and down the target. This is done by feeding d.c. through the scan coils. The position of the spot on the target will then be the resultant of the steady field developed by the d.c. and the varying scan signal which is superimposed on this. The overall effect is that the whole raster shifts by an amount depending on the magnitude and direction of the d.c. Fig. 10 shows how a shift control can be added to this circuit.

Next Month

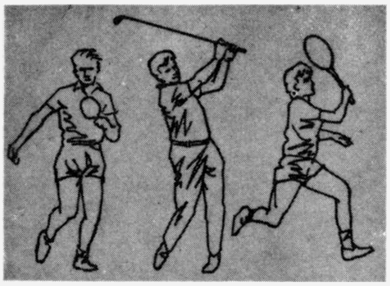
Next month we will look at the line scan circuits, at how the vidicon can be protected against scan failures, and at some practical tips on servicing this part of the circuit.



TV FOOTBALL & other GAMES ON THE TELEVISION SCREEN

P. BUSBY* B Sc

*IPC SERVICES LTD.



THIS month we will finish describing the ball control logic for the football game and give details of sound circuits for both games. We will also suggest some modifications to the ramp generators to overcome temperature drift effects when the game is first switched on.

Ball Control Logic

The logic circuit is shown in Fig. 27. You will also need to refer to the boundary generators in the fourth article, Fig. 19, and the man and ball circuits in the first article, Figs. 5 and 7. Points F1-F6 are interconnections from the other half of the board containing the boundary generators; the remaining connections are given in the interconnection table. The circuit arrangement of IC214 together with IC212a, IC207b is identical to the man/ball coincidence circuit discussed last month.

Terminals F7, F8, F9 are inputs from the left man circuit. The output from IC207b is fed into the monostable IC216 which gives a pulse of about 0·15S at coincidence. The leading edge of this pulse is differentiated by C213, R217 and used to trigger the appropriate sample and hold circuit. This arrangement prevents the sample and hold circuit being retriggered for a period of 0·15S after a coincidence. Without this safeguard the kicking action of the player would be thwarted, for in kicking the ball the player usually runs through the ball and stops in front of it. The ball then takes off and runs into the stationary player. If the sample and hold circuit was retriggered here the stationary player would cause zero output from the differentiators to be transferred to the hold circuit, resulting in a stationary ball.

The output is coupled into a NOR gate (IC207c) together with the output from the identical right man coincidence circuit. The output from this gate is used as a reset signal for the boundary reflection circuitry which we will deal with next.

Signals representing the left and right boundaries enter at F1 and F2. The X-component of the ball signal at F13 is buffered by IC218a, IC218b and fed to the coincidence detector gates IC211a and IC211b. A zero-going signal at the output of IC211a, representing a ball/left boundary coincidence, is fed into the NOR gate IC208b. The second input to this gate is fed with a signal which is high when the ball is in the vicinity of the goal mouth. Thus, the output from IC208b will be inhibited when the ball passes into the goal mouth, allowing the ball to pass through.

The circuitry that recognises when the ball is in the goal area is embodied in IC213; it is exactly the same arrangement that we used for detecting a man/ball coincidence (see last month's article).

The ball/boundary coincidence signal at the output of IC208b is a positive-going pulse which passes to the NOR gate IC208a. Assuming the second input to IC208a to be zero, the output from IC208a will be a zero-going pulse which resets the latch circuit IC211c and IC211d.

The gates IC211b, IC208c and IC208d perform the same function for a ball/right boundary coincidence, tripping the latch circuit into its other state. The output from the latch (F15) controls the X polarity reverse circuit on the analogue board.

Initial Conditions

The reflection circuitry so far described will function properly only if the latch is initially set in the correct state. The second inputs to the NOR gates IC208a and IC208d are used to supply reset pulses to the latch each time a man/ball interception causes the ball direction to change. A zero-going pulse is produced by IC207c whenever a man/ball coincidence occurs. This is applied to the NOR gates IC209a and IC209b together with a logic level from F19 which indicates the direction of travel of the ball.

The signal at F19, which is obtained from the full-wave rectifier circuit on the analogue board, is inverted by IC218c before feeding the gate IC209a. The net result is that a reset signal is applied to IC211c when F19 is at zero and to IC211d when F19 is high.

The ball reflection circuitry for the upper and lower boundaries is similar to the circuitry just described. As there are no goals however circuitry corresponding to IC213, IC208b, IC208c is not needed. The coincidence detectors use NOR gates in this case (IC210b, IC210c) to present the correct polarity signals to the reset gates IC210a, IC210d. The use of a NOR gate requires the boundary inputs F3, F4 and the ball F14 to be zero-going during their active period as opposed to the positive-going signals at F1, F2 and F13.

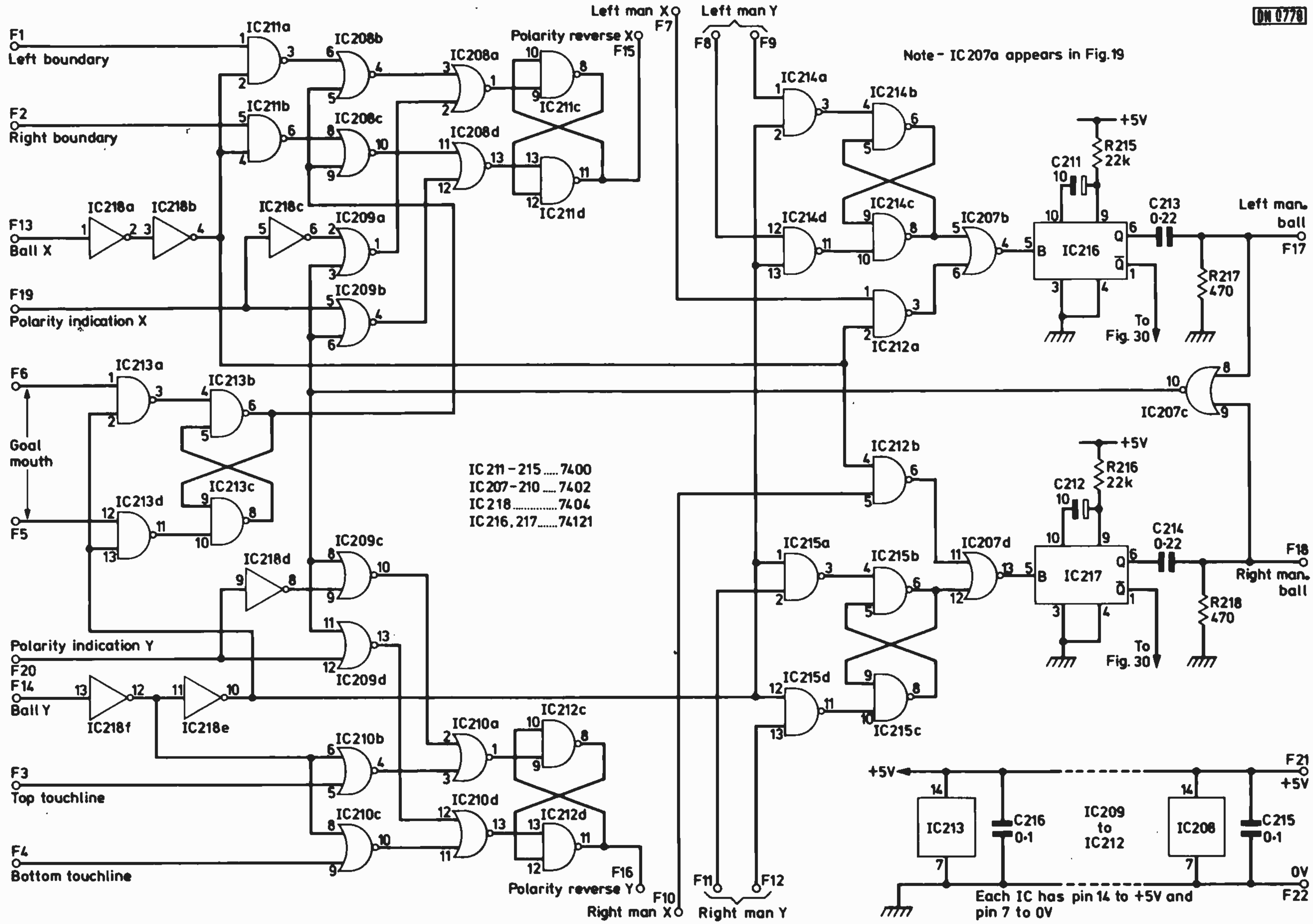


Fig. 27: Circuit diagram of the ball control logic for the Football game. This forms part of Board F, shown in Fig. 20.

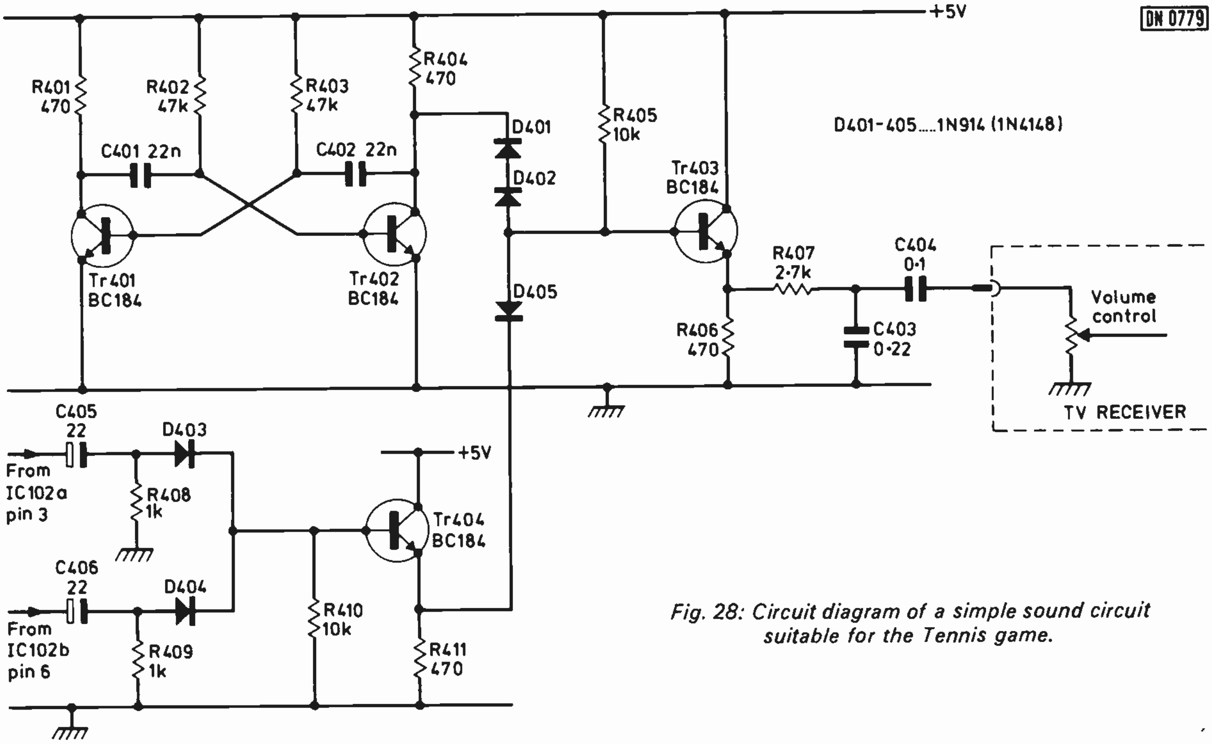


Fig. 28: Circuit diagram of a simple sound circuit suitable for the Tennis game.

Testing

This circuit is best tested in situ. Provided the other boards have been tested, the complete game can be wired up. The accompanying table shows the interconnections between the analogue board E and the logic board F. Testing is simplified if the ball motivation in the vertical and horizontal directions is tested separately.

Sound Circuits

A very basic simulation of a ball being kicked or hit can be produced by modulating an audio frequency with an envelope which has a sharp rise and a fairly gentle decay. In the circuit shown in Fig. 28, which is suitable for the tennis game, a modulation envelope of this form is produced by differentiating a positive-going step. This step is generated by the latch IC102a, IC102b (Fig. 14) which changes state when the ball's horizontal velocity is reversed after a man/ball coincidence.

The differentiators C405/R408, C406/R409 each produce a modulation envelope which is fed via the analogue OR gate D403, D404, R410 to the buffer Tr404. The low-impedance output from Tr404 is fed to a second analogue gate together with a squarewave of about 600Hz which is produced by the multivibrator Tr401, Tr402.

Modulation

This second gate, comprising D401, D402, D405 and R405, is of the opposite type to the first: its output consists of the lowest of the signals present at its inputs. The compounded signal thus obtained, shown in Fig. 29, is buffered by the emitter follower Tr403. The quality of the sound is improved by rounding off the squarewaves with the integrator circuit R407, C403: the output is fed into the TV sound channel via the volume control potentiometer.

Variable Pitch

A more interesting sound can be created if the velocity of the ball is used to control the pitch. The multivibrator circuit shown in Fig. 30 has been modified to become a voltage-controlled oscillator by returning the cross-coupling capacitor charging resistors R460, R461 to the emitter-follower Tr451. Voltages representing the vertical and horizontal velocities of the ball are summed by resistors R456 and R457 at the input to this emitter-follower.

These voltages should ideally be summed vectorially using the formula

$$V = \sqrt{Vx^2 + Vy^2}$$

since we would expect the pitch to increase with ball speed irrespective of direction. A straightforward addition ($V = Vx + Vy$) would be totally wrong as the

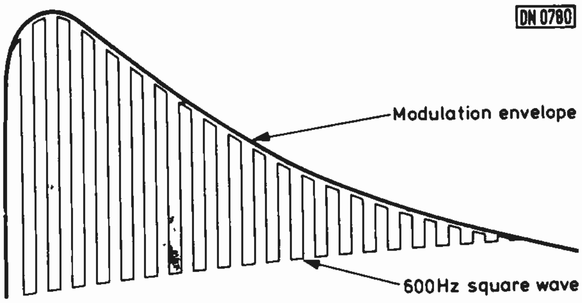


Fig. 29: Typical waveform of the sound circuit output.

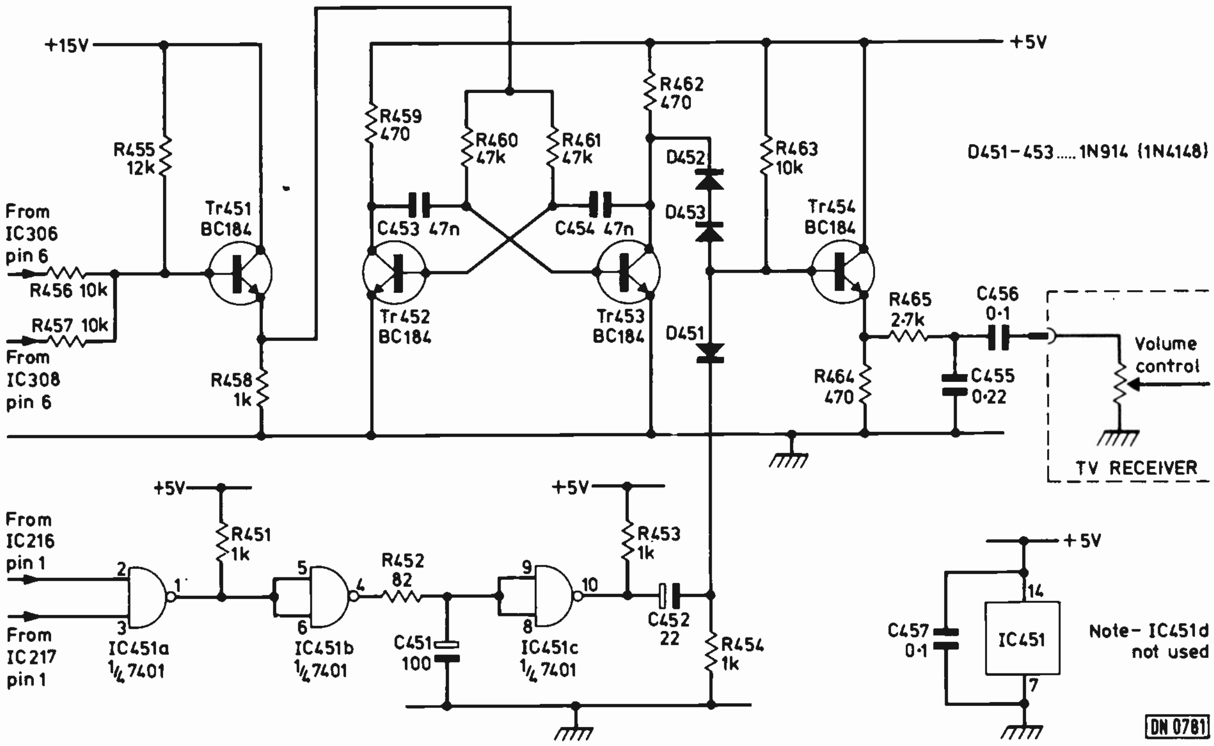


Fig. 30: This circuit produces sound effects for the Football game. The pitch of the note is controlled by the velocity of the ball by means of the summing amplifier Tr451 which varies the "aiming voltage" of the multivibrator. IC451b and c form a pulse stretching circuit for the coincidence pulses. This more sophisticated circuitry (compared with Fig. 28) is necessary because of the much shorter pulses coming from IC216 and IC217.

Interconnections: Analogue Board E (Fig. 22)

Pin	*Destination*
E1	Left joystick horizontal control (VR4)
E2	Right joystick horizontal control (VR6)
E3	F18
E4	F19
E5	F15
E6	Ball speed potentiometer (VR303a)
E7	Joystick pushbuttons (S1a, S2a)
E8	Ball speed potentiometer (VR303a)
E9	Joystick pushbuttons (S1a, S2a)
E10	Man/Ball circuits—ball X control
E11	Joystick pushbuttons (S1b, S2b)
E12	Ball speed potentiometer (VR303b)
E13	Joystick pushbuttons (S1b, S2b)
E14	Man/Ball circuits—ball Y control
E15	Ball speed potentiometer (VR303b)
E16	F16
E17	F20
E18	F17
E19	Right joystick vertical control (VR7)
E20	−15V
E21	Left joystick vertical control (VR5)
E22	+5V
E23	Ground (0V)
E24	+15V

Interconnections: Logic Board F (Figs. 17, 19, 27)

Pin	*Destination*
F1	Boundary generators F1
F2	Boundary generators F2
F3	Boundary generators F3
F4	Boundary generators F4
F5	Boundary generators F5
F6	Boundary generators F6
F7	Man/Ball circuits IC9b pin 5
F8	Man/Ball circuits IC7 pin 1 ($\overline{Q}$)
F9	Man/Ball circuits IC7 pin 6
F10	Man/Ball circuits IC9a pin 2
F11	Man/Ball circuits IC6 pin 1 ($\overline{Q}$)
F12	Man/Ball circuits IC6 pin 6
F13	Man/Ball circuits IC9c pin 9
F14	Man/Ball circuits IC9c pin 10
F15	Analogue Board E5
F16	Analogue Board E16
F17	Analogue Board E18
F18	Analogue Board E3
F19	Analogue Board E4
F20	Analogue Board E17
F21	+5V
F22	Ground (0V)

★ Components list

BALL CONTROL LOGIC (Part of Board 'F')

Resistors: (all ±5%, ¼W)

R217, R218	470 Ω	R215, R216	22k Ω

Capacitors:

C215, C216	0·1μF ceramic	C211, C212	10μF 15V
C213, C214	0·22μF		

Semiconductors:

IC211, IC212, IC213, IC214, IC215			7400
IC208, IC209, IC210			7402
IC218	7404	IC216, IC217	74121

Note: IC207 appeared in the Component list in Part 4

TENNIS SOUND CIRCUIT

Resistors: (all ±5%, ¼W)

R401, R404,		R407	2·7k Ω
R406, R411	470 Ω	R405, R410	10k Ω
R408, R409	1k Ω	R402, R403	47k Ω

Capacitors:

C401, C402	22nF	C403	0·22μF
C404	0·1μF	C405, C406	22μF 15V

Semiconductors:

Tr401—Tr404	BC184
D401—D405	1N914 (1N4148)

FOOTBALL SOUND CIRCUIT

Resistors: (all ±5%, ¼W)

R452	82 Ω	R465	2·7k Ω
R459, R462,		R456, R457,	
R464	470 Ω	R463	10k Ω
R451, R453,		R455	12k Ω
R454, R458	1k Ω	R460, R461	47k Ω

Capacitors:

C453, C454	47nF	C452	22μF 15V
C456, C457	0·1μF	C451	100μF 15V
C455	0·22μF		

Semiconductors:

D451—D453	1N914 (IN4148)		
IC451	7401	Tr451—Tr454	BC184

IMPROVED RAMP GENERATORS
(Changed components)

Resistors:

R47 becomes	10k Ω	R55 becomes	15k Ω

Semiconductors:

Tr13, Tr18 become BC214

sound would be high pitched when travelling say from left to right and low pitched on the return journey from right to left. A compromise solution is to remove the sign from the voltages and then add their magnitudes—mathematically written thus

$$V = |V_x| + |V_y|$$

Here we have an unexpected bonus in the football game, as these voltages are already available at the outputs of IC306 and IC308 (Fig. 22).

The remaining circuitry in Fig. 30 is particular to the football game. Man/ball coincidence pulses are taken in inverted form from the complementary outputs of monostables IC216, IC217 (Fig. 27). The NAND gate IC451a (used in an OR function) accepts either pulse and passes it to the pulse stretching circuit IC451b, R452, C451 and IC451c. The coincidence pulse, which is now of about 1S duration, is differentiated by C452, R454 and applied to the analogue gate as before.

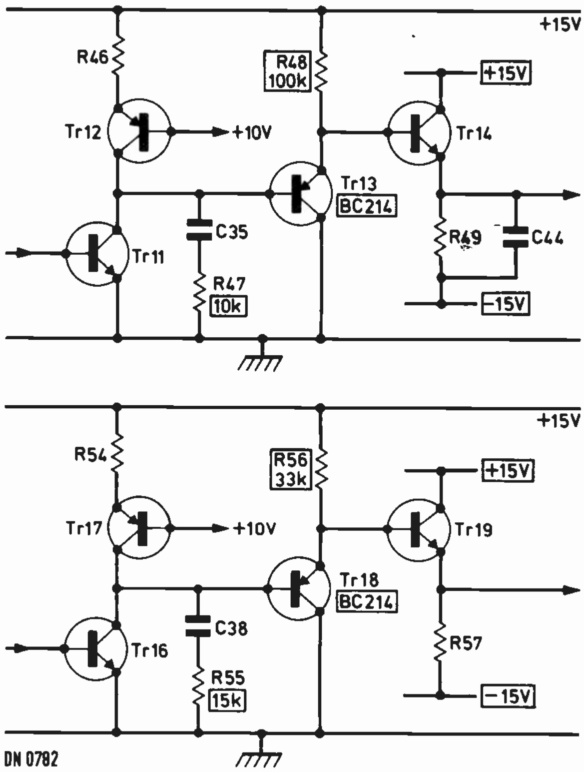


Fig. 31: Circuit diagram for the improvements to the Ramp Generators (Fig. 8). Changes to components and circuitry are shown boxed.

Ramp Generators

The original ramp generators shown in Fig. 8 have two deficiencies. First, the emitter-followers are temperature sensitive, which shows up in a drifting of the football field boundaries as the circuit warms up. The modified circuits (Fig. 31) use complementary emitter-followers which cancel the temperature effects. Note that the value of R47 and R55 has been altered to compensate for the loss of the 1V drop in the original emitter-followers.

The second defect is that under certain conditions the output emitter-follower is unable to sink the external currents from the following circuitry. This manifests itself in the disappearance of men or ball near the edges of the field. Taking the output emitter resistor to −15V should cure this.

In our concluding article next month we will give details of a net generator for the tennis game and also of a circuit we've christened Superman. Plugged in as a replacement for one of the joysticks, he fields the ball with a preset degree of agility and scores goals both direct and by bouncing off the touch lines.

YOUR PROBLEMS SOLVED

★ Requests for advice in dealing with servicing problems must be accompanied by an 11p postal order (made out to IPC Magazines Ltd.), the query coupon from page 91 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone. We cannot provide modifications to circuits published nor comment on alternative ways of using them.

FERGUSON 3710

The brightness went slightly brighter than normal with the brightness control having no effect. This fault was traced to an open-circuit offset pulse generator transistor VT204. Replacing this restored operation of the brightness control and the video adjustments were carried out, a good picture and grey-scale being obtained. With the back cover replaced however the picture gradually dims, faces become brown and the three dark steps of the grey-scale merge to form a uniform black. When the aerial is disconnected the noise rises over a period of an hour, the video signal across the contrast control staying constant. The c.r.t. voltages remain stable over a two hour period. If after an hour the back cover is removed the picture improves, the noise returning when the aerial is removed. A second replacement offset pulse generator transistor has resulted in a normal though slightly bright picture which remains steady over a three hour period: the noise level remains high on removing the aerial, even with the back cover off.—T. Garfield (Muswell Hill).

Check by substitution the luminance signal coupler C205 (16μF) and the adder transistor VT205. C237 (1μF) which provides emitter decoupling in the offset pulse adder stage and the luminance emitter-follower transistor VT206 are less likely suspects. It should be possible to isolate the faulty component by applying a squirt of freezer to the suspects when the chassis has warmed up and the fault is present. (BRC 3500 chassis.)

HMV 2705

The trouble with this set is picture breathing—when the picture content changes suddenly to peak white it expands and when the scene gets darker it contracts. Three exchange power modules have been tried but the effect is still present. I have been told that the effect is normal as the width and e.h.t. track. The expansion and contraction seem excessive however. With one of the power modules foldover was momentarily observed at the bottom of the raster when the width came in. Also when the channel change button is pushed but not pressed fully home there is a lot of snow on the screen, a free-running raster and foldover at the bottom. The picture size also varies as the brightness control setting is altered.—F. James (Colchester).

The foldover at the bottom is normal when the field timebase is unsynchronised. The poor e.h.t. regulation is not normal however. It is usually due to a fault in the power module. If you are sure that this is in order check the settings of the preset brightness and beam limiter controls on the line timebase module. If the voltage across R907 in the emitter circuit of the beam limiter transistor VT901—this resistor forms the earth return path for the line output stage—is much in excess of 1·4V at zero beam current suspect excessive line output stage current drain. (BRC 3000 chassis.)

PYE 13U

Normally the picture and sound are o.k. but sometimes both go off leaving just a blank screen. If the channel selector switch is turned a few times the sound and vision return and may stay for an hour or so or go off again after a minute. Sometimes just touching the channel switch brings the vision and sound back. Your guidance on dealing with the switch would be appreciated.—L. Matlock (Windsor).

You should be able to locate the faulty switch contact by touching each in turn with an insulated probe. Then try cleaning the contacts with a little vaseline dissolved in white spirit. If necessary tension them with long-nose pliers. (Pye 11U series.)

PHILIPS G26K526

The problem with this fairly new colour set is the old one of vision buzz occurring when the picture contains a lot of white or pale bright areas, e.g. captions. I have been told that the i.f. strip is correctly aligned and that nothing can be done about it.—P. Frayn (Buxton).

We suggest you wait for a test tone transmission then carefully adjust the 6MHz quadrature coil L601a for minimum buzz. The coil is in the small can adjacent to the TAA570 10-leg circular i.c. on the i.f. panel. If the signal from the aerial is strong it may help matters to adjust the a.g.c. crossover preset R169—this is also on the i.f. panel. (Philips G8 chassis.)

BUSH CTV25

The sound is very poor on this set. If the volume control is turned down low the sound is all right but when it is turned up to about half full volume the sound is like that from a transistor radio with a nearly flat battery. Could this be due to low voltage?—J. Ironside (Milton Keynes).

The trouble is commonly caused by leakage in the sound output transistors—7VT3 and 7VT4. Check them and replace if necessary—use a matched AC176/AC128 pair. The driver transistor 7VT2 (BFY52) can suffer if 7VT3 is faulty. The supply voltage at 7VT3 collector should be 25V.

EKCO T433

The picture and sound are correct but on switching off a bright spot remains at the centre of the screen for some time before dying away to a pinpoint. I would like to correct this before the tube is damaged.—R. Brackman (Dover).

The voltage dependent resistor R122 (E299DD/P336) which returns the earthy end of the brightness control to chassis is the only component concerned with switch-off spot suppression. If the c.r.t. is of some age it will not be wholly effective. The natural decrease in tube emission will prevent harm being done however. (Pye 11U series.)

MARCONIPHONE 4807

This set works perfectly for about an hour. There is then loss of picture, the tube heater still being alight. If the set is turned off and allowed to cool down the picture returns on switching on again.—G. Peterson (Halifax).

The fault could be due to change of temperature causing a break in a capacitor which mends as it cools down, a hair-line print crack which breaks at a certain temperature and remakes on cooling, or an intermittent valve or transistor.

It is impossible unfortunately to give an exact location of the likely fault area. Check all joints in the tuner, i.f. and video sections, and the print where it meets a joint. Flex the panel slightly to see if the fault can be brought on: spray the i.f. transistors with Freeze-it and tap around gently in the hope that it occurs. Try making voltage checks on the valves and transistors before and after the fault occurs to try to find a clue to its location. (BRC 1500 chassis.)

PHILIPS G19T212A

The warm up time is normal and the sound and field OK but there is only a vertical line on the screen—with an occasional crackle on sound. Viewing the top of the board at the back I noticed sparks in the vicinity of the white four-pin plug and the adjacent valve.—T. Epworth (Heywood).

Since there is brightness and the field timebase is working the fault must be in the line deflection coils or the connections to them. This is confirmed by the sparks around the four-pin socket which is the seat for the plug that carries the leads to the line coils on the c.r.t. neck. Check that the leads are secure in the plug, check across the pins for continuity and ensure that the plug seats securely on the socket. Next follow the tracks on the printed panel, looking for dry or intermittent joints. The adjacent valve is the PFL200 video/sync valve and should not have been affected by the fault. (Philips 210 chassis.)

PYE CT152

The problem with this set is that the width decreases and the picture sometimes collapses. The sound remains o.k. If the set is switched off and allowed to cool the same results are obtained on switching on again. The voltages at the screen grid (130V instead of 250V) and control grid (−55V instead of −89V) of the line output valve are low while the cathode voltage (3–4V depending on the brightness control setting instead of 0–2·4V) is high. The valve has been replaced without effect and the beam limiter circuit checked. Could the line output transformer be faulty?—R. Hetherington (Ramsgate).

The incorrect line output valve voltages indicate that the stage is overloaded. Common causes of this are: shorting turns on the shift choke (L39) in series with the horizontal shift control slider; faulty e.h.t. tripler (to check this switch off the guns and disconnect the input to the tripler from pin 10 on the line output transformer—if the screen grid and boost voltage return to normal the tripler is faulty); leakage in the pulse feedback capacitor C217 (270pF); the c.r.t. first anode smoothing capacitor C244 being leaky (this will burn the associated filter resistor R227); short-circuit turns on the line output transformer (replacement is the only cure unfortunately). (Pye 691 chassis.)

DEFIANT 9A62U

The problem with this set is in the field timebase which is operating at half speed (two pictures). The hold control locks the picture, but only in the two picture condition. The linearity seems to be all right. The PCL85 field timebase and ECH84 sync separator valves have been changed and an Avo check appears to show that the associated resistors and capacitors are in order.—A. Gurney (Salford).

The printed circuit boards on these receivers are notorious for hair-line cracks and similar troubles: carefully check the continuity of all tracks around the PCL85 valveholder, especially those associated with the field hold control and the triode grid (pin 2). If all is well you will have to check the components in the hold control network by substitution. (Plessey dual-standard chassis.)

DECCA DR21

With the brightness and contrast controls set half way the picture is dark and there is a black band (about 1in.) at each side. When the brightness is turned up the picture widens, starting with the dark patch in the middle, then balloons to give a completely blank screen. With the aerial disconnected there is a thin white line down the centre of the screen. Changing the DY802 e.h.t. rectifier made some improvement but changing the other timebase valves made no difference. Most of the components in the line output stage have been checked without success. There is a good spark from the PL504 top cap but very little from the PY800 or DY802 top caps. The line whistle seems normal though a little quiet. Is the line output transformer at fault—I have been told the thin white line means that it has shorted turns?—P. Brown (Birmingham).

This symptom with this model is unfortunately almost certainly due to a faulty line output transformer. Basically, the e.h.t. regulation is poor and as a new e.h.t. rectifier has been fitted this leaves only the line output transformer. Quote the model *and* serial number when ordering a replacement.

FERGUSON 3631

There is excessive height—mainly at the top of the picture—while the width control has to be at the end of its travel in order to fill the screen. After the set has been on for about twenty minutes the picture breaks up into four or five separate pictures (horizontally) and there is rapid rolling from the bottom to the top. The field hold control is at the end of its travel. The PCL805 and the valves in the line output stage—in fact most of the valves in the set—have been replaced and a new smoothing block fitted. What type of thermistor should be fitted in the heater chain?—L. Newton (Bridgwater).

If there is inadequate output from the line output stage the e.h.t. will be low and in consequence the height excessive. The symptoms appear to be due to low h.t. or incorrect heater current. Since you have renewed the main smoothing block the mains autotransformer comes under suspicion. A type VA1070 thermistor is used in the heater chain: alternatively the RS type TH1 can be used. (BRC 950 chassis.)

QUERIES COUPON

This coupon is available until December 16 1974 and must accompany all Queries sent in accordance with the notice on page 89. Don't forget the 11p (inc. VAT) postal order!

TELEVISION DECEMBER 1974

TEST CASE

144

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

? *A dual-standard Decca Model DR23 suddenly failed on picture, sound on both standards remaining normal. The symptom was that of line timebase failure; that is, the picture diminished horizontally and then faded from the screen. Preliminary checks indicated that the line oscillator was functioning since the line whistle was present, and that the pitch of the whistle could be varied by adjusting the appropriate line hold control. It was also discovered that by viewing in a darkened room screen illumination could be discerned at a low setting of the brightness control, but that as the control was advanced the display reduced in intensity, expanded over the screen and then disappeared.*

This, the classic symptom of poor e.h.t. regulation, gave the impression of a low-emission e.h.t. rectifier valve. A replacement had no effect on the symptom however. The boost voltage was then measured and was found to be about 150V below normal even at the maximum setting of the boost preset control—on both standards. The line output valve was running at a high temperature, as also were the primary winding and e.h.t. overwinding on the line output transformer.

The pulse voltage at the line output valve anode appeared to be quite respectable and the emission of the boost diode was up to standard—proved by valve replacement. The 0·1μF boost reservoir capacitor was changed to no avail, as also was the VDR associated with the boost voltage preset control. One or two high-value resistors in this area were found to have risen in value, but replacing them made not the slightest difference to the symptom.

The basic effect was rather like that produced by incorrect line output valve bias or drive. As this can be caused by poor insulation resistance in the capacitor coupling the anode of the line oscillator valve to the control grid of the line output valve this capacitor was disconnected at the line output valve grid and the d.c. voltage (to chassis) at the open end measured using a 20,000 Ω/V meter with the receiver switched on. About 80V on the d.c. range of the meter was measured! The capacitor was thus considered to be electrically leaky and was duly replaced. The symptom was just as before however!

What was overlooked when this test was made, and what would be the most likely cause of the trouble? See next month's TELEVISION *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 143

Page 43 (last month)

As is well known the line oscillator frequency is basically set by an *RC* time-constant circuit. Thus apart from change in valve characteristics—there is a flywheel sync comparator ECC82 in addition to the line oscillator ECC82 in this chassis—drift in value of a resistor or capacitor in an *RC* time-constant circuit is a likely cause of the trouble. Drift of this type is often produced as a result of increasing temperature inside the cabinet. It will be recalled that after the valve replacement the set was operated with the back cover removed. The ventilation was thus improved and the temperature prevented from rising to its normal operating level.

The resistors in this part of the chassis tend to change value in these sets but the fault was eventually traced to a 56pF capacitor (C2060) which is one of the anode-to-grid cross-couplers in the ECC82 line oscillator circuit developing a leak of several megohms as it warmed up. This altered the time-constant of course and so caused the oscillator frequency to change.

Published on approximately the 22nd of each month by IPC Magazines Limited, Fleetway House, Farringdon Street, London EC4A 4AD. Printed in England by Fleetway Printers, Crete Hall Road, Gravesend. Sole Agents for Australia and New Zealand—Gordon and Gotch (A/sia) Ltd.; South Africa—Central News Agency Ltd. Publisher's subscription rate (including postage): for one year, £3.25 inland rate, £3.85 overseas rate. International Giro facilities Account No. 5122007. Please state reason for payment "message to payee". "Television" is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to VAT, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

TELEVISION CLASSIFIED ADVERTISEMENTS

The pre-paid rate for classified advertisements is 8p a word (minimum 12 words), box number 30p extra. Semi-display setting £4.50 per single column inch. All cheques, postal orders, etc., to be made payable to TELEVISION and crossed "Lloyds Bank Ltd." Treasury notes should always be sent *registered post*. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, TELEVISION IPC Magazines Ltd., Fleetway House, Farringdon Street, London, EC4A 4AD, for insertion in the next available issue.

SETS & COMPONENTS

Top 20 Plus Electronically Tested TV Valves

PL504	18p	30FL1/2	15p
PCF801	15p	PCL84	10p
DY86/7	15p	PCL82	10p
PL36	15p	PD500/A	50p
PC88	15p	ECC82	10p
PC86	15p	EH90	10p
PC97	15p	EY86	15p
PCL805/85	15p		

Colour Valves Fully Tested

PL509	40p	PY500/A	30p
PL508	30p	GY501	50p
PL802	40p	PCF802	15p

Many others available including Mazda Types.
P. & P. 4p per valve, over 12 2½p per valve, orders over £4 post free.
Prompt service. S.A.E. for New free list
Mail order only.
L. & D. COMPONENTS LTD.,
71 Westbury Ave., London N22 6SA.
Tel. 01-888 2701.

COMPONENTS GALORE
Pack of 500 mixed components manufacturers surplus plus fall-out. Pack includes resistors, carbon and W.W., capacitors various, transistors, diodes, trimmers, potentiometers, etc. Send £1 plus 15p p & p. C.W.O. to:
Cascade Components Company, Dept. TV, Bankhead Farm, South Queensferry, West Lothian.

MAINS DROPPERS.
37-31-97-26-168 Ω 50p.
25-35-97-59-30 Ω 50p.
14-26-97-160 Ω 50p.
14-26-97-173 Ω 50p.
15-19-20-70-63-28-63 Ω 50p.
Post free. C.W.O.
Durham Supplies, 367 Kensington Street, Bradford, 8, Yorkshire.

Components Galore. Pack of 500 mixed components, manufacturers' surplus plus once used. Pack includes resistors, carbon and W.W., capacitors various, transistors, diodes, trimmers, potentiometers etc. Send £1 + 10p P. & P. C.W.O. To: Caledonian Components, Strathore Road, Thornton, Fife.

BRC 2000, 3000, 3500, 8000, 8500
Panel Repairs—Singles or Bulk
All Details:
MODULAR ELECTRONICS
160 Brabazon Road, Hounslow TW5 9LP
Tel. 01-897 0976

ABSOLUTELY Unbeatable Value. Our quality pack of 550 components is a must for every experimenter. Pack comprises loads of transistors, diodes, potentiometers, resistors, capacitors etc., plus free panels packed with components. Send only £1.50 for speedy delivery to Capital Components, BCM 3276, London WC1V 6XX.

VALVE LIST
ALL VALVES FULLY TESTED
One valve postage 4p. Over 5 valves postage paid.

DY86/87	13p	PC900	8p	PCL85	20p
DY802	20p	PCC84	8p	PFL200	25p
EB91	12p	PCC89	8p	PL36	20p
ECC82	10p	PCC189	8p	PL504	25p
ECL80	8p	PCC805	15p	PY81/800	15p
EF80	8p	PCC85	20p	PY801	20p
EF183	10p	PCF80	8p	U191	18p
EF184	10p	PCF86	13p	6F23	15p
EH90	13p	PCF805	20p	6/30L2	15p
EY86/87	13p	PCL82	13p	30F5	10p
PC86	15p	PCL83	13p	30FLI	20p
PC88	15p	PCL84	13p	30PLI	20p

AND MANY MORE AVAILABLE
S. W. ELECTRONICS
114 Burnley Road, Rawtenstall
Rossendale, Lancs.

250—New Resistors well assorted ¼—2 watts. Carbon—Hi-Stab Oxide etc. £1.00 Post 10p. Whitsam Electrical, 33 Drayton Green Road, London W.13.

AERIALS

Prices include VAT and Postage
J and A Tweedy Limited Incorporating Baines High Frequency Aerials
Multibeams: MBM 30 £5.20. MBM 46 £8.35, MBM 70 £14.25. **Parabeams:** PBM 12 £4.05, PBM 18 £5.15 Log-periodic £7.20. **Stereo-beams:** SBM 1 £2.65, SBM 2 £3.66, SBM 3 £5.30, SBM 4 £5.80. SBM 6 £8.75.
Masthead Amplifiers UHF or FM VHF £10.00, Setback £5.50.
We are stockists of **Amtron Kits** and **BIB Accessories.** VHF Co-ax 8p/m. Low Loss 12p/m.
Open Tuesday to Saturday 0900-1730
79 Chatsworth Road, Chesterfield S40 2AP

"DX-TV". Long range television aerials. Band I 5 elements £5, ten for £35. Band III 9 elements £3, ten for £20. "Broadside Array" £6, ten for £40. Carriage extra. Cook, 90 Ewhurst Road, Crawley 23885, Sussex.

WRIGHT'S AERIALS
Full range of J Beam and Antiference aerials and accessories. Antiference Trucolour: TC10 £4.00, TC18 £5.30. J Beam High Gain: MBM 30 £5.15, MBM 46 £7.70, MBM 70 £13.25. New Antiference Extra Gain: XG8 £7.90, XG14 £14.00, XG21 £19.00. Please state transmitter or channel group if known. Labgear UHF masthead amplifiers: CM6000 (grouped) £11.05, CM6019 (wideband) £9.75. Both with mains power supply. Coax: semi air-spaced low-loss 12 p / yd. Prices include VAT and UK mainland postage. Comprehensive stocks of high gain aerials and accessories. SAE for list. Information sheets and individual advice supplied with order if requested. Dept. 1, 3 Cheltenham Rise, Scawsby, Doncaster, S. Yorks.

EDUCATIONAL

TELEVISION TRAINING

16 MONTHS' full-time practical and theoretical training course in Radio & TV Servicing (Mono & Colour) for beginners.

13 WEEKS' full-time Colour TV Servicing course. Includes 100 hours practical training. Mono revision if necessary. Good electronics background essential.

NEXT SESSION commences on January 2nd.

PROSPECTUS FROM:
London Electronics College, Dept.TT12
20 Penywern Road, London SW5 9SU.
Tel. 01-373 8721.

C. AND G. EXAM
Make sure you succeed with an ICS home study course for C and E Electrical Installation Work and Technicians, Radio/TV/Electronics Technicians. Telecommus Technicians and Radio Amateurs.
COLOUR TV SERVICING
Make the most of the current boom! Learn the techniques of servicing Colour and Mono TV sets through new home study courses, approved by leading manufacturers
TECHNICAL TRAINING
Home study courses in Electronics and Electrical Engineering, Maintenance, Radio, TV, Audio, Computor Engineering and Programming. Also self-build radio kits.
Get the qualifications you need to succeed. Free details from:
INTERNATIONAL CORRESPONDENCE SCHOOLS
Dept. 750B, Intertext House,
London SW8 4UJ. Or phone 01-622 9911

SERVICE SHEETS

BELL'S TELEVISION SERVICES

SERVICE SHEETS • MANUALS • BOOKS

SERVICE SHEETS 40p plus S.A.E. ★ SERVICE SHEET CATALOGUE 25p

OVER 12,000 SERVICE SHEETS & MANUALS IN STOCK ON COLOUR/MONO TELEVISIONS RADIOS, RADIOGRAMS, T/RECORDERS, R/PLAYERS, ETC. S.A.E. WITH ENQUIRIES

Send large S.A.E. for FREE booklists.

NEW BOOKS & PUBLICATIONS ..... PRICES INCLUDE POST & PACKING	PRICE
COLOUR TV With Particular Reference to the PAL System by G.N.Patchett. 3rd Edn. 360 pages.....	£5.15
HANDBOOK OF DATA TABLES ON AMERICAN TRANSISTORS. 263 pages	£1.30
" " " " " JAPANESE TRANSISTORS. 171 pages	£1.30
" " " " " EUROPEAN TRANSISTORS. 227 pages	£1.30
HANDBOOK OF DATA TABLES ON SCRs. TRIACs. DIACs. PUTs. & UJTs. 159 pages..............	£1.10
HANDBOOK OF TRANSISTOR COMPARISON TABLES. 1974-75 Edition. 220 pages	£1.20
HANDBOOK OF DIODE COMPARISON TABLES. 152 pages..	£1.10
Comprehensive COLOUR TV REPAIR MANUAL by McCourt. Vol.1. Covers most British models	£3.25
Comprehensive COLOUR TV REPAIR MANUAL by McCourt. Vol.2. Covers ITT/KB & Foreign sets....	£3.25
Comprehensive B/W TV REPAIR MANUAL by McCourt. Vol.1. Covers approx 259 British models....	£3.20
" " " " " " " Vol.2. Covers approx 197 British models....	£3.20
" " " " " " " Vol.3. Covers UK & Foreign Portables	£3.20
BEGINNER'S GUIDE TO ELECTRONICS by Squires & Deason. 3rd Edition. 240 pages..............	£2.07
UNDERSTANDING & USING THE OSCILLOSCOPE by C.Hallmark. 272 pages.......................	£1.90
How to Choose & Use TAPE RECORDERS by H.W.Hellyer. 243 pages	£3.25
How to Choose & Use TUNERS & AMPLIFIERS by John Earl. 187 pages	£2.35
How to Choose & Use PICKUPS & LOUDSPEAKERS by John Earl. 203 pages	£3.25
MANUAL OF SOUND RECORDING by J.Aldred. 2nd Edition. 269 pages..........................	£3.75
PUBLIC ADDRESS HANDBOOK by V.Capel. 208 pages...	£3.25
GUIDE TO PRINTED CIRCUITS by G.J.King. 140 pages	£2.75
TRANSISTOR-TV SERVICING GUIDE by Robert G.Middleton. 128 pages........................	£2.50
101 TV TROUBLES FROM SYMPTOM TO REPAIR by A.Margolis. 218 pages	£1.60
104 EASY TRANSISTOR PROJECTS YOU CAN BUILD by Robert M.Brown. 223 pages	£1.40
104 EASY PROJECTS FOR THE ELECTRONICS GADGETEER by Robert M.Brown. 160 pages	£1.40
HOW TO MAKE 2 and 4 METRE CONVERTERS FOR AMATEUR USE by J.R.Hey	£0.67

"RADIO & TELEVISION SERVICING" books available, from Volume 1 to 1974 edition. Prices on request.

Back issues of PW. PE. EE. TV. E-Today & Constructor available, Cover price plus 7p postage per copy..

OPEN UNTIL 6pm DAILY & 8pm SATURDAY. CALLERS WELCOME TO COME AND BROWSE

B.T.S (Mail Order Dept.) 190, KINGS ROAD, HARROGATE, YORKS. Tel. 55885

SERVICE Sheets for over 6,000 models of Televisions, Radios, Transistors, Stereo, Tape Recorders, Record Players etc., at only 30p plus S.A.E. with free Fault-Finding Guide. Over 50,000 sheets in stock for 10,000 models. S.A.E. enquiries. Catalogue 20p plus S.A.E. Hamilton Radio, 47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 429066.

LARGE SUPPLIER OF SERVICE SHEETS

All at 40p each

(T.V., RADIO, TAPE RECORDERS, RECORD PLAYERS, TRANSISTORS, STEREOGRAMS, RADIOGRAMS, CAR RADIOS)

"PLEASE ENCLOSE LARGE S.A.E. WITH ALL ENQUIRIES & ORDERS"

Otherwise cannot be attended to

(Uncrossed P.O.'s please, original returned if service sheets not available.)

PLEASE NOTE
We operate a "by return of post" service. Any claims for non-delivery should be made within 7-days of posting your order.

C. CARANNA
71 BEAUFORT PARK
LONDON, NW11 6BX

We have the largest supplies of Service Sheets (strictly by return of post). Please state make and model number alternative.

Free T.V. fault tracing chart or T.V. list on request with order.

Mail order or phone 01-458 4882

SERVICE SHEETS, Radio, TV etc. 8,000 models. Catalogue 20p. S.A.E. enquiries. Telray, 11 Maudland Bank, Preston.

A.L.S. TECHNICAL INFORMATION SERVICE
10 DRYDEN CHAMBERS, 119 OXFORD STREET, LONDON W1R 1PA

MAIL ORDER ONLY

Books

We are pleased to be able to offer a very large and interesting choice of Books on all electronic subjects.

Radio & Television Servicing Books brought and sold.

Complete Lists of Service Sheets, Books & Printed Circuit Boards etc., Plus Free Fault-Finding Charts & Newsletter 25p + S.A.E.

As a Service to our customers we buy and sell good clean copies of back issues of the leading magazines—
Television
Practical Wireless
Practical Electronics
Wireless World etc.

Note: Do not send us any of the above until we write to you—Thank You.

Our stocks now exceed 20,000 items
Service Sheet Service only 40p plus S.A.E.

"Comprehensive Colour TV Manual"
by J. McCourt
Covers Faults & Causes on most British Sets.
Price £3 including Post & Packing

"Comprehensive Colour TV Circuit Pack"
Contains circuits on all the sets in the above manual Price £2.50 post paid.

"Beginner's Guide to Colour Television"
by G. J. King
Highly recommended from our Book List
£2.20 post paid

"Questions and Answers on Colour Television" Reddihough
Simple, practical account on PAL system
£1.00 post paid

"TV Fault-Finding" J. R. Davis
Profusely illustrated including many photographs of actual faults £1.00 post paid

"Getting the Best from Your Colour TV"
By R. Maude Price only 50p post paid

"A Guide to Television Aligement Using Only Transmitted Test Signals"
by B. R. Epton
Price 30p plus S.A.E.

Colour TV Manuals

All prices quoted are post paid.

BRC
2000 Series £3.50
3000 Series
3500 Series £2.50
8000 Series
8500 Series

DECCA
CTV19
CTV22
CTV25
CTV2200
CTV2203
CTV2207
CTV2225 £3.50
CTV2500
CTV2503
CTV2505
CTV2506
CTV2509
CTV2520
CS1730
CS1733
CS1830
CS1910
CS2030
CS2211
CS2213 £2.50
CS2230
CS2225
CS2227
CS2230
CS2500
CS2611/2
CS2630/1

GEC
2028/A/B
2029/A/B
2030
C2040/B
C2041/B
C2073 £2.50
C2100
C2103
C2107
C2110
C2115

ITT/KB
CVC1
CVC2
CVC5
CK403
CK405
CK500
CK550 £2.50
CK600
CK701
CK750
CK822
Studio 100
Col Scene

Philips
G8D/ST
G8S/ST
G8 Series
G25K500
All to 513
G22K500 £3
All to 537
G26K500
All to 520
Please state full Model no. required

Sony
KU1320 UB
KU1800 UB £2
etc.

All R.B.M. manuals in short supply but some still in stock
Prices from £2.50

Many more makes and models available offered subject stock position and/or availability.

All prices are subject to change by the publishers, but are correct at time of going to press

Please supply one Service Sheet, for which my cheque/P.O. for 40p & S.A.E. is enclosed.

Name .... PLEASE USE BLOCK CAPITALS

Address ....

Model Number **MAKE** **TV, Radio etc**

FOR SALE

NEW AND UNUSED at greatly reduced prices. A set Radio and Television Servicing '67-'73 £17. Heathkit R.F. Signal Generator £15. TT169 Transistor Tester £10. Large selection Resistors, Mains Droppers and Capacitors £10. Phone Lutterworth 3602.

TELEVISION Colour Project. IF aligned by Television, Decoder, RGB panels complete, pushbutton control. OFFERS. Box 120.

DECCA 25" full console colour receiver. Excellent cabinet and sound quality; picture usually good but too temperamental for non-technical owner. £80. Telephone 01-624 9298.

E.M.I. MK6. CCTV complete with Lens, Manuals, Vidicons and spares. £77. E.M.I. Oscilloscope type WM8, DC to 15 MHz, with pre-amp, leads and Manuals. £35. For full details and view, ring after 7 p.m. 01-855 8892.

"TELEVISION" Colour Receiver, all new parts, complete in cabinet. £100 o.n.o. Emigrating. Bond, 311, Milton Road, Cambridge CB4 1XQ.

WANTED

TOP PRICES PAID for NEW VALVES and TRANSISTORS
popular T.V. and Radio types
KENSINGTON SUPPLIES (A)
367 Kensington Street, Bradford 8, Yorkshire.

SERVICE SHEETS purchased. HAMILTON RADIO, 47 Bohemia Road, St. Leonards, Sussex.

SURPLUS TV Stocks, Colour Tubes, Components, B.R.C. etc. Cliff (TV) 200 Ifield Drive, Crawley, Sussex.

TELEVISION December 1969 will pay 50p plus postage. Symes, Titchborne, Redlynch, Salisbury.

NEW VALVES (pref BVA) of popular types, PCL805, PFL200, PL504 etc. Cash waiting. Bearman, 6 Potters Road, New Barnet, Herts. Tel: 449/1934-5.

MISCELLANEOUS

Build the Mullard C.C.T.V. Camera
Kits are now available with comprehensive construction manual
(also available separately at 80p)
Send 5" x 7" S.A.E. for details to
CROFTON ELECTRONICS
124 Colne Road, Twickenham, Middlesex TW2 6QS

LOWEST COST IC SOCKETS. Use Soldercon IC socket pins for 8 to 40 pin DIL's. In strips of 100 pins: 100 plus pins 70p, 300 plus 50p, 1000 plus 40p. Instructions supplied. 10p p & p for orders under £2. Add 8% VAT. SINTEL, 53d Aston Street, Oxford.

BRC 950/1400/1500. E.H.T. rectifier 3 sticks £3.50, 5 sticks £3.75. Philips 210/310 mains dropper £1.00. Post free c.w.o., Devi, 44 Sandells Avenue, Ashford, Middx. 58335.

LADDERS

LADDERS. "Special Offer". 13' 4" closed—23' 10" extended. Unvarnished. £16.87. Carriage £1.28. Home Sales Ladder Centre (PTT2), Haldane (North), Halesfield (1) Telford, Shropshire. Tel: 0952-586644.

ALUMINIUM Cat Ladders 12 ft-24 ft. Tel: Telford 586644. for Brochure.

color TV

25" tube **COLOUR TVs** Working, CASH 'N CARRY only, £90+VAT
Non-working sets as available from £25.
MONO UHF TVs sold complete but unserviced with good cabinets. Valve tuner type, £4.50 (+£2.50 carr). Transistor tuner type £9.50 (+£2.50 carr). Quantity discounts.
Mono sets as available from 50p to callers.
New Radiograms & Audio Units 'Slight seconds', working & non-working at greatly reduced prices. New **'Gram cabinets** from £5 (Callers only).
25" CRT X-ray shields with degaussing coils. ex-equip. £1.25+carr 50p.
DLI & DLIE Delay lines 25p+20p carr.
UHF tuners brand new. 4 button £4.50.
Add VAT to total price. S.A.E. with enquiries please.

SUMIKS
1532 Pershore Road, Stirchley, BIRMINGHAM B30 2NW
(Main A441 from City centre. Look for the 'COLORCARE' sign)

AERIAL BOOSTERS £3.30
We make three types of Aerial Boosters: B45-UHF 625, B12-VHF 405, B11-VHF RADIO

VALVE BARGAINS
Any 5—50p, 10—75p, 50—£3.30
ECC82, ECL80, EB91, EBF89, EF80, EF85, EF183, EF184, EY86, PCC84, PCC89, PCC PCC189, PC97, PCF80, PCF86, PCF805, PCF808, PCL82, PCL83, PCL84, PCL85, PFL200, PL36, PL81, PL504, PY33, PY82, PY800, PY801, 30L15, EH90, PC86, PC88.

COLOUR VALVES
P7500/A PL508 PL509 **25p each**

Press Button U.H.F. Tuners—£2.50.

Rotary U.H.F. Tuners—£2.00.

PLUGS—SOCKETS
Price per item, in brackets for ten
CO-AX PLUGS **6p (50p)** Socket surface **7p (60p)**, Connectors **4p (35p)**.
D.I.N. PLUGS
2 pin, 3 pin and 5 pin **20p (£1.65)**.
JACK PLUGS. Standard **18p (£1.50)**, 3.5 mm **10p (80p)**. 2.5 mm **10p (80p)**.
All prices include **V.A.T. p. & p. 10p** per order. Money back refund, S.A.E. for leaflets.

ELECTRONIC MAILORDER (BURY) LTD.
62 Bridge St., Ramsbottom, Bury, Lancs. Tel. Rams 3036.

Learn to *understand* electronics for your hobbies

1. Lerna-Kit course

Step by step, we take you through all the fundamentals of electronics and show you how easily the subject can be mastered.

(1) BUILD AN OSCILLOSCOPE.
(2) READ, DRAW AND UNDERSTAND CIRCUIT DIAGRAMS.
(3) CARRY OUT OVER 40 EXPERIMENTS ON BASIC ELECTRONIC CIRCUITS AND SEE HOW THEY WORK.

2. Become a Radio-Amateur

Learn how to become a radio-amateur in contact with the wide world. We give skilled preparation for the G.P.O. licence.

FREE!
Brochure, without obligation to:
BRITISH NATIONAL RADIO & ELECTRONICS SCHOOL, Dept TX104
P.O. BOX 156, JERSEY, CHANNEL ISLANDS.

NAME ____________________

ADDRESS ____________________

____________________ BLOCK CAPS PLEASE TL124

PUBLISHER'S ANNOUNCEMENT

Due to production difficulties existing at the time this issue went to press, we strongly advise readers to check with advertisers the prices shown, and availability of goods, before purchasing

REBUILT TUBES!

YOU'RE SAFE WHEN YOU BUY FROM RE-VIEW!

HERE IS WHAT YOU PAY:

MONO

15-17"	£5.00
19"	£5.50
21"	£6.50
23"	£7.50

RIMBAND & TWIN PANEL

19"	£7.00
20"	£8.00
23"	£9.00
24"	£10.00

Carriage £1.00

COLOUR

19"	£25.00
22"	£27.50
25"	£30.00
26"	£32.50

Exchange Basis (carriage-ins. £2.00)

Guarantee 1 year

Cash or cheque with order, or cash on delivery

RE-VIEW ELECTRONIC TUBES
237 LONDON ROAD,
WEST CROYDON, SURREY
Tel. 01-689 7735

PHILIP H. BEARMAN

6 POTTERS ROAD, NEW BARNET, HERTS.

We offer one of the finest range of new or rebuilt tubes in the country; tubes tested before despatch and usually ex stock and despatched daily securely packed. Deliveries arranged World Wide, prices on application.

Colour tubes, 4 year g'tee.

17"/20" 90° types	
A49/11X, A49/120X and A49/191X	£52.92+cge
A51/110X and 20" 510CKB22	£54.00+cge
22" A55/14X, A56/120X-140X	£57.24+cge
25" A63/11X, A63/120X and A63/200X	£66.00+cge
26" A66/120X & A67/120X	£83.00+cge
Note. 1 year g'tee 20" colour	£47.00+cge
22" Mullard A56/120X	£53.00+cge
26" Mullard A66/120X & 140X	£75.00+cge
25" Mullard A63/11-120X (when available)	£54.00+cge

We often have Mullard 22"/26" electrically perfect with fractional marks from £42.00 upwards, availability etc. on application, also 20" 2nds. Excellent value, g'teed.

Colour cge £2.00 (sea journeys 99p extra).

TEL. 449-1934/5

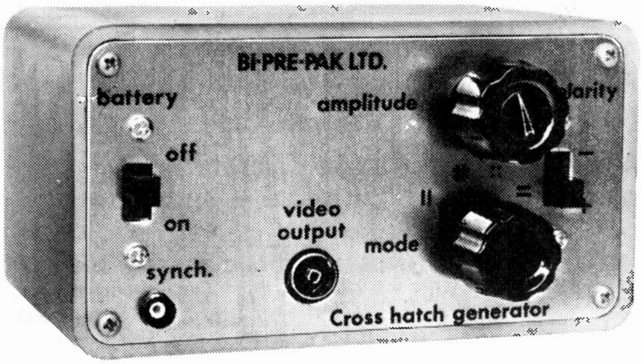
MONO Tubes, usually 2 year g'tee.

TSD217/282 (1 year)	£13.50+54p cge
Cathodeon MW31/74 ...	£3.24+54p cge
TSD290/CME1201	£10.80+54p cge
CME1202	£10.80+54p cge
CME1220/A31-120W ...	£11.34+54p cge
CME1402/AW36-80	£5.13+59p cge
MW36/24-44	£5.13+59p cge
CME1601	£10.26+59p cge
CME1602	£11.34+59p cge
CME1713 (A44/120W) ...	£14.00+59p cge
Other 17" tubes	£6.35+59p cge
A47/11 (CME1907) rebuilt ...	£10.80+64p cge
A47/11, 26W (CME1913) ...	£13.65+64p cge
A47/14W-CME1908	£10.80+64p cge
A47/14W-AW47/91 rebuilds when available	£6.05+64p cge
A47/13W (CME1906)... ...	£13.50+64p cge
A50/120 (CME2013)	£12.28+64p cge
A50/120 rebuilds when available	£10.45+64p cge
A59/15W (CME2308) ...	£10.80+70p cge
Rebuilds on application.	
A59/11W-A59/23W rebuilds	On application
A59/11W-A59/23W New	£15.22+70p cge
A59/13W (CME2306) ,,	£15.20+70p cge
A61/120 (CME2413) ,,	£16.20+70p cge
24" rebuilds	£12.65+70p cge

NOTE. All prices subject to fluctuations when due to circumstances beyond our control.

STOP PRESS. Philips A28/14W £11.50+50p cge.

THE MARK TWO GENERATOR



This is our Mark Two, vastly improved Cross Hatch Generator

* With plug in I.C.'s and a more sensitive sync. pick-up circuit.
* Virtually unbreakable–designed with the engineers tool-box in mind. Size 3" x 5¼" x 3".
* Supplied to large T.V. Rental companies for service engineers

TV SIGNAL STRENGTH METER
As described in this issue of *Television*. We can supply a complete kit of parts and if possible a reprint of the article.
£19.50 + 40p. p. & p.

Ready built unit only **£9.93**
Kit only **£7.93**
p. & p. 27p.
N.B. No batteries included

BI-PRE-PAK LTD
Co Reg No 820919
Dept. G 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX.
TELEPHONE: SOUTHEND (0702) 46344.

Please add V.A.T. at current rate

I enclose cheque/P.O./M.O. of £.................... for....................

Name ....

Address ....

WITWORTH TRANSFORMERS

MONOCHROME
TV Line out-put transformers
(Discounts to Trade)

ALL ONE PRICE
£5.72 EACH V.A.T. & CARRIAGE PAID
(£5.45 PERSONAL SHOPPERS)

BUSH

TUG versions	TV125
TV75 or C	TV125U
TV76 or C	TV128
TV77	TV134
TV78	TV135
TV79	TV135R
TV83	TV138
TV84	TV138R
TV85	TV139
TV86	TV141
	TV145
TV91	TV148
TV92	TV161
TV93	TV165
TV94	TV166
TV95 or C	•TV171
TV96 or C	TV175
TV97	TV176
TV98C	TV178
TV99 or C	181S
TV100C	183
TV101C	183D
TV102C	183S
TV103 or D	183SS
TV105 or D or R	185S
TV106	186
TV107	186D
TV108	186S
TV109	186SS
TV112C	191S
TV113	191D
TV115 or C or R	193S
TV118	193D
TV123	
TV124	

From model TV123 to TV139 there have been two types of transformer fitted. One has pitch overwind, the other has plastic moulded overwind. Please state which type required as they are not interchangeable.

BAIRD

600	628	662	674
602	630	663	675
604	632	664	676
606	640	665	677
608	642	666	681
610	644	667	682
612	646	668	683
622	648	669	685
624	652	671	687
625	653	672	688
626	661	673	

Please quote part No. normally found on tx. base plate; 4121, 4123, 4140 or 4142.

DECCA

DR20	DM34	DR71	DR505
DR21	DM35	DR95	DR606
DR23	DM36	DR100	666TV-SRG
DR24	DM39C	DR101	777TV-SRG
DR29	DR41	DR121	
DR30	DM45	DR122	MS1700
DM30	DR49C	DR123	MS2000
DR31	DM55	DR202	MS2001
DR32	DM56	DR303	MS2400
DR33	DR61	DR404	MS2401

SOBELL

T24	ST284 or ds	1010dst	1033
SC24	ST285 or ds	1012	1038
TPS173	ST286 or ds	1013	1039
TPS180	ST287 or ds	1014	1047
ST195 or ds	ST288 ds	1018	1048
ST196 or ds	ST290ds	1019	1057
ST197ds	ST291ds	1020	1058
SC270	ST297ds	1021	1063
T278	1000ds	1022	1064
ST282	1002ds	1023	1065
ST283	1005ds	1032	1066

MURPHY

V310	V430	V520	V879 or C•	V789	V2015SS
V310A	V430C	V530	V923•	V153	V2016S
V310AD	V430D	V530C	V929 or L•	V159	V2017S
V310AL	V430K	V530D	V973C•	V173	V2310
V310CA	V440	V539	V979•	V179	V2311C
V320	V440D	V540	V653X	V1910	V2414D
V330 or D	V440K	V540D	V659	V1913	V2415D
V330F or L	V470	V649D	V683	V1914	V2415S
V410	V480	TM2 Chassis	V739	V2014	V2415SS
V410C	V490	V843•	V735	V2014S	V2416D
V410K	V500	V849•	V783	V2015D	V2316S
V420	V510	V873•	V787	V2015S	V2417S
V420K	V519				

•Two types fitted. One has pitch overwind, the other has plastic moulded overwind. Please state which type required as they are not interchangeable.

PHILIPS

23TG111a	G19T210	G23T210
23TG113a	G19T211	G23T211
23TG121a	G19T212	G23T212
23TG122a	G19T213	G24T230
23TG131a	G19T214	G24T232
23TG142a	G19T215	G24T236
23TG152a	G20T230	G24T238
23TG153a	G20T232	G24T300
23TG156a	G20T236	G24T301
23TG164a	G20T238	G24T302
23TG170a	G20T300	G24T306
23TG171a	G20T301	G24T307
23TG173a	G20T302	G24T308
23TG175a	G20T306	G24T324
23TG176a	G20T307	
23FG632	G20T308	

GEC

2000	2015	2022	2043	2064
2001	2017	2023	2044	2065
2010	2018	2032	2047	2066
2012	2019	2033	2048	2082
2013	2020	2038	2063	2083
2014	2021	2039		

PYE

11u Series	
12u	
13u	State Pt. No.
14u	required
15u	AL21003 or
20u	772494

V700 or A or D	
V710 or A or D	State Pt. No.
V720	required—
V830A or D or	772444 or
LBA	771935

FERGUSON, ULTRA, MARCONI, H.M.V. (BRC, Jellypots).
ALL MODELS IN STOCK.

ALBA, COSSOR, EKCO, FERRANTI, K.B., PYE. ALL MODELS IN STOCK.

E.H.T. RECTIFIER TRAYS (MONOCHROME)

THORN B.R.C. MONOCHROME	ORDER Ref.	
980, 981, 982	RT1	£3.30
911, 950/1, 960	RT2	£3.60
950/2, 1400 -5 stick	RT3	£3.90
1400 Portable-3 stick	RT3A	£3.60
1500 20" 3 stick	RT4	£3.60
1500 24" 5 stick	RT5	£3.90
1580 Portable-2 stick	RT16	£3.50
1590, 1591	RT17	£1.30

E.H.T. RECTIFIER TRAYS (COLOUR)

MAKE	CHASSIS COLOUR	
DECCA	CTV19, CTV25	£8.00
DECCA	CS1910, CS2213	£8.00
DECCA	CS1730	£5.80
GEC	Dual & Single std. Valve Type	£6.70
ITT-KB	CVC-1, 2, 3	£7.20
PHILIPS	G8 510-550 Series	£7.20
PYE	691, 692, 693, 697	£6.70
PYE	713 CT200	£6.40
BUSH MURPHY	Single std plug-in	£8.00
BUSH MURPHY	Dual standard	£9.80
THORN BRC	2000	£8.00
THORN BRC	3000	£7.10
THORN BRC	8000	£4.10
THORN BRC	8500	£7.00
GEC	Solid State 90°	£7.80
PYE	CT262 & 266 731 Chassis	£7.40

COLOUR TV Line out-put transformers

THORN (BRC)
2000 Chassis
Scan O/P Tx.
EHT O/P Tx.

3000 Chassis
Scan O/P Tx.
EHT O/P Tx.

8000 Chassis

8500 Chassis

All £6.80 ea.

GEC
Dual Standard
Single Standard
£7.90 ea.

ITT-KB
CVC1 Chassis
CVC2 ,,
£7.10 ea.

CVC5 Chassis
£8.10 ea.

PHILIPS
G6 Chassis D/S
G6 ,, S/S
£8.70 ea.

G8 Chassis
£7.90 ea.

BUSH
CTV25 Mk. 1 & 2
£11.50 ea.

CTV25 Mk.3
CTV162
£7.90 ea.

CTV167 Mk.1 & 2
£11.50 ea.

CTV167 Mk.3
CTV174D
CTV182S
CTV184S
CTV187CS
CTV1945
CTV197C
CTV199S
£7.10 ea.

DECCA
CTV19 Valve Rec.
CTV25 ,, ,,

Primary Coil
£3.70 ea.

CTV19 D/S Tripler
CTV25 ,, ,,
CTV25 S/S Tripler
CS1730
£7.80 ea.

CS1910
CS2213
£7.10 ea.

EKCO
CT102
CT104 £12.00 ea.

CT103
CT105
CT106
CT107
CT108
CT109
CT111
CT120
CT121 &/T
CT122 £8.90 ea.

PYE
CT70
CT71 £12.00 ea.

CT72
CT73
CT78
CT79
CT152
CT153
CT154 £8.90 ea.

MURPHY

CV1912	CV2510 Mk.3
CV1916S	CV2511 Mk.3
CV2210	CV2516S
CV2212	CV2610
CV2213	CV2611
CV2214	CV2614

£7.90 ea.

CV2510 Mk. 1 & 2
CV2511 Mk. 1 & 2
£12.00 ea.

Most items listed stocked. Most newer and older models in stock. S.A.E. for quotation

For by-return service contact your nearest depot. Callers welcome.

Tidman Mail Order Ltd., Dept. NA.
236 Sandycombe Road,
Richmond, Surrey.
London: 01-948 3702
MON - FRI 9 am to 12.30 pm 1.30 pm to 4.30 pm
SAT 10 am to 12 noon

Hamond Components (Midland) Ltd., Dept. NA.
89 Meriden Street,
Birmingham 5.
Birmingham: 021-643 2148

NO HIDDEN EXTRAS - PRICES INCLUDE V.A.T. and CARRIAGE