SERVICING · VIDEO · CONSTRUCTION · COLOUR · DEVELOPMENTS

Television

SEPTEMBER 1975 40p

REMOTE CONTROL SYSTEM

PART 1

A TV PROJECT

ULTRASONIC

PLUS:

REPORT FROM MONTREUX

JUGFETS IN TV CIRCUITS

SERVICING TV RECEIVERS

GEC HYBRID COLOUR RECEIVER FAULTS

TRANSISTORS, ETC.

Type	Price (£)	Type	Price (£)
AC107	0.35	BC177	0.20
AC117	0.24	BC178	0.22
AC126	0.25	BC178B	0.22
AC127	0.25	BC179	0.20
AC128	0.25	BC179B	0.21
AC141	0.26	BC182L	0.11
AC141K	0.27	BC183	0.11
AC142	0.20	BC183K	0.12
AC142K	0.19	BC183L	0.11
AC151	0.24	BC184L	0.13
AC152	0.25	8C186	0.25
AC153K	0.28	8C187	0.27
AC154	0.20	BC208	0.12
AC176	0.25	BC212L	0.12
AC178	0.27	BC213L	0.12
AC187	0.25	BC214L	0.15
AC187K	0.26	BC238	0.12
AC188	0.25	BC261A	0.28
AC188K	0.26	BC262A	0.18
AC193K	0.30	BC263B	0.25
AC194K	0.32	BC267	0.16
ACY28	0.25	BC268C	0.14
ACY39	0.68	BC294	0.37
AD140	0.50	BC300	0.60
AD142	0.52	BC301	0.35
AD143	0.51	BC303	0.60
AD149	0.50	BC307B	0.12
AD161	0.48	BC308A	0.10
AD162	0.48	BC309	0.15
AF114	0.25	BC323	0.68
AF115	0.25	BC377	0.22
AF116	0.25	BC441	1.10
AF117	0.20	BC461	1.58
AF118	0.50	BCY33	0.36
AF121	0.32	BCY42	0.16
AF124	0.25	BCY71	0.22
AF125	0.25	BCY88	2.42
AF126	0.25	BD115	0.65
AF127	0.25	BD123	0.98
AF139	0.35	BD124	0.80
AF147	0.35	BD130Y	1.42
AF149	0.45	BD131	0.45
AF178	0.55	BD132	0.50
AF179	0.60	BD135	0.40
AF180	0.55	BD136	0.46
AF181	0.50	BD137	0.48
AF186	0.40	BD138	0.50
AF239	0.40	BD139	0.55
AF279	0.84	BD140	0.62
AL100	1.10	BD144	2.19
AL102	1.10	BD145	0.75
AL103	1.10	BD163	0.67
AL113	0.95	BD183	0.56
AU103	2.10	BD222	0.78
AU110	1.90	BD234	0.75
AU113	2.40	BD410	1.65
BC107	0.12	BD519	0.76
BC107A	0.13	BD520	0.76
BC107B	0.14	BD599	0.75
BC108	0.12	BDX18	1.45
BC108B	0.13	BDX32	2.55
BC109	0.13	BDY18	1.78
BC109C	0.14	BDY20	0.99
BC113	0.13	BF115	0.20
BC114	0.20	BF117	0.45
BC115	0.20	BF120	0.55
BC116	0.20	BF121	0.25
BC117	0.20	BF123	0.28
BC119	0.29	BF125	0.25
BC125	0.22	BF127	0.30
BC126	0.20	BF158	0.25
BC132	0.15	BF159	0.27
BC134	0.20	BF160	0.22
BC135	0.19	BF161	0.45
BC136	0.20	BF162	0.45
BC137	0.20	BF163	0.45
BC138	0.20	BF167	0.25
BC142	0.30	BF173	0.25
BC143	0.35	BF177	0.30
BC147	0.13	BF178	0.33
BC148	0.12	BF179	0.33
BC149	0.14	BF180	0.35
BC152	0.25	BF181	0.33
BC153	0.20	BF182	0.44
BC154	0.20	BF183	0.44
BC157	0.15	BF184	0.26
BC158	0.13	BF185	0.26
BC159	0.15	BF194	0.15
BC161	0.48	BF195	0.15
BC167B	0.15	BF196	0.15
BC168B	0.13	BF197	0.17
BC169C	0.13	BF198	0.20
BC170	0.15	BF199	0.25
BC171	0.15	BF200	0.35
BC172	0.14	BF218	0.35
BC173	0.20	BF222	1.08
BC174B	0.26	BF224J	0.15
BC176	0.22	BF240	0.20

Tel: Stoke Climsland (05797) 439

Type	Price (£)
BF241	0.22
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	0.60
BF459	0.63
BF596	0.70
BF597	0.15
BFR39	0.24
BFR41	0.30
BFR61	0.30
BFR79	0.24
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	1.90
BPX29	1.70
BPX52	1.90
BRC4443	0.68
BRY39	0.47
BRY56	0.40
BR101	0.47
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
BSY95A	0.27
BT106	1.24
BT116	1.20
BU105/02	1.95
BU108	3.25
BU126	2.99
BU204	1.98
BU205	1.98
BU207	3.00
BU208	3.15
BU209	2.55
BUY77	2.50
BUY78	2.55
BUY79	2.85
D40NI	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
MJE3000	1.85
MJE3055	0.74
MPF102	0.40
MPS6566	0.21
MPSA05	0.47
MPSA55	0.50
MPSU05	0.66
MPSU06	0.76

Type	Price (£)
MPSU56	1.26
MPSU55	1.26
OC26	0.38
OC28	0.65
OC35	0.59
OC36	0.64
OC42	0.55
OC44	0.25
OC45	0.32
OC70	0.32
OC71	0.32
OC72	0.32
OC73	0.51
OC75	0.25
OC76	0.35
OC81	0.53
OC81D	0.57
OC139	0.76
OC140	0.80
OC170	0.25
OC171	0.30
OC200	1.30
OCP71	0.92
ON236A	0.65
ORP12	0.55
R2008B	2.05
R2010B	2.95
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
TIS90	0.23
TIS91	0.23
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
2N1164	3.60
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	0.51
2N2217	0.36
2N2218	0.60
2N2219	0.50
2N2221A	0.41
2N2222A	0.50
2N2270	0.41
2N2369A	0.42
2N2401	0.60
2N2484	0.41
2N2570	0.18
2N2646	0.53
2N2712	0.12
2N2894	0.77
2N2904	0.22
2N2904A	0.26
2N2905	0.26
2N2905A	0.28
2N2926G	0.13
2N2926Y	0.12
2N2926O	0.12
2N2955	1.12
2N3012	0.91
2N3019	0.75
2N3053	0.21
2N3054	0.55
2N3055	0.60

Telex: 45457 (A/B Mercury Calgton)

Type	Price (£)
2N3133	0.54
2N3134	0.60
2N3232	1.32
2N3235	1.10
2N3250	1.02
2N3254	0.28
2N3323	0.48
2N3391A	0.23
2N3501	6.99
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
2N3766	0.99
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	0.43
2N4033	0.54
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
2N4392	2.84
2N4871	0.24
2N4902	1.30
2N5042	1.05
2N5060	0.32
2N5061	0.35
2N5064	0.45
2N5087	0.32
2N5294	0.35
2N5296	0.57
2N5298	0.58
2N5322	0.85
2N5449	1.90
2N5457	0.30
2N5458	0.35
2N5494	0.85
2N5496	1.05
2N6027	0.65
2N6178	0.71
2N6180	0.92
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
AC187K/AC188K	0.61
AC193K/AC194K	0.71
AD161/AD162	0.95
BC142/BC143	0.70
TIS90M/TIS91M	0.50

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
AAZ17	0.12
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
BAY72	0.11
BB104	0.52
BB105B	0.52
BB105G	0.45
BB110B	0.45
BR100	0.50
BY100	0.22
BY103	0.22
BY126	0.16
BY127	0.17
BY133	0.23
BY140	1.40
BY164	0.55
BY176	1.68
BY179	0.70
BY206	0.31
BYX10	0.15
BYZ12	0.30
FSY11A	0.45
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	1.85
IN914	0.07
IN914E	0.06
IN916	0.10
IN1184	0.92
IN1185	1.10
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

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 (£)
CA3045	1.35
CA3046	0.70
CA3065	1.90
MC1307P	1.19
MC1310P	2.94
MC1327PQ	1.01
MC1330P	0.76
MC1351P	0.75
MC1352P	0.82
MC1358PQ	1.85
MC1496L	0.87
MC3051P	0.58
MFC4000B	0.43
MFC4060A	0.70
MFC6040	0.91
NE555	0.72
NE556	1.34
PA263	1.90
SL414A	1.91
SL901B	3.84
SL917B	5.12
SN76001N	1.45
SN76003N	2.92
SN76013N	1.95
SN76013ND	1.72
SN76023N	1.95
SN76023ND	1.72
SN76033N	2.92
SN76227N	1.46
SN76530P	1.05
SN76533N	1.20
SN76666N	0.90
TAA300	1.76
TAA320	0.94
TAA350A	2.02
TAA435	0.85
TAA450	2.70
TAA550	0.55
TAA570	2.02
TAA611A	1.70
TAA611B	1.85
TAA630Q	4.18
TAA630S	4.18
TAA661B	1.32
TAA700	4.18
TAA840	2.02
TAA861A	0.49
TAD100	2.66
TBA120S	0.99
TBA240A	2.97
TBA281	2.28
TBA480Q	1.90
TBA500	1.99
TBA500Q	2.00
TBA510	1.99
TBA520Q	3.34
TBA530	2.71
TBA530Q	2.71
TBA540	3.21
TBA540Q	3.21
TBA550Q	4.10
TBA560C	4.09
TBA560CQ	4.10
TBA570	1.17
TBA641	0.76
TBA673	2.28
TBA700	2.59
TBA720Q	2.45
TBA750Q	2.33
TBA800	1.75
TBA810AS	1.75
TBA920Q	4.23
TBA990	4.10
TBA990Q	4.10
TCA270Q	4.18
ZN414	1.25

Please enquire for linear op. amps, 709, 710, etc.

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
7425	0.37
7430	0.20
7440	0.20
7441	0.85
7445	1.95
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
7489	4.32
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

MOUNTING KITS

Type	Price (£)
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**
1.3W 3.3-100V **18p each**

VDR'S, PTC & NTC RESISTORS

Type	Price (£)	Type	Price (£)
E295ZZ/01	14	E299DD/P116-P354	all 8
E295ZZ/02	14	VA1015	50
E298CD/A258	7	VA1026	41
E298ED/A258	6	VA1033	8
/A260	6	VA1034	8
/A262	6	VA1040	8
/A265	6	VA1053	8
/P268	6	VA1055S	10
E298ZZ/05	7	VA1077	12
/06	6	VA1104	35
		VA8650	110

RESISTORS

Carbon Film (5%) ea
¼W 5.6 Ω-330k Ω (E12) **1.5p**
½W 10 Ω-10M Ω (E24) **1.5p**
1W 10 Ω-19M Ω (E12) **3p**
2W 10 Ω-10M Ω (E6) **5p**

WIREWOUND (5%)
2½W 0.22 Ω-270 Ω **15p ea**
5W 10 Ω-8.2k Ω **13p ea**
10W 10 Ω-25k Ω **18p 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 uhf group amplifier complete with mains power unit CM6001/PU. Groups A, B, or C/D please specify **£12.65**

Labgear CM6030 WB vhf/uhf ultra wideband amplifier (channels 1-68). Complete with mains power unit CM6001/PU **£18.95**

Labgear CM6019 WB uhf wideband amplifier (channels 21-68). Complete with mains power unit CM6020/PU **£9.85**

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) **£58.80**

Labgear CM6038 DB Pocket size vhf/uhf generator. Outputs as CM6004 PG above but can be used either on mains or battery **£46.60**

COLOUR/BAR GENERATORS

Labgear CM6037/DB: Dual standard band 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 **£125.15**

VHF/UHF CONVERTERS

Labgear "Televertas" for DX-ing or single-standard receiver use on relay systems. Type 6022/RA **£15.90**

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

P. & P.: UK £0.12 per order.
Overseas: At cost.
Please add VAT at 25% on all items except test generators which are at 8%.
All prices subject to availability.
Giro A/c 23 532 4000.

EAST CORNWALL COMPONENTS
CALLINGTON - CORNWALL

Television

SERVICING
VIDEO
CONSTRUCTION
COLOUR
DEVELOPMENTS

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

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

this month

OUR NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED ON SEPTEMBER 15

TV'S AND SPARES TO THE TRADE
MONOCHROME TELEVISIONS

BBC 2 Dual Standard TV's (19", 23") in batches of 10 – £2.00 each. (makes include Bush, Thorn, Philips, Pye/Ekco, Baird). Many with transistorised tuners.
GEC 2000, Thorn 950 series, Bush 141, Philips Style 70, Baird 600 and 700 series all at £6.00 each.
Thorn 1400, Bush 160/170 series, Philips 210, Pye-Ekco Olympic etc., Baird 673, Push Button – all at £12.50 each.
20" and 24" square screen Dual Standard sets – Thorn, G.E.C. etc., 20" – £15.00, 24" – £16.50.
20" and 24" Single Standard Thorn 1500, G.E.C., Bush Acoustic, 20" – £17.50, 24" – £19.50.

1. Discounts for quantities.
2. All monochrome spares supplied free of charge.
3. All tubes guaranteed.
4. All cabinets very good.
5. All sets "walk and talk".
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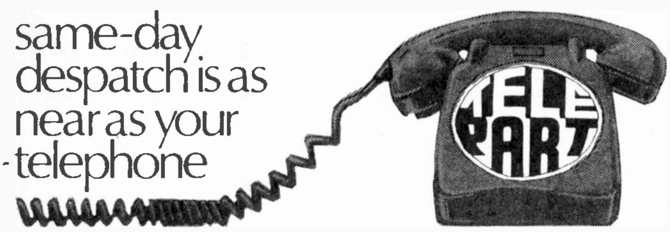

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Television

TO SERVICE OR NOT TO SERVE

The servicing policies of radio and TV retailers are many and varied. They range from flat refusal to have anything at all to do with any equipment they have not sold recently under guarantee, to the small dealer who may do more servicing than retailing. Many dealers feel that it is up to them and them alone to decide upon what their policy is to be, and up to a point this is right and proper. There does nevertheless seem to us to be a certain minimum of courtesy and helpfulness that should be observed in dealings with the public.

What we have in mind is the sort of organisation that will literally show you the door if you present yourself with an interest in anything other than the latest luxury colour TV or quadraphonic audio system. Perhaps you may have gone in for a fuse or maybe even a valve, or to ask about the possibility of getting a faulty set looked at. It'll all be the same; out you go and don't dare come in again with ideas of spending less than £250.

We still vividly recall reading the numerous speeches made a few years ago by a past president of the RTRA whose shop happened to be in our local high street. During his term of office this gentleman was forever on about the excellent service provided by the trade in spite of the many difficulties under which traders operated, and about the importance of goodwill and the way in which traders and the public alike benefitted from reputations deservedly established. Inspired by all this, we went into the shop one day when we happened to be short of an EF80 . . . and received the out you go old boy treatment. In our innocence, we'd thought that a radio and TV dealer would have had valves like you expect to be able to buy a light bulb at a mainly electrical shop.

Now this wasn't one of those shops that have nothing in sight but expensive wall-to-wall carpeting, concealed lighting, subtle wallpaper and maybe two or three luxury 26in TVs of Scandinavian origin displayed with great artistry. One might expect an organisation of that type, probably presided over by a dolly bird, to be blissfully unaware of such things as fuses, soldering irons and bits of wire! No, this was a perfectly ordinary, rather ramshackle shop with the service department right next door, with valve cartons well to the fore amidst the sets receiving attention. Maybe at some time in the past the service manager might have been annoyed at salesmen depleting his stocks without letting him know so that he could re-order, leaving him in a tricky situation over a set he'd promised to return the same day and resulting in a clamp down on valve sales. Somehow however we don't think that this was the case. What we do know is that we've never been through that door since and it would be the last place we'd venture for anything however desperate we were.

In an ideal world all dealers would be enthusiasts interested in the technicalities of the subject as well as the business side, and anxious to please everyone who came to them for whatever reason. Fantastically, some are. But you can't expect the ideal in the hard world of everyday business.

There are some very sound reasons for laying down limits as to how far a firm should go in providing service. It is unfair when you find the point of sale profits being taken by the local discounter while you have to rely increasingly on repairs and the loyalty of a dwindling number of customers you've dealt with over many years. Also, let's face it, there are customers who will take advantage of your goodwill, expecting you to go to a lot of trouble time and again and then being decidedly awkward when it comes to paying anything even remotely approaching an economic charge. There are also the less sound reasons for being selective about the service you provide: like those businesses that have no idea of the cost of servicing but do know they will go broke if they do more than a reluctant minimum, and others who simply won't pay what it costs to employ a capable engineer and provide him with the necessary stock and equipment.

One policy we've never understood is the "won't touch anything we've not sold ourselves" one. Don't such dealers realise that many people have to move around the country for one reason or another, that some get given equipment or inherit it, and so on?

The least that should be expected is courtesy. If you don't want to handle it, say so politely, give a sensible reason and if possible suggest where the customer may be able to get his problem dealt with. A customer will generally understand when told that the economics of dealing with a set that is past it are unlikely to be worthwhile for you or him, that you only have the agency for certain brands, or whatever the situation is. As a minimum the customer should receive a considerate hearing and reasonable advice.

One thing is certain. With the present decline in new sales as a result of money being in short supply and prices still rising, there will be an increased call for servicing – and an increased opportunity to build up a reputation for helpfulness that will pay off when the market turns up again.

teletopics

New Thorn Chassis Presage End of Thermionic Valve Era

THE introduction of a new solid-state, large-screen monochrome TV chassis by Thorn – the 1600 chassis – brings home the fact that we are fast approaching the end of the era in which valves have been used in current production TV sets. Amongst the UK colour set makers, only ITT and Decca still produce hybrid chassis, with valves in the high-power sections. On the monochrome side, valves have now all but disappeared. So the days will not long be with us when a look in the back of a faulty set gave a quick idea of what was wrong: soon it'll be the meter first in every case. A pity maybe, but part of the price of progress. One unfortunate aspect will be the increasing cost of keeping old sets going: the price of valves is already high, goodness knows what it will reach when they have become a rarity.

The new 1600 chassis is certainly representative of the current "state of the art". A three-stage transistor i.f. strip is followed by a TCA270SQ for detection and a.g.c., with a video channel d.c.-coupled through to the c.r.t. cathode. I.C.s are used for the intercarrier and audio stages, and there's a varicap tuner of course. The BU205 line output transistor is operated in an antiboost arrangement, i.e. the 30V l.t. line is derived from its emitter circuit, where the power supply regulator is also to be found. A discrete component field oscillator drives an SN76033N-07 i.c. which acts as the field output stage.

There is also an export version of the chassis (coded 1700) fitted with either a Fagor or Mullard multiband tuner. Which reminds us that those followers of Roger Bunney who may be after a Mullard ELC2000S multiband tuner (see *Long-Distance Television*, April 1974) can now obtain these from Forgestone Colour Developments Ltd. (Ketteringham, Wymondham, Norfolk) who keep them in stock for the export versions of their colour receiver kit. The price of this tuner is about £14.

Thorn have also introduced a new chassis (1613) for their latest mains-battery monochrome portables. This differs from the previous 1612 chassis in having a new power supply regulator circuit.

Colour Projection TV System Announced

A colour projection TV system which was first introduced in the USA some two years ago is to be made available in the UK, with a price tag of around £3,500. This is the Advent videobeam system which provides a 69in picture. The equipment will operate with off-air signals or with inputs from a videotape recorder or camera. The projector unit employs three special 3in screen projection tubes each of which has its own built in Schmidt optical system. This gives an accurate colour display with minimum need for setting up. The screen, which was developed by Kodak and is made by Advent under license, has a highly reflective aluminium surface to overcome the lack of brightness that was commonly experienced with older projection systems. It is important to mount the screen at the exactly correct distance, eight feet, from the projector: serious lack of focus occurs if the screen is more than an inch or so out of position. The sound is also projected at the screen for reflection. All solid-state electronic circuitry mounted on plug-in boards is used.

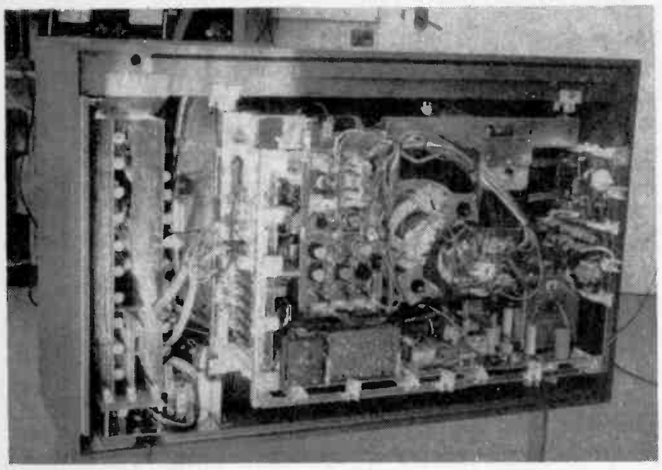
IBC 76

The sixth International Broadcasting Convention – IBC 76 – will be held in London at the Grosvenor House Hotel, Park Lane, on September 20th-24th, 1976.

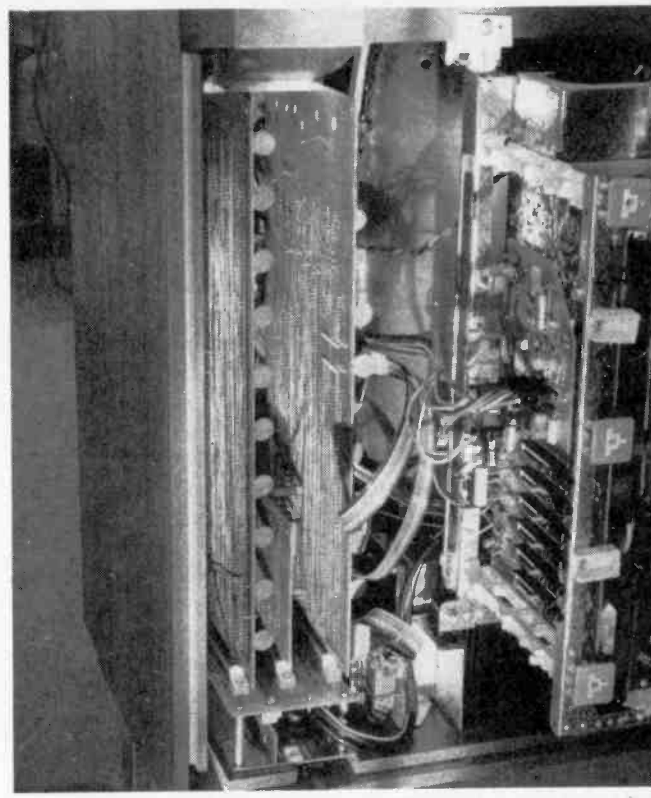
New Decoder IC

The availability of an interesting new integrated circuit, type CA3128Q, for use in colour receiver decoders has been announced by RCA Solid-State, Sunbury-on-Thames, Middlesex. The i.c. incorporates the complete chrominance channel, with colour-killer, automatic chrominance control and an automatic chrominance overload reduction circuit, and the voltage-controlled reference oscillator together with its control loop and the burst detector. Along with this i.c. therefore all that is required for a complete decoder is a PAL switch, the chrominance synchronous detectors, and matrixing circuits, all of which are available in i.c.s such as the MC1327 or TCA800. This gives a two i.c. PAL decoder with the minimum of external components and adjustments. In fact the number of external components required by the CA3128Q is negligible: the reference oscillator crystal of course, plus a handful of filtering components.

To reduce the number of decoder adjustments – there is only one in the CA3128Q's peripheral circuit, a trimmer to set up the reference oscillator – use is made of sample-and-hold techniques in the burst detector and the a.c.c./colour-killer detector circuits. These compare the detected signals with the quiescent circuit conditions, avoiding the need for



Above: Rear view of the latest GEC colour receiver incorporating a Ceefax/Oracle decoder. Standard GEC colour receivers are modified to include the decoder at the GEC Hirst Research Centre, Wembley. A small-scale production line is in operation at Wembley, producing sets for industry and broadcasting authorities both in the UK and overseas. The sets are development receivers for research purposes and are not available to the public.



Right: Close-up view of the three-panel decoder, which fits within the space available in the standard cabinet.

any external burst, a.c.c. or colour-killer adjustments. The chrominance channel operates without any external adjustments apart from the usual user colour control, which is of the d.c. type.

The sample-and-hold technique used is strikingly simple. The detector output filter capacitor – which does the holding – is linked to the detector via a gated emitter-follower transistor – which does the sampling when switched on once each line period. When the transistor is cut off between sampling periods it represents a very high resistance path so that the hold capacitor retains its charge. Two separate sample-and-hold circuits follow each detector: one samples the signal and the other the quiescent conditions, the comparison between these giving the control action.

The device is housed in a 16 lead QUIL pack.

TV-Telephone Compatibility?

The BBC/IBA/BREMA working group on the future of Ceefax/Oracle Teletext systems is hoping that the final system evolved will be compatible with other proposed systems for displaying data on domestic TV sets, in particular the Viewdata system on which the Post Office is working.

New Association and a Video Group

Earlier this year the first national low-definition television convention was held at Nottingham College of Education. The meeting consisted of an exhibition of low-definition TV equipment both ancient and modern and a discussion as a result of which a formal Association was inaugurated. The president is F. C. Ward (G2CVV), Secretary of the Derby and District Amateur Radio Society, and the chairman D. B. Pitt (1, Burnwood Drive, Wollaton, Nottingham). Mr. Pitt points out that modern audio tape recorders have a bandwidth adequate for recording low-definition TV signals, while stereo machines offer the advantage of synchronised sound and vision; also that many other developments in electronics have contributed towards making LDTV a practical proposition.

A Video Group has been formed by the Barking Radio and Electronics Society (G3XBF/G8GPK). The group meets every Wednesday evening from 7-10 p.m. and would welcome new members interested in either constructing TV equipment or staging productions. Further details can be obtained from the honorary secretary J. R. Wiles at the Society's headquarters: Westbury Recreation Centre, Westbury School, Ripple Road, Barking, Essex IG11 7PT (telephone 01-594 4009).

Aerials Standard

Following almost two years' work by the British Aerial Standards Council's technical subcommittee, a technical standard for u.h.f. and v.h.f. television aerials has been submitted for adoption to the British Standards Institute. The subcommittee has been operating in liaison with the BBC, the IBA and the Home Office radio branch. The proposed standard deals with characteristics such as nominal impedance at the terminals, directivity, cross-polarisation rejection, voltage standing wave ratio, forward gain, and bandwidth and beamwidth measurements. The BASC is publicising the details of its standard amongst aerial installers, rental organisations and dealers, and hopes that it will in due course become a British and International standard for aerial manufacturers.

New Stations

The following relay transmitters are now in operation:

Balgownie (Aberdeen) BBC-1 channel 40, BBC-2 channel 46. Receiving aerial group B.

Cirencester (Gloucestershire) ITV channel 23 (HTV West programmes), BBC-2 channel 26, BBC-1 channel 33. Receiving aerial group A.

Treharris BBC-2 channel 48, BBC-Wales channel 56. Receiving aerial group C/D.

Westwood (Wiltshire) BBC-1 channel 40, ITV channel 43 (HTV West programmes), BBC-2 channel 46. Receiving aerial group B.

All these relay transmissions are vertically polarised.

Flywheel Sync Time-Constant

Our apologies for getting the bit about flywheel sync time-constants wrong in the article about Rank's new 18in colour chassis (see circuit description on page 429 of the July issue). This was an editorial slip in preparing the copy. Let's put the record straight on this subject once and for all.

The basic idea of flywheel sync, as opposed to direct synchronisation of the line oscillator by the line sync pulses, is to introduce a delay in the synchronisation of a free-running oscillator so that the effect of interference spikes or the temporary loss of sync pulses is minimised. A flywheel line sync circuit consists (see Fig. 1) of a discriminator which compares the timing of the line flyback pulses with that of the line sync pulses, and produces an error signal whose amplitude and polarity depend on the direction – i.e. whether too fast or too slow – and extent of the time difference. The error signal is smoothed by an *RC* filter – a series resistor and a capacitor to chassis – which provides the line oscillator control voltage and gives the flywheel effect. The filter introduces a time-constant, i.e. the time taken for the capacitor to charge or discharge via the associated resistor as a result of changes in the error signal.

The time-constant of the filter depends upon the stability of the line oscillator. Because the operating frequency of a multivibrator or blocking oscillator is set by *RC* timing networks, these forms of oscillator are not very stable. In consequence the flywheel sync circuit must have a wide pull-in range, i.e. it must be capable of quickly pulling back into lock an oscillator that may be say several hundred cycles off frequency. This requires a filter with a short time-constant, so that the control voltage can change quickly. But the noise immunity, i.e. the effectiveness of the system in avoiding disturbance due to interference, what the flywheel sync system was originally intended to avoid, is then poor – with fast action (a short time-constant) noise at the sync input is much more likely to affect the synchronisation. In nearly all modern sets this problem does not arise since a sinewave line oscillator, whose frequency is set by an *LC* tuned circuit, is used. This has much greater stability, so that only a narrow pull-in range is required of the flywheel sync system, i.e. we can use a long time-constant filter to provide the small amount of correction necessary to compensate for a drift of only a few tens of cycles. The correction is averaged over several hundred lines and the noise immunity is exceptionally good.

The problem presents itself in a new form today since many sets are being produced capable of operating with a videocassette recorder as well as with off-air signals. Now the stability of the sync pulses obtained from a VCR is inevitably much less than that of a broadcast signal – simply because of variations in the mechanical operation of the deck. So to keep the line oscillator locked with either type of signal we need to be able to switch the time-constant of the flywheel sync circuit between short for VCR operation and long for off-air operation. Noise immunity is not important with VCR operation since the signal should be free from interference.

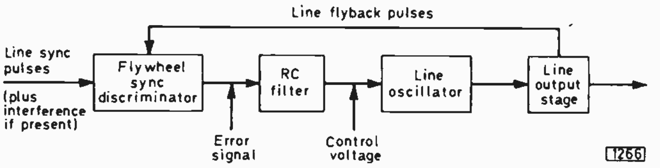


Fig. 1: Block diagram showing the basic elements of a flywheel line sync circuit.

New Colour Sets

A new range of colour sets has been introduced by **GEC**. The range consists of three models, the 20in C2001H, 22in C2201H and 26in C2601H, and features an eight-position microtouch channel selector mechanism. Indicator lights show the channel selected, position eight being for VCR operation. The chassis is basically the same as the solid-state one used in the previous C2110 series, the main change being the use of a different tuner control system.

A 20in model with 110° tube has been added to the **Mitsubishi** range. Model CT203 has a recommended price of £270 plus VAT.

Trade Scene

Strange things have been happening in the high street. Following the staggering increase in colour set deliveries (177,000) during April, reflecting the pre-25% VAT buying spree, deliveries in May slumped to 86,000, 53% down on the same month last year. Up to the end of May total colour set deliveries reached 740,000, 24% down on 1974. Imports were down from 24% to 14% of deliveries. Monochrome set deliveries this year have risen however. They were 28% up in April at 86,000, and even in the slump month of May were 9% ahead of a year ago, at 70,000. Overall this year monochrome receiver deliveries are 2% up at 367,000. This is approaching half the number of colour sets delivered, quite a change in the scene. It would appear to us that in the present economic climate many customers are replacing their monochrome sets or buying portables as an interim measure rather than splashing out on a new colour set.

On the colour c.r.t. front the Ministry of Trade is considering anti-dumping measures following the failure of talks with the Japanese Ministry of Trade and Industry to reach agreement on a voluntary reduction of exports to the UK. Anti-dumping would involve the imposition of a surcharge to bring the price up to what it would normally be in the country of origin. Mullard's managing director Jack Ackerman claims that Japanese tube makers are undercutting UK manufacturer's prices by upwards of 15%. But despite their low prices, first quarter colour c.r.t. imports from Japan fell to £3 million compared to £7 million in the first quarter of 1974.

According to the Electronic Industries Association of Japan, the Japanese colour set manufacturing industry has begun to pull out of the recession. Deliveries in May were 14·3% higher, at 631,000, than in May 1974: domestic deliveries were up 20%. The following figures spell out just what has happened in Japan: total colour set manufacture in 1973 6·5 million, in 1974 5·1 million, with an expected 5·3-5·5 million for 1975. The present Japanese domestic market splits up as follows: 30% replacement sets, 30% new first time sales, 40% second sets.

BATC Slow-Scan TV Convention

The British Amateur Television Club is organising a slow-scan TV convention at Aston University, Birmingham, on Saturday October 11th from 10·00-18·00. Tickets at 50p are available to anyone interested in SSTV from Mike Crampton G8DLX, 16 Percival Road, Rugby CV22 5JS. There will be lectures and a display of equipment.

JUGFETS in COLOUR TV Receivers

S. GEORGE

THE junction gate field effect transistor (JUGFET) is being increasingly used in colour television receivers in a variety of applications where its characteristics are particularly suitable. Since we have published little on this device in the past we will start off by describing its mode of operation and summarising its characteristics.

Basic Operation

Fig. 1 shows at (a) the basic arrangement used in an n-channel junction gate field effect transistor, and at (b) the circuit symbol. In manufacture, if we start with p-type silicon, the first step is to diffuse in an n-type region, then to diffuse into this a p-type region, giving the structure shown. We thus get an n-type region sandwiched between p-type regions. Connections, termed the source and drain, are made to each end of the n region, the narrow centre section being termed the channel. Obviously if we connect a supply to the source and drain, current will flow around the circuit. The drain is connected to the positive side of the supply and the source to the negative side, so that current flows from the source to the drain. Suppose now that we apply bias to the gate so that it is negative with respect to the source. The result, as shown, will be a depletion region, i.e. an area depleted of current carriers, around the pn junction. The extent to which the region – or field – extends into the channel depends on the bias applied. If this is sufficient the depletion region will extend right across the channel, thus making impossible the flow of current from source to drain. If it is negligible there will be hardly any effect upon the flow of current through the channel. Note that the depletion region is wedge shaped: this is because the drain is positive with respect to the gate and source.

Clearly then the conduction of the device depends on the gate-source bias applied. By connecting a load resistor in the drain circuit, and applying a voltage signal between the gate and source, amplification is achieved.

The JUGFET has to be distinguished from the more sophisticated IGFET – insulated gate field effect transistor – in which as the name implies the gate is insulated from the channel. These latter devices are more generally known today as MOSFETS, i.e. metal-oxide-silicon field effect transistors, the gate being of metal which is insulated by an oxide layer from the underlying silicon semiconductor source-channel-drain structure. The vast majority of JUGFETS are of the n-channel type since they are easier to fabricate, though p-channel types have also been produced. All the JUGFETS we have encountered in TV circuits are of the n-channel variety.

Characteristics

As regards characteristics, the JUGFET differs from the ordinary (bipolar) pnp or npn transistor in the following ways: since the input is applied to a reverse biased pn junction the input impedance is very high; current flows through the device without any current being injected at the input; the device is voltage and not current operated, the extent of the depletion region in the channel being directly proportional to the voltage between the gate and the source.

The negative gate-source bias can be applied in two ways: either by applying a voltage which is negative with respect to the source to the gate connection, or by connecting in series with the source a resistor across which a voltage making the source positive with respect to the gate is developed (this is the same principle as cathode bias of course). With source bias, the resistor used for biasing often consists of a potentiometer in series with a fixed resistor across the supply, the slider being connected to the source to provide a smoothly controllable bias.

Another feature of the JUGFET is its high voltage amplification factor, the dynamic characteristics being similar to the those of a pentode valve. As with valves and bipolar transistors, the JUGFET can be operated in three basic ways: as a common-source amplifier (input to the gate, output from the drain), as a common-gate amplifier (input to the source, output from the drain), or as a source-follower (input to the gate, output from the source).

Circuits

So much then for basics: now on to some circuit applications.

Probably the first place where a JUGFET appeared in a UK produced TV set was in the Thorn 8000 colour chassis, where one is used in the decoder as a d.c. amplifier between the burst detector and the reference oscillator reactance control device (varicap diode) to magnify the error voltage. The circuit is shown in Fig. 2. The gate of the BC256LC JUGFET VT110 is returned to chassis from the d.c. point of view via the burst detector diodes and the resistors in the burst detector circuit, while the source is returned via the 330Ω resistor R161 to the slider of the set oscillator frequency control potentiometer R163. In practice the potentiometer is set to produce about 2V at the source of VT110. Ideally, i.e. when the reference oscillator is locked to the bursts, there would be zero output from the discriminator circuit and the working bias on the device would be −2V. If the reference oscillator output leads the mean burst frequency (remember that the bursts are

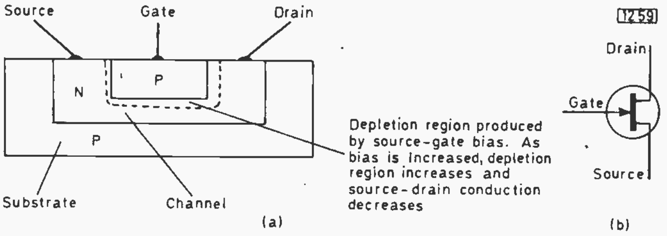


Fig. 1: (a) Basic construction of the junction gate field effect transistor, n-channel version. Conduction from source to drain via the channel varies as the bias applied between the source and gate connections alters. (b) Circuit symbol for an n-channel junction gate field effect transistor.

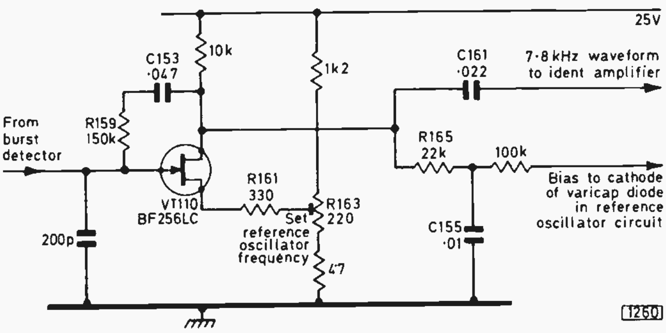


Fig. 2: JUGFET used as a d.c. amplifier in the decoder reference oscillator control loop in the Thorn 8000/8500 series chassis. Source bias is used in this circuit, with the signal applied to the gate.

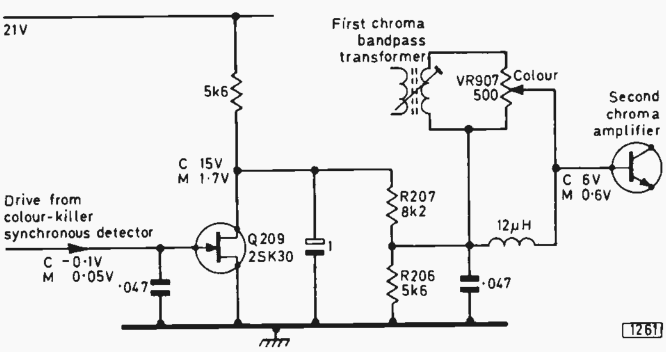


Fig. 3: This JUGFET d.c. amplifier circuit is used in the Sanyo Models CTP430/CTP431 to amplify the colour-killer turn-on potential. Both the signal and the bias are applied to the gate – the bias is obtained from a potentiometer in the colour-killer detector circuit.

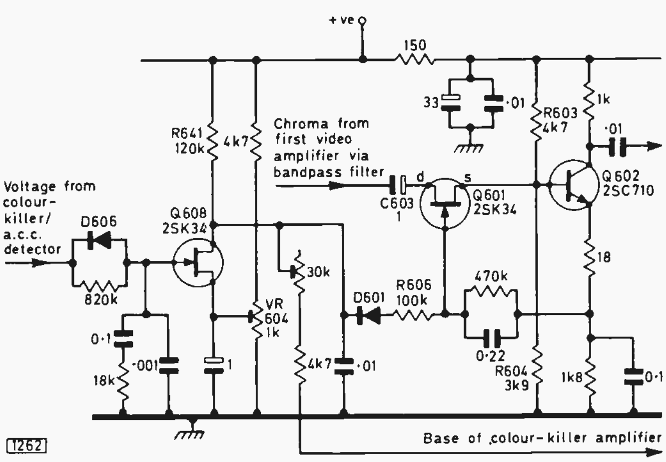


Fig. 4: Two JUGFETs are used in the a.c.c./colour-killer circuitry in Mitsubishi colour receivers. The first (Q608) is a d.c. amplifier, the second (Q601) acts as a variable impedance providing the a.c.c. action. Component reference numbers apply to Model CT200B.

deviating ±45° line by line because of the line by line R –Y signal phase alternations in the PAL system) however the burst detector will produce a mean positive potential at VT110 gate. This will reduce the effective gate-source bias, increase the current through the device, lower the drain voltage and thus decrease the reverse bias applied to the cathode of the varicap diode in the reference oscillator's base circuit. As a result the varicap diode's capacitance will increase, marginally lowering the frequency of the reference oscillator until it is synchronised in phase with the bursts. The opposite action occurs if the oscillator lags the mean burst frequency. R165/C155 filter the signal applied to the varicap diode while the 2V peak-to-peak ripple signal at the drain of the JUGFET is fed via C161 to the ident amplifier. A similar circuit is used for the same purpose in Finlux and Mitsubishi colour sets.

The JUGFET colour-killer circuit used to apply a turn-on bias to the base of the second chrominance amplifier in Sanyo colour sets is shown in Fig. 3. In this case the source is connected directly to chassis, while the gate is linked to the output of a synchronous colour-killer detector circuit which is driven by the final burst amplifier. On monochrome the killer threshold control (in the detector circuit) is adjusted so that about 0·05V is applied to the colour-killer amplifier Q209. The drain current is then heavy, the drain voltage being only 1·7V and the voltage at the junction of the potential divider R207/R206 0·6V. This is insufficient to turn on the second chrominance amplifier transistor. On colour however the detector produces an output in the region of –0·1V. This greatly reduces the JUGFET's drain current, its drain voltage rising to 15V while the voltage at the junction R207/R206 is then 6V, sufficient to turn on the second chrominance amplifier transistor.

An unusual JUGFET circuit is used in Mitsubishi colour receivers to apply automatic chrominance control. Fig. 4 shows the circuit as used in Model CT200B. Q608 is a straightforward d.c. amplifier whose gate is fed with the output from the synchronous a.c.c./colour-killer detector which is driven by the R –Y burst gate/amplifier (there are separate B –Y and R –Y burst detectors – this is a "non-PAL" set). This signal is directly proportional to the amplitude of the bursts therefore, and an amplified version is developed across R641. Drain voltage variations are applied to the colour-killer amplifier and via D601 and R606 to the gate of Q601. This JUGFET is connected in series with the chrominance signal feed to Q602 and thus acts as a variable impedance, providing a.c.c. by means of the attenuation it introduces in the chrominance signal path. Since there is no d.c. connection to the drain of Q601 the forward bias applied to Q602 is held constant, determined by the values of the potential divider resistors R603/R604.

Servicing

JUGFETs have proved to be very reliable devices. If the working voltages are close to the correct values a JUGFET can be taken to be operating normally – for as with valves and bipolar transistors, any change in the electrical characteristics will result in voltage changes. Where the source voltage and thus the bias can be controlled by a potentiometer, adjusting this will produce a marked change in the drain voltage – if the JUGFET is used as a d.c. amplifier in the reference oscillator control loop this action will cause loss of colour sync. Where, as in the Sanyo circuit (Fig. 3), the source is connected direct to chassis and the bias is applied to the gate, connecting a resistor between the gate and chassis will, by reducing the effective bias, normally produce a marked change in the drain voltage. Thus testing in circuit does not present problems.

It is also a simple matter to test the pn junction of a JUGFET out of circuit. To test the reverse resistance of an n-channel device connect the ohmmeter lead connected to the negative side of the battery (usually the red lead) to the gate and the other lead to the source or drain. Even on the highest resistance range a reading approaching infinity should be obtained. Reversing the meter leads will then test the forward resistance of the junction. This varies widely from type to type, but a comparatively low resistance reading should be obtained. If you happen to come across a p-channel device, these polarities must be reversed. ■

MONTREUX REPORT

Philip Ross

IF topic number one amongst the 100-plus UK delegates to the 9th International Television Symposium and Exhibition at Montreux was the disastrous rate of exchange, topic number two was undoubtedly that the event once again justified its premier position as the market place for European television. Although the number of registered delegates was slightly down compared to the previous Montreux Symposium/Exhibition in 1973, nevertheless some 1,500 or so, from over 50 countries, made the pilgrimage along with many hundreds of Exhibition visitors and the sales representatives of about 130 European and American firms.

Was it worth those costly Swiss francs? The answer must be "yes". Montreux gives a unique insight not only into the latest nuts and bolts of broadcasting but also its timbre. Here in 1975 one could feel the changed atmosphere that now predominates in television – the belief that new ideas and new products must not only offer the highest standards of performance but must do so within budgets that are no longer sky high. As R. J. Clayton said of space broadcasting, it is less a question of what is technologically feasible than of what is needed. Television has become increasingly economy-minded, and the price-tags, though often in units of tens of thousands of pounds, are carefully scrutinised. It used to be said of the capital goods side of television that if you had to ask the price you were in the wrong league: today however the prime selling point for most equipment is that it costs less in relative terms to buy or to operate than the previous generations of products.

Picture origination

At least ten firms were showing broadcast cameras, though many of these turned out to be the latest versions of well-tried designs. It is claimed that it takes sales of 500 or so units to fully recover the development costs of a completely new design. Most firms now concentrate on a basic camera family, offering studio versions with or without the data transmission facilities that provide control over a simple triax or coax cable, and an adapted "portable" design. Variations on this approach could be seen at the Marconi, RCA, Thomson-CSF, Bosch, Philips, Ampex and IVC stands. Link Electronics were concentrating on their 110 design while EMI seem, at least temporarily, to have lost interest in this area.

The increasing importance of "electronic news gathering" or "electronic journalism" (i.e. using electronic rather than film cameras for news coverage) and also for "location drama" shooting was reflected in such cameras as the RCA TK76, Ikegami HL33 and Bosch KCN. An increased number of portable microwave links – for example by Microwave Associates and RCA – is another facet of this trend.

The lead-oxide vidicon pickup tube continues to dominate the broadcast camera field, and improved tubes providing more uniform bias lighting were announced by EEV and Philips.

Siemens demonstrated their new single-tube Interplex colour camera, offering better resolution possibilities than previous single-tube systems which have been limited to CCTV applications (see *Television*, June 1973). Unfortunately the demonstration camera did not seem to be providing a very consistent picture, but one gathered that it was an early prototype.

A future challenge to current practices is clearly looming up in the form of charge-coupled-device technology (see *Television*, October 1974) which offers a practical approach to the all solid-state camera. The engineers most closely concerned with this put the challenge as still some five years away however. RCA demonstrated a CCD colour camera though freely admitting that it still suffers from blemishes and is very insensitive in the blue region. The large CCD arrays required are really pushing at and over the present limits of solid-state technology: a number of problems have still to be overcome, including absorption loss in the blue spectrum. Theoretically this latter problem can be overcome by thinning the chip, but this increases fragility. During the Conference, M. F. Tompsett of the Bell Laboratories announced the largest CCD array yet developed, used in a black-and-white camera with 496 vertically interlaced scan lines and 475 horizontal picture elements. He believes that an effective news gathering camera could be developed by reducing the dark current, possibly by incorporating an internal cooling unit.

Telecines and VTRs

Amongst the new studio equipment attracting a lot of interest was the brand new Rank-Cintel Mark III flying-spot telecine which features a new film transport system and breaks new ground in providing interchangeable 16mm and 35mm facilities: this dual facility will allow studio engineers to reappraise the requirements of their technical areas, and in addition underlines the versatility of modern flying-spot machines in catering for both 60-field and 50-field systems.

There is no abatement yet in the introduction of new tape formats for broadcast applications, though in practice the industry is still dominated by 2in quadruplex machines. Challenges are mounting from Quad 2 formats which offer tape economy and from a wide variety of helical-scan formats (yet one more appeared at Montreux, with a new family of Bosch machines based on 1in tape with three audio/control tracks). The current generation of Quad machines, represented by the Ampex AVR2 and the RCA TR600, are significantly more economical in capital costs than earlier Quad machines of comparable performance.

Digital techniques

New possibilities for using low-cost helical-scan machines for such purposes as electronic news gathering stem from the successful development of "digital timebase correctors" (DTBC). Several firms – including the British firm Quantel – were demonstrating the remarkable effectiveness of these units in providing a perfectly steady picture from a low-cost cartridge helical-scan machine. The DTBC works on the principle of writing and reading digital signals at different clock rates – the output rate being locked to the station sync pulses: they use electronic stores of quite modest dimensions, but the need for analogue-to-digital conversion means that they are not cheap units.

Nevertheless, one DTBC can be used with a large number of low-cost recorders and the system is rapidly catching on in North America.

Further possibilities can be realised by using additional electronic storage. NEC, in conjunction with the Tokyo Broadcasting System, have made an impact with a range of digital frame synchronisers – six units are already in use by NBC in the United States. These provide full synchronisation between any two picture sources (including local pictures and satellite relays affected by Doppler shift). In other words, they eliminate the need for complicated genlock techniques. It was announced at Montreux that a new unit, the FS-20, with one field store, is being produced by NEC for use with 625-line PAL systems. The cost is in the region of £45,000.

The most complex digital TV system yet in operational use is undoubtedly the IBA-developed DICE (digital intercontinental conversion equipment). The latest two-way version, similar to the unit now used by ITN, was shown at Montreux by Marconi. The ability to transport such a complex system to Switzerland and demonstrate immediately its impeccable performance says a great deal for the ruggedness of digital systems.

A number of the conference papers were concerned with an important aspect of digitalisation – the optimum form of coding for digital transmission over bandwidth-limited intercity and satellite circuits. While straight pulse code modulation (PCM) coding of a 625-line signal requires a bit rate exceeding 100Mb/s, various techniques, including orthogonal transformations, can be used to reduce this by a factor of about three or four. When this is done any transmission errors tend to become more significant however: there is a lot of work still to be done to decide whether it is wise to go far along this route, since we could end up with results no better than existing analogue transmission.

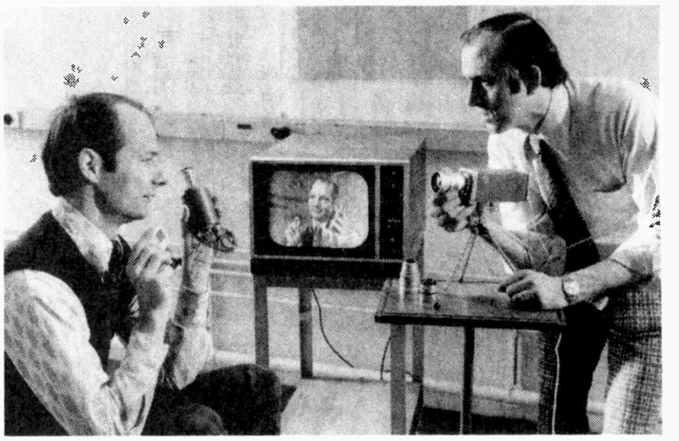
There is also interest in the method to be adopted for encoding the colour signal. Some organisations favour the use of U, V, Y to allow the receiving end to encode this for broadcast in either PAL or SECAM form without the need for transcoding.

SECAM still important

Montreux 75 underlined once again that although most of West Europe is very happy with PAL the SECAM colour system cannot be disregarded by those seeking world markets. SECAM has now been selected by some 20 countries, including a number in the very important Middle East region (Iran, Iraq, Saudi Arabia and Egypt). A number of British firms, for example Michael Cox Electronics, are now making SECAM equipment.

A SECAM-type coding system is used very effectively in the new Thomson-CSF laser-type videodisc system. Although this is still in the development stage, the disc was demonstrated providing a picture which must be regarded as very acceptable for the consumer market. The disc runs for 30 minutes, has a claimed resolution of 4MHz and features a novel stabiliser to maintain the position of the upper surface of the disc very accurately in relation to the laser beam. Some drop-outs were observable, but offering as it does such facilities as frame freeze and forward or backward motion this must be considered a formidable videodisc system.

In terms of picture quality, an experimental videodisc system – for both playback and recording – shown by Bosch-Fernseh gave astonishingly good pictures, with up to 5MHz resolution. An argon laser is used for scanning but in this case the disc is a transparency. The company states that it is part of a development study, and makes no claim to early marketing. It is clearly aimed at the professional user and broadcaster rather than the domestic market (and might thus be seen as a competitor to the company's new range of helical-scan broadcast machines).



The world's first entirely solid-state TV camera with broadcast quality resolution. Bell Laboratories engineer Carlo Sequin (left) shows the CCD sensor he designed to replace the bulky tube with its deflection assembly held in his left hand. His picture, taken by the experimental solid-state camera designed by Edward Zimany (right), appears on the 525-line monitor.

Miscellaneous

Significantly greater electrical efficiency is being achieved with the latest multicavity klystrons for use in the output stage of high-power u.h.f. transmitters. For example, ITT have improved five-cavity units with an efficiency of around 40 per cent, while EEV showed a prototype four-cavity unit capable of over 50 per cent efficiency or roughly double what was possible just a few years ago.

A number of European countries have clearly made good progress in the installation of low-power, gap-filling relay transmitters, some of them visually of very attractive design. Some countries are now contemplating extending their TV coverage to communities of only 150-250 people.

Transmitter control and measuring equipment was featured by a number of firms. A novel "text inserter" system from Philips allows short announcements to be made from unattended stations, while an IBA paper described the use of microprocessor or pocket calculator electronics for digital automatic measuring.

Highly complex studio automation techniques seem to be rather less popular than a few years ago, and a warning against excessive use of such systems was delivered by a German speaker – past experience suggests that anticipated cost savings are not always realised.

TV broadcasting in Band VI (12GHz) seems feasible via terrestrial networks only in combination with CATV systems, but continues to attract interest. 12GHz space broadcasting experiments are to be held later this year by NASA with a Communications Technology Satellite, and a Japanese 12GHz satellite is being planned for experimental use within the next few years. Meanwhile the use of satellites for distribution links, as in the successful Canadian Anik system, is likely to expand in North America.

But Montreux 75 emphasised that broadcasters are now mainly concerned with finding economical ways of maintaining their existing services rather than with new ways of providing more programme channels. ■

WATCH OUT for the UNEXPECTED

Steven KNOWLES

ALL service engineers at some time or other have the misfortune of having to deal with a set that has had previous unsuccessful service attention. In cases where obvious butchery has taken place the results are usually immediately apparent to the practised eye. In other cases butchery may not have taken place but a simple mistake which is only beginning to show itself may have been made.

Conversion Error

An example of this latter sort of thing occurred to me a few years ago when I was called to examine a set which was displaying the symptoms of bad field cramping at the bottom of the raster accompanied by critical field lock. The owner mentioned that the set had been converted to dual-standard operation some time previously and that the fault had started and become progressively worse since then. On switching the set on, the first thing I noticed was that the warm up time was excessive for the particular model. The symptoms were then found to be as reported and on removing the back of the set it was immediately noticed that the PCL85's cathode bias resistor was cooking. Replacing the PCL85 made no difference at all and it was then noticed that all the valve heaters were dimmer than normal. The fault was eventually found to be as follows. Part of the 625-line conversion procedure for this model involved fitting an additional (valved) i.f. strip. Along with this the largest section of the heater dropper resistor had to be shorted out in order to accommodate the extra valve heaters in the chain. By mistake however the main section of the h.t. dropper had been shorted out instead. Thus while all the valves were being starved of heater voltage they were all receiving a greatly increased h.t. voltage which, surprisingly enough, enabled full line scan, near normal brilliance and reasonable sound to be maintained. The excessive current through the PCL85 had cooked its cathode resistor however to produce the above symptoms. After putting right the conversion mistake the PCL85 and its cathode components were replaced, effecting a complete cure. Fortunately none of the other valves seemed to have suffered unduly.

Aerial Problems

A television receiver obviously gives only as good results as the signal it receives. In the days of 405-line only transmissions set-top aerials ranging from simple Vee types with extending arms to the single straight rod dipole with sometimes removable sections at each end and slightly more elaborate "luxury" versions were common. Then came 625 lines and a whole new range of "dual" indoor aerials. The uninitiated were informed that all they required for "crystal clear" reception was the latest arrangement of rods, rings, reflectors and springy wires which never seemed to stay in the position the proud owner required! Sufficient to say that these were never very successful. Now that we are in the era of single-standard 625-line sets most of these ghastly aerials are disappearing.

More aerials than ever before are being seen on the rooftop as opposed to the top of the telly itself, since satisfactory results at u.h.f. can seldom be obtained without an outdoor aerial. Which brings us back to the starting point, that a set gives results only as good as the signal it receives. At u.h.f. if one of the stations is weaker than the others the cause could be slight tuner misalignment – especially if the trimmers show signs of having been altered – but the trouble is far more likely to be the result of the aerial having been incorrectly installed.

In my particular area there are a large number of blocks of council flats without communal aerials. Consequently the roofs of many of these blocks are littered with private aerials, many of them redundant v.h.f. types. Consider however the case of a customer who had a dual-standard set working from his own Band I, Band III and u.h.f. arrays which he had had installed some years previously. BBC-1 and ITV were still being received at v.h.f. and it was on this system that the trouble was first noticed. It took the form of wavy verticals with bad ghosting mainly on ITV. Over a period of time this got worse until BBC-1 and eventually u.h.f. were affected as well. Imagine this gentleman's surprise on going up to the roof to inspect his aerial to discover that no less than *seven* other aerials had been attached to *his* mast! Six of these were u.h.f. arrays, the seventh being a six element f.m. aerial which was placed so close to his own ITV aerial that the elements of one were poking through the spaces between the elements of the other. The owner's initial shock at being confronted with this amazing collection of arrays attached to his structure soon subsided into anger and needless to say he had the aerials removed in a very short time.

This sort of thing is far from uncommon unfortunately and aerial riggers called back to remove aerials attached to other people's masts without permission are often heard to comment that they can't see what the fuss is about and that it doesn't do any harm anyway. This is not really the point. One or maybe two arrays may not cause harm but when as in the case quoted several are attached in close proximity there will be considerable interference between them. A person who has had an aerial fixed on a roof has paid for the aerial *plus* all the accessories, which are his property, and no one else should fix anything to that property without the owner's permission. A quote from an aerial company to instal an aerial will include the cost of the aerial plus all accessories: if the aerial is attached to someone else's structure it means that the bracket, pole and lashing wire, which have been paid for, have not been used. I don't intend to suggest that all aerial companies indulge in these practices, but there is no doubt that some do. Perhaps it would not be a bad idea if managers took a greater interest in the way their company's work is carried out.

A Smoky Fault

A feature of the commonly encountered Thorn 900 and 950 dual-standard chassis is a heat operated cut-out (fusible resistor) in the h.t. line. In the event of excessive h.t. current the cut-out operates shutting off the h.t. supply and preventing further damage. *When* the fault has been located and cleared, the clip should be resoldered in place. In a case I recently came across the fusible resistor had simply been replaced with an ordinary 15Ω one. The complaint was that on switching to 405 lines the raster had collapsed and smoke had started to belch out of the back of the set. As the switched capacitors in the line output stages in these chassis often give trouble our first step was to remove the line output stage screening cover, set the system switch to 625 lines, and switch the set on. Sound and vision came on normally after a short while so with a cautious hand on the system switch and a beady eye on the line output stage we changed over to 405 lines. There were no fireworks however and apart from faint sound 405 was dead. A good raster was still visible so the fault lay either in the i.f. strip or the v.h.f. tuner. It was then noticed, as it should have been earlier, that R2 (8·2kΩ – 950 chassis) had completely burnt out. Hence the smoke mentioned by the owner. This resistor is the centre one of three mounted at the rear of the chassis to the right of the sound output valve, and supplies h.t. to the anode of the triode section (oscillator) of the v.h.f. tuner frequency changer. With the set switched off, an ohmmeter check from the tuner end of this resistor revealed a dead short to chassis. The meter was left in circuit and the PCF805 frequency changer valve removed. The short-circuit reading persisted so there was no internal short in the valve. A check with the circuit diagram indicated that the only possibility was a short-circuit in the associated 0·001μF feedthrough capacitor: this proved to be the case. The moral of this little story is not to be too hasty in condemning the line output stage in the event of an h.t. short-circuit.

Lack of Contrast

Whilst on the subject of these chassis (900 and 950), a few faults which are occurring more frequently as the sets age. Lack of contrast is commonly caused by R22 and R28 and in the 950 chassis R145. R22 and R145 are in series with the sliders of the contrast control(s) while R28 is the second vision i.f. amplifier (PCF808/30FL14) anode feed resistor. On more than one occasion however the fault has been traced to the contrast control developing an open-circuit track at one end.

Capacitors to Watch

In the line output stage the scan-correction capacitors C98 (625 lines) and C99 (405 lines) and the width stabilising circuit pulse feedback capacitor C106 are the capacitors to watch. If C106 has to be replaced the width stabilising v.d.r. Z3 should also be checked as it can be damaged by a short in this capacitor. C106 can also be responsible for the width control disappearing in a cloud of smoke.

Field Faults

In the field timebase Z1 – the v.d.r. in the PCL85 triode anode feed circuit (height stabilisation) – can be responsible for intermittent variation in height. If on the other hand the symptom is loss of height with slight bottom cramping, critical field hold and a tendency towards field jitter at the slightest provocation, a different kettle of fish has to be dealt with. With this fault condition any attempt to increase the scan or correct the linearity distortion by adjusting the preset controls will result in complete loss of field lock. If the usual checks (valve etc.) fail to reveal the cause of the trouble take a close look at the height stabilising thermistor X2 which is mounted in series with the field scan coils on the deflection assembly. This commonly goes high-resistance after some years' use to produce the symptoms described. It is on the right-hand side of the deflection yoke and as a quick test can be shorted out.

"What do the flesh tones look like now, Smithy?"

Exploding Electrolytic

The sound output pentode cathode decoupling capacitor C77 (50μF) has gone off with a bang on several occasions recently. It seems that the bias resistor R96 (150Ω) changes value and eventually goes open-circuit. Since the cathode voltage then rises considerably C77 breaks down. The cathode current then flows through C77 and it blows its top (literally). A check on the condition of the bias resistor when the set is being serviced will prevent the trouble occurring at a later date.

A Clear Case of Butchery

Finally, another example relating to our original theme of butchery. A set fitted with the Pye 169 chassis came in recently with the complaint no picture. No picture turned out to be no raster and from the fierce glow in the PL504 line output valve it was obvious that no drive was forthcoming from the line oscillator stage. This employs the commonly used PCF802 and our first check was on the valve which turned out to be in order. It was then noticed that the oscillator coil adjacent to the valve had several layers of Sellotape wrapped round it. On further examination the coil completely fell apart – it had been broken into two pieces with the Sellotape holding it together. The coil is the only line hold adjustment on this chassis and is slug tuned. It appeared that someone had at some time tried to adjust the line hold, probably with the wrong tool, had jammed the core and had then by the look of things set about trying to unjam it with a hammer! On questioning the owner he said that a friend had taken the set to cure "lines on the screen" and had returned it minus a picture of any sort. Whereupon it came the way of yours truly.

Don't Take Anything for Granted

To sum all this up then, the moral seems to be never to take anything for granted. Be on the lookout for things that are not as they should be; and if a set shows signs of having had above normal activity inside, tread warily. ■

VIDEOTAPE RECORDING

Part Two **M. P. RILEY**

IN last month's issue the basic problems of recording a video signal onto magnetic tape were described together with typical tape formats and tape transport layouts. This month we describe the electronic techniques used in videotape recorders, together with circuits of the more unusual sections. At the moment the only VTR on the market which has a built-in tuner and i.f. amplifier is the Philips VCR. As this machine will be covered in depth in the next two issues of the magazine, the present article will concentrate on the video processing and servo techniques used in machines by other manufacturers. All of the VTRs aimed at the CCTV and educational markets operate using 1V composite input and output video signals, and normally employ separate off-air receivers when broadcast programmes are to be recorded.

The video system record path

The block diagram in Fig. 9 shows a typical video system for a monochrome helical scan VTR. The video signal from the TV camera or other video source is fed to a variable gain amplifier which alters the amplitude of the video signal applied to the f.m. modulator. The level of the signal leaving this amplifier will determine the deviation of the modulator up to the peak white frequency. Because all the lower cost VTRs economise on bandwidth of the video signal, a low pass filter is introduced to the recording path so that the higher video frequencies will not produce "Moiré".

"Moiré" is caused by sidebands of the f.m. signal's harmonics falling within the passband of the machine. This can be explained by reference to Fig. 10. Assume that the f.m. carrier is at 4MHz and is being modulated by a video frequency of 3MHz. This will produce sidebands of 1MHz and 7MHz. The third harmonic of the carrier frequency will lie at 12MHz, with a first lower sideband at 9MHz and a second lower sideband at 6MHz. This 6MHz information will beat with the carrier to produce a 2MHz pattern. Third harmonics of the f.m. signal are the most troublesome, because they are produced by the limiting action of the playback circuits before f.m. demodulation. The f.m. signal itself is produced by a multivibrator which gives a squarewave output containing a large number of harmonics.

With the bandwidth of the video signal limited to the system capabilities it is now fed to a video amplifier containing a black level clamp and peak white limiter. Although clamping is desirable in any video process which requires the d.c. component of the signal to be maintained, it is even more important in this particular case because the d.c. level of the video signal can alter the frequency of the f.m. carrier. Clamping is normally carried out on the line back porch as this represents the true black level of the picture. In this application, however, we require to clamp the carrier frequency of the f.m. signal so that compatibility with other machines can be maintained. For this reason the video signal is clamped during the line sync pulse, the clamp reference voltage will then determine the carrier frequency of the f.m. modulator.

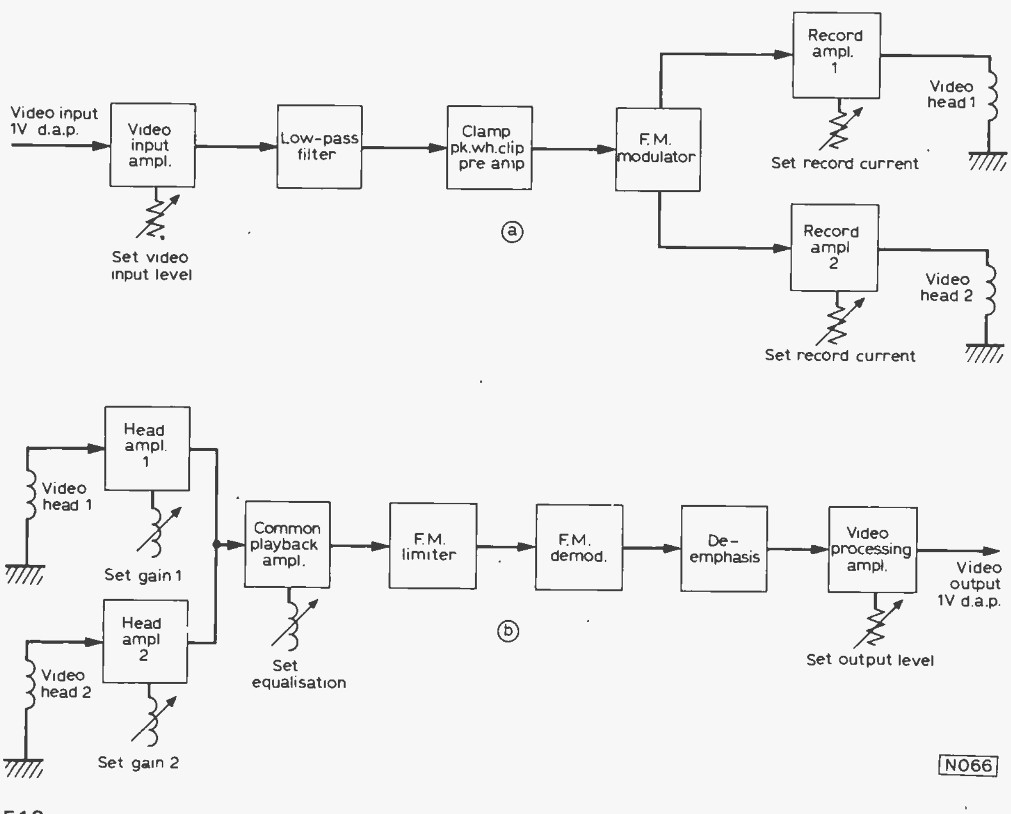


Fig. 9: The video system of a videotape recorder.
(a) In the Record mode.
(b) In the Playback mode.

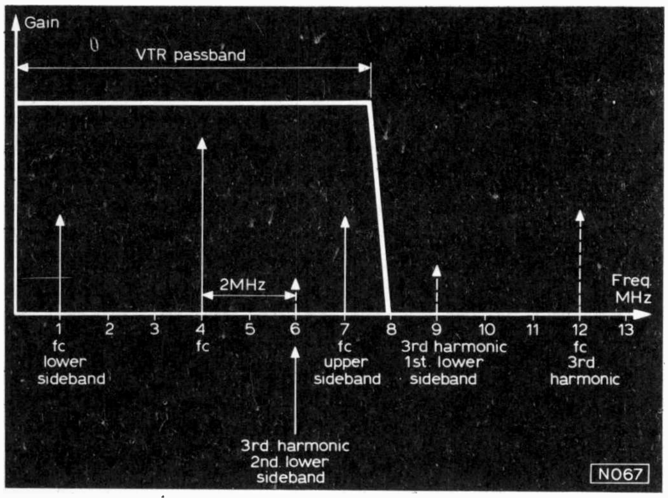


Fig. 10: The VTR spectrum and the production of "Moiré".

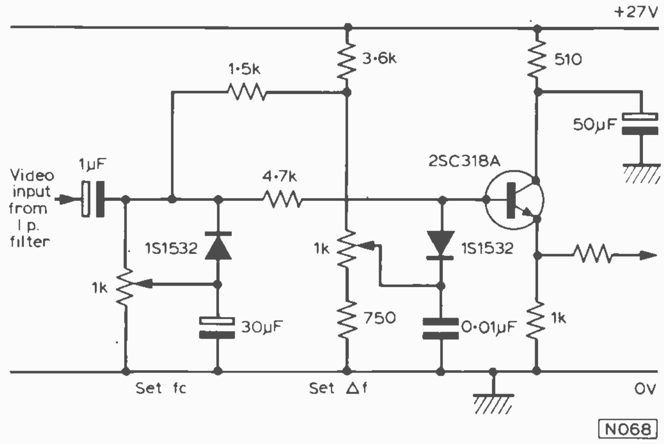


Fig. 11: Deviation control circuitry.

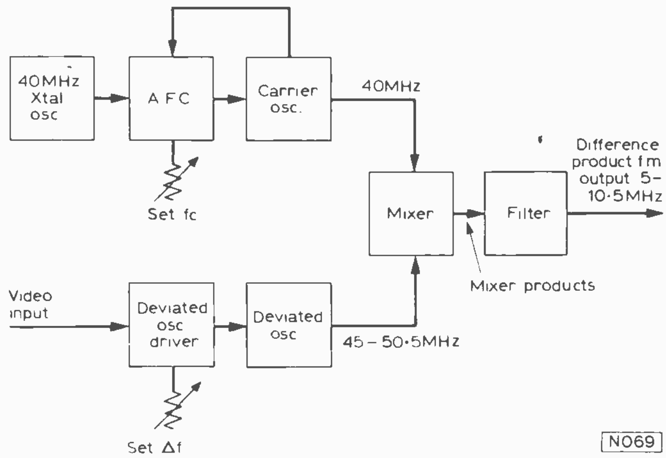


Fig. 12: Two-oscillator method of f.m. generation.

The maximum deviation frequency of the f.m. carrier must also be accurately set if machine compatibility is to be maintained, and a peak white limiter is employed to prevent over modulation. Simple diode circuitry is used by many manufacturers to carry out these two operations. True black level clamping is seldom used as it requires the costly generation of clamp pulses: d.c. restoration normally suffices. A circuit comprising a black level restorer and peak white limiter is shown in Fig. 11. After this stage the signal is pre-emphasised and then fed to the modulator.

Deviation of the f.m. carrier is typically 1·5MHz, and to save bandwidth this modulation is normally in one direction only, i.e. 3 to 4·5MHz. This large frequency change required by the modulator (compared with the carrier frequency) makes the use of the conventional reactance controlled oscillator very difficult, and a new technique has to be employed. In broadcast VTRs, and some helical scan machines, two crystal oscillators are used. One runs at a fixed frequency and is controlled by an a.f.c. loop which sets the carrier frequency. A second oscillator is run at the first oscillator frequency plus the f.m. carrier frequency, and is deviated by the video signal. As the frequency of the deviated oscillator is high, modulation with a video signal is much easier. The outputs of both oscillators are now mixed and the difference frequency filtered to produce the f.m. signal to be recorded. Because the carrier frequency of the signal is controlled by an a.f.c. loop a high degree of stability is maintained, and compatibility between machines is greatly improved. Fig. 12 shows the block diagram of such an arrangement with typical frequencies.

This method of producing the f.m. signal is of course very expensive and is used in only a few helical scan VTRs. A much cheaper way of solving the problem is to use an astable multivibrator and alter its frequency by applying the video signal to the bases of the two transistors. Stability of the carrier frequency will now be determined by the design of the circuit, and great care must be taken to ensure that as the frequency of the multivibrator changes the mark-space ratio does not change. The circuit shown in Fig. 13 is the modulator used in the Sony CV 2100 ACE, note the symmetry controls enabling the bias on the bases and collectors of the two transistors to be set very accurately.

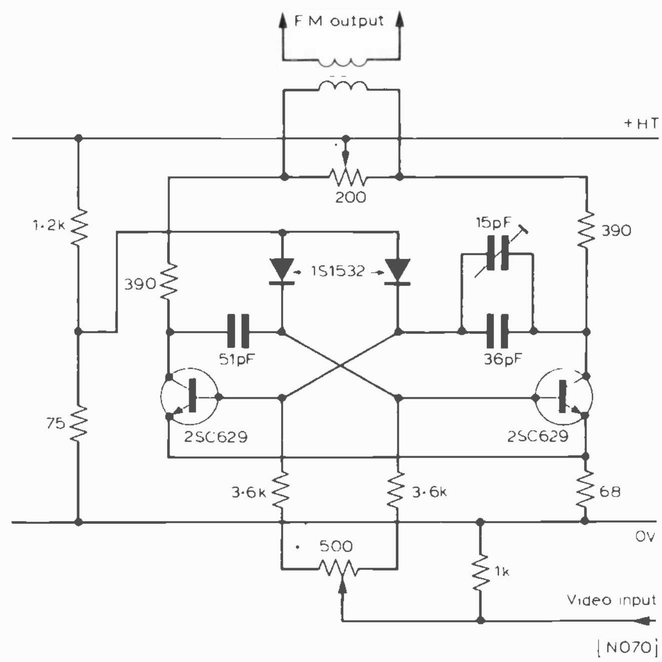


Fig. 13: A typical multivibrator f.m. generator.

If the VTR is of the two head variety then the f.m. signal from the modulator is split into two paths and fed to separate record drive amplifiers. Because an f.m. signal has a constant amplitude, the record current drive for each head is adjusted so that the tape is just being saturated by the signal. This arrangement gives the maximum possible transfer of energy from the head to the tape and therefore the best possible signal to noise ratio.

The video system playback path

The output signal from the heads during playback is very low indeed, and a head amplifier with high gain and low noise is required to amplify the signal to an acceptable level before it can be limited. A typical head amplifier uses a cascode stage which has an output load tuned to the f.m. signal frequency. This output is then fed to an emitter follower which matches the output impedance of the cascode stage to a common playback amplifier which contains frequency equalisation. Some two-head VTRs have the heads wired in parallel, and therefore only one train of record and playback amplifiers is required.

After the head amplifiers an f.m. limiter is required to remove any variations in the playback signal amplitude caused by changes in the h.f. losses, especially spacing loss. This section consists of a large number of common emitter amplifiers and diode clippers connected in series. The clipping diodes are arranged so that both the top and the bottom of the f.m. waveform are removed. It is this limiting action that helps to produce the harmonics which cause "Moiré". A typical circuit is shown in Fig. 14.

When the limited signal is demodulated it is de-emphasised and fed to a conventional video processing amplifier, which includes a video output level control.

Dropout compensation

Dropouts are caused by the oxide on the tape being removed by creases, scratches and tape wear. The effect of these defects is to produce small gaps of noise, which occur at random throughout the picture. In the case of tape creases, the dropout takes the form of a horizontal line that runs vertically through the field. A dropout compensator detects the loss of the f.m. carrier signal from tape, and inserts in place of the noise on the video signal a fixed d.c. level. The resultant effect is to make the dropout less noticeable to the viewer. Fig. 15(a) shows a typical block diagram.

Part of the f.m. signal at the input to the limiter is amplified separately and then fed to a conventional a.m. detector. When a dropout is present, and the f.m. signal disappears, a change in d.c. level at the output of the a.m. detector will be produced. This change in level is then fed to a Schmitt trigger which will produce a switching pulse of duration equal to the length of the dropout. In the processing amplifier there is a video switch which is operated by the output of the Schmitt trigger. The switching waveform causes this switch to disconnect the video signal from the f.m. demodulator and insert in its place a d.c. level which normally corresponds to a picture intensity of mid grey.

In colour machines this type of compensation cannot be used because the d.c. level is much more noticeable when inserted into a background of saturated colour. Fig. 15(b) shows the arrangement in a colour machine. The d.c. level is replaced by video information from the previous line derived from a 64μs delay line. This has one major disadvantage: R-Y information contained in the inserted section of the video signal will be in the same phase as the previous line. Because the PAL switch in the receiver changes state every line the reinserted information will have its R-Y component 180° out of phase with the R-Y information contained in the rest of the line. Larger colour disturbances can be produced if the dropout occurs during the colour burst period, and the burst from the previous line is inserted. As the inserted burst will be in the wrong phase (i.e. the TV receiver will receive two consecutive bursts of the same phase) the subcarrier oscillator in the decoder, and the PAL switch will be thrown out of synchronisation and take a short while to recover. The colour defects on the screen of the receiver as a result of the problems just described are quite small, however, as they only take place over a limited number of lines.

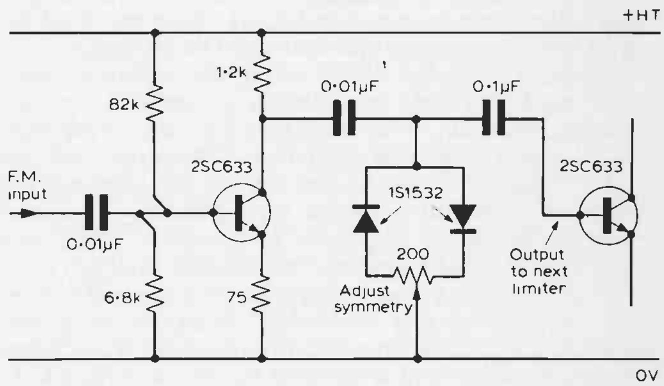


Fig. 14: A diode f.m. limiter stage.

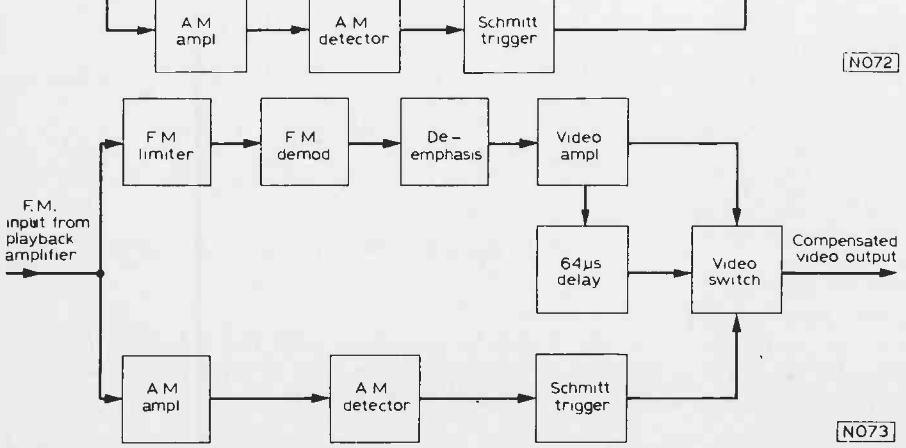


Fig. 15: Dropout compensation circuits.
(a) (top) For a monochrome videotape recorder.
(b) (bottom) For a colour VTR.

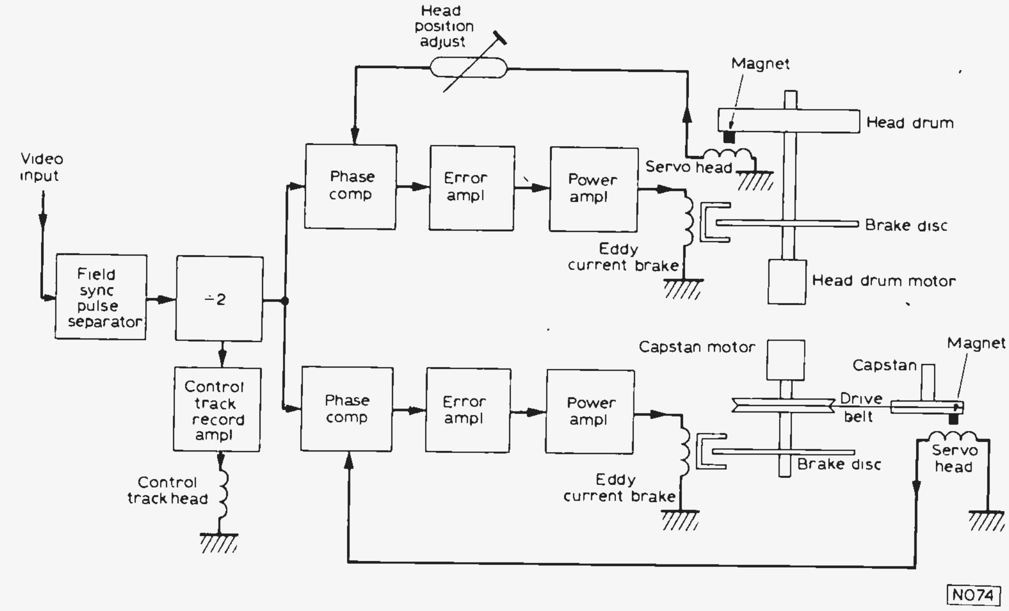


Fig. 16: A typical VTR servo system in the Record mode.

Servo systems

The servo system in a VTR is responsible for controlling the speed of the head drum and capstan motors on record and playback. The correct speed control of these two motors is critical, for example if the head drum is not correctly synchronised during a recording, the dropout band (described in Part 1) would run at random through the picture. During recording the field sync information must be recorded at the beginning of the video track on the tape, and the information must be laid on the tape at a constant speed. To achieve this both the position and speed of the head must be able to be controlled. The capstan speed must be held constant so that the gap between successive video tracks on the tape remains the same.

During a recording both the capstan and the head drum are phase-locked to the field sync information on the video signal being recorded. A typical block diagram is shown in Fig. 16. The incoming video signal is fed to a sync separator and then to an integrator to produce field sync pulses. As the drum in a two-head VTR revolves at 25Hz the field sync is divided by two to produce a 25Hz servo reference. This signal is then amplified and recorded on the control track, producing a reference indicating when a new picture has started being recorded by the video head.

The speed of the drum is monitored by a sensing device producing one output pulse per revolution of the drum. This 25Hz signal is phase-compared with the servo reference, and the error voltage resulting from any phase difference between the two signals is amplified and used to control the speed of the head drum motor. By altering the delay in the feedback signal from the drum, the phasing of the drum (and therefore the recorded position of the field sync) can be adjusted.

The capstan speed is controlled in exactly the same way as the head drum in the record mode. Delay is not inserted in the feedback path between the sensing head and the phase comparator because all that is required of the capstan at this stage is to run at a constant speed.

Control of the drum and capstan motors can be carried out in two ways. The most common system uses eddy current brakes which are fed with the amplified error signal from the phase comparator. The magnetic field generated by the brake coil sets up a magnetic flux in an aluminium disc mounted on the motor shaft. The direction of the flux opposes the direction of rotation of the disc and therefore alters the speed of the motor. The motor itself is of the synchronous type and is designed to run slightly faster than the required speed to allow the necessary range of control by the servo.

The second method of controlling the speed of the capstan and head drum motors makes use of an oscillator. The error signal from the phase comparator is again amplified, but then used to control the frequency of a sinewave oscillator in an arrangement similar to that used for flywheel sync in a 625-line TV receiver. The output of the oscillator is then fed to a power amplifier which drives the synchronous motor. Any change in oscillator frequency will now change the speed of the motor. This arrangement is shown in Fig. 17.

During the playback of a pre-recorded tape, the machine's servo system has to reproduce the exact tape transport conditions that were present during the recording. The servo reference is now changed from field sync to 50Hz mains, which is shaped and divided by two producing the 25Hz reference signal. The head drum is now phase-locked to the reference signal in exactly the same way as in the record mode. To complete servo lock-up the capstan must adjust the horizontal phasing of the tape so that the head scans exactly along the video bands recorded. As the position of the head during the recording has been stored in the form of the control track, all the capstan servo has to do is to phase lock to this signal. The feedback signal from the control track head is fed to a phase shift network which

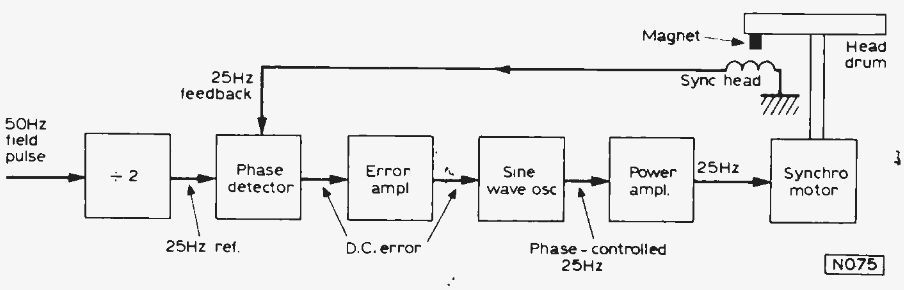


Fig. 17: A Record servo system using a phase-controlled oscillator.

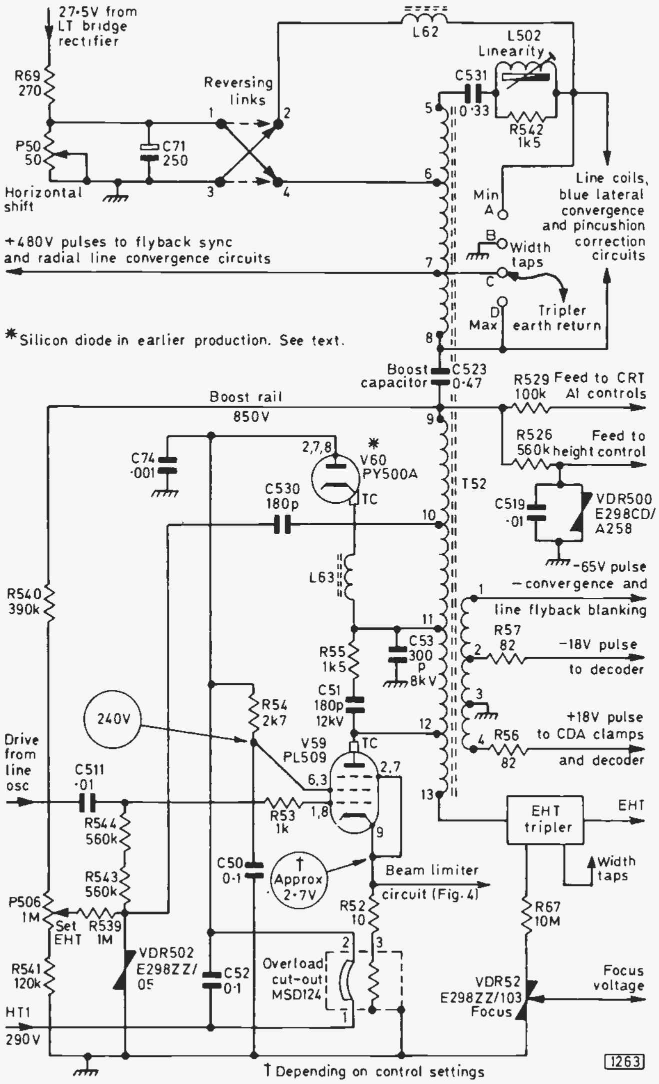


Fig. 2: Circuit diagram of the line output stage. In earlier production a silicon diode boost rectifier was used. The line output valve's cathode decoupling electrolytic C529 is mounted near the beam limiting transistor Tr535 on the timebase board (see Fig. 4).

when the case of the cut-out does not make contact to chassis. It is held to the chassis by two metal clips, but the best way to overcome the problem is to screw a solder tag to the chassis and then solder a lead from this to the cut-out's control case.

No picture followed by smoking can be caused by the lead from the line output transformer (tag 12) to the top cap of the line output valve. The lead passes through a metal plate via a grommet. The insulation breaks down, causing a minor burn up. This can also happen with the lead from tag 11 of the transformer to the top cap of the boost diode.

Another line output stage cause of no picture is C51. The symptoms here include smoking from the back with slight arcing. Failure of C51 can also result in R55 going open-circuit.

The e.h.t. tripler gives its share of problems – anything from arcing over to chassis to the corner blowing right off the unit.

The feed resistor (R529) from the boost line to the c.r.t. first anode potentiometers can go high-resistance, producing a dim picture or no picture at all.

R539 can increase in value resulting in reduced width.

Line output stage capacitors which can go short-circuit to blow the mains fuse (FS1) are the tuning capacitor C53 and the boost capacitor C523 which is returned to chassis (not to the h.t. line).

Poor Line Sync

Poor line sync is usually caused by R509 (560Ω) going open-circuit. This is the resistor which links the flywheel sync circuit to the triode grid (pin 9) of the PCF802 line oscillator valve.

Focus Troubles

Focus troubles should direct attention to the high-value resistor R67 (10MΩ) which is in series with the focus control. This can go high-resistance.

Boost Diode

In earlier sets fitted with a silicon diode boost rectifier the heater chain is fed via a diode dropper (D503, type BY126 or BY127). With the PY500A valve boost rectifier used in later production the D503 position (timebase board) is shorted out and a 130Ω resistor (R59) is added in series with the heater chain. This resistor is part of the mains dropper assembly. R64 is then a separate component – it is part of the dropper in versions with the BY147P boost diode. It is important when making replacements to ensure that the complete circuit is correct in these respects.

Field Timebase

The field timebase works fairly well, the usual trouble being simply that the PL508 field output valve looses emission resulting in field collapse or lack of height. Other causes of lack of height are R526 (560kΩ) which feeds the

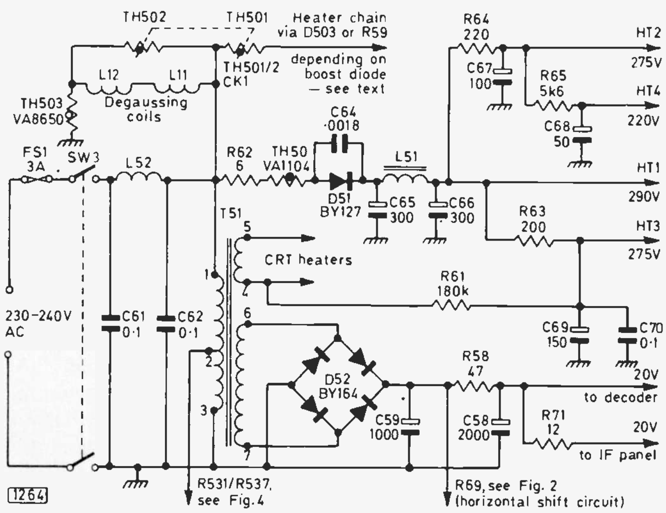


Fig. 3: The power supply circuit. HT1 feeds the line output stage, the PCL84 colour-difference output stages and the PCL86 audio output stage. HT2 feeds the anode of the PL508 field output valve via the vertical shift control taps, HT3 feeds the sync separator, the line oscillator, the section of the field multivibrator not fed from the boost rail, the PL802 luminance output stage and the audio amplifier (triode) section of the PCL86. HT4 feeds the screen grid of the field output valve – thus if R65 goes open-circuit, the field will collapse giving a horizontal white line. Where a valve boost diode is used the heater chain is fed via R59 (130Ω) which is part of the mains dropper: where a silicon diode boost rectifier is used the heater chain is fed via a diode dropper – D503, type BY127.

height control going high in value, or a bad burn up caused by the associated decoupler C519 (0·01μF) going short-circuit and producing a large hole in the Paxolin board.

Power Supplies

No sound or vision with the 3A mains fuse FS1 blown is often due to one or other of the mains filter capacitors C61 or C62 (both 0·1μF) being short-circuit.

A hum bar is a common fault which may be permanent or intermittent. The usual cause is the 20V l.t. supply reservoir and smoothing electrolytics, C59 (1,000μF) and C58 (2,000μF) respectively.

A common cause of no sound and vision is lack of supply to the valve heaters (except the c.r.t. which is fed from the l.t. transformer). This is generally due to a break in the three-lead, two-thermistor assembly TH501/TH502 (type CK1) which is mounted on the timebase board. The circuit arrangement is somewhat unusual and is shown in Fig. 3. TH501 is the heater chain surge limiter thermistor. The other section of the double-thermistor assembly (TH502) is connected across the degaussing coils. At switch on the resistance of TH501 and TH502 is high, while the resistance of the positive temperature coefficient thermistor TH503 is low. Consequently the heater current is reduced while considerable current flows via the degaussing coils and TH503. TH501 quickly heats up, and since it is combined with TH502 the resistance of both falls. Consequently the voltage across and the current through the degaussing coils decreases. The resistance of TH503 increases, reducing the current in this side of the circuit to negligible proportions, but the resistance of TH502 remains low due to its connection with TH501 which continues to carry the heater current.

Output Panel

There are three PCL84 colour-difference output/clamp valves (V407, V408 and V409) on the output panel. These are prone to heater-cathode short circuits, producing all red (V407), all green (V408) or all blue (V409) pictures depending on which valve is defective. They also lose emission, resulting in poor red, green or blue colour. Faulty c.r.t. first anode presents – P613 (red), P614 (green) and P615 (blue) – can also cause poor colours. Another cause is change of value of the clamp triode load resistors – R417 (red), R425 (green), R434 (blue), each 8·2MΩ.

The PL802 luminance output valve (V402) is also mounted on this panel. When it loses emission there is lack of brightness and poor colour. Often however the trouble here is the double-sided printed circuit, with dry-joints at the valve base. If the PL802 is cut off the screen will be blank. This can occur if the flyback blanking circuit in its cathode lead is faulty. Should the protection diode D402 (BA115) go short-circuit for example the bias to the blanking transistor will be removed and neither it nor the PL802 will pass any current.

The final valve on this panel is the PCL86 audio amplifier (V401). Naturally this can cause no or distorted sound. The usual fault however is that the valve becomes microphonic, producing noise as a result of mechanical vibration or shock.

Tuner Units

Most of these sets are fitted with push-button mechanical tuners. Common faults are tuning drift or getting just a herring-bone pattern when a button is pressed. The usual cause is the mechanical parts sticking together due to the grease on the moving parts.

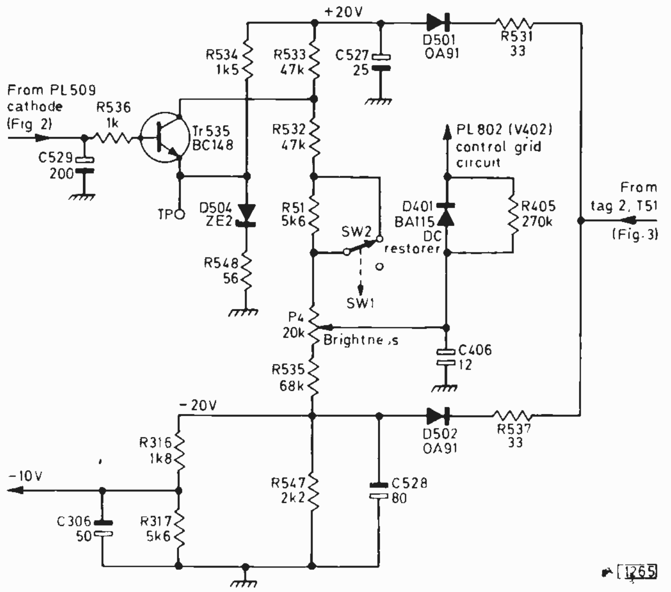


Fig. 4: The brightness control, which sets the d.c. restoration level in the PL802 luminance output pentode's control grid circuit, is connected across +20V and −20V lines. The beam limiter acts on the brightness circuit: with excessive line output valve cathode current Tr535 is driven into conduction, the increased current flowing through R533 reducing the positive feed to the brightness control and thus the conduction of the luminance output pentode which is d.c. coupled to the c.r.t. cathodes. C529 is the line output valve's cathode decoupling capacitor. SW2 is coupled to SW1 which collapses the field scan – for grey-scale adjustment purposes. A −10V supply to bias the emitters of the R −Y (Tr321) and B −Y (Tr323) preamplifiers is provided by R316/R317/C306 which are mounted on the decoder panel – there is no G −Y preamplifier since the G −Y matrixing is carried out at high level in the anode circuits of the colour-difference output valves.

The Decoder

A trouble with the decoder panel is dry-joints, mainly outside or inside the reference oscillator can (PC314).

In cases of no colour check the voltage at the base of the second chroma amplifier TR319 (BF194). If this is found to be between 3V and 6V positive the colour killer circuit is working. I have usually then found the fault to be the result of the first chroma amplifier transistor TR318 (BF194) having an open-circuit base-emitter junction.

To over-ride the colour killer, connect a 27kΩ resistor from the junction of R385/R386 to the 20V rail – a convenient point is pin 4 of plug 6.

Another transistor which can be faulty on the decoder panel is TR327 (BC148). This is the d.c. amplifier between the burst detector circuit and the reference oscillator. When this transistor is defective the oscillator is not locked to the bursts, i.e. the colour is not locked. Check whether its collector voltage is between 11-14V and if not whether it can be brought to this figure by adjusting the oscillator frequency control P302.

Insufficient colour has been traced to a faulty second chroma amplifier transistor TR319.

Bad blinds, i.e. the PAL switch not operating, has been traced to the switching diodes D309/D310 (type OA47). The cause of this fault can lie outside the decoder however. In one case shorted turns on the line output transformer pulse winding resulted in very low amplitude trigger pulses which failed to drive the bistable circuit. ■

LARGE-SCREEN TV OSCILLOSCOPE

PROJECT — PART 3 — D.HALEY C.Eng MIEE

IN this third article the various circuits necessary to turn the instrument into a servicing monitor are described. These include the i.f. preamplifier and the a.f./v.f. preamplifier and attenuator. Also very important is the sample and hold circuit, so vital for checking timebases or for the presence of the colour-burst signal.

I.F. preamplifier

To investigate signals in the i.f. stages of a receiver a high impedance attenuating probe must be used to avoid loading or detuning the circuits under test. To compensate for the loss of signal level in the high impedance probe an i.f. amplifier with a gain of approximately ten is required. The circuit for this amplifier, built on a small piece of strip board, is shown in Fig. 7. An integrated circuit type CA3028A is used as the amplifier, with an emitter follower feeding the i.f. section of the oscilloscope. Fig. 8 shows the component layout and board detail. When completed, the amplifier should be mounted behind the front panel adjacent to the i.f. probe socket, using two small brackets. The component side of the board should face towards the left.

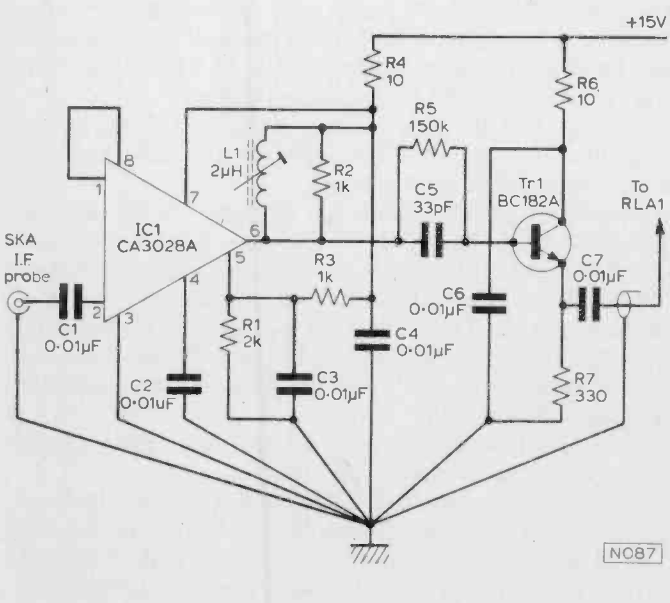


Fig. 7: Circuit diagram of the I.F. Preamplifier.

★ Components list

I.F. PREAMPLIFIER

Capacitors:
C1 – C4, C6, C7 0·01μF
C5 33pF silvered mica

Resistors: (all ±5%, ¼W)

R1	2kΩ	R5	150kΩ
R2, R3	1kΩ	R7	330Ω
R4, R6	10Ω		

Semiconductors:
IC1 CA 3028A (RCA) Tr1 BC182A

Miscellaneous:
L1 2μH coil with dust-iron core; Socket for IC1; Stripboard 51 x 95 mm (2 x 3¾ in) 2·54 mm (0·1 in) matrix. (Strips parallel to shorter dimension); 13 wiring pins.

INPUT ATTENUATOR & PREAMPLIFIER

Capacitors:

C1	1μF 250V	C6, C7	100μF 25V
C2, C3	See Fig. 9	C8	150pF polystyrene
C4	200pF		
C5	0·01μF		

Resistors: (all ±5%, ¼W)

R1	2MΩ	R8, R12	5·6kΩ
R2	1·8MΩ	R9, R13	1·2kΩ
R3	180kΩ	R10	270Ω
R4	22kΩ	R11, R14	220Ω
R5	220kΩ	R15	4·7kΩ
R6	1MΩ	R16	680Ω
R7	100Ω		

Variable Resistors:
VR1 1kΩ lin. potentiometer

Transistors:
Tr1, Tr2, Tr4, Tr5, Tr8 BC182A
Tr3, Tr6, Tr7 BF244

Switches:
S1 1 pole 3 way wafer switch
S2 2 pole 3 way wafer switch
S3 SPDT min. toggle switch
S4 SPDT min. toggle switch

Miscellaneous:
Stripboard 98 x 65 mm (3⅞ x 2 9/16 in) 2·54 mm (0·1 in) matrix; 12 wiring pins.

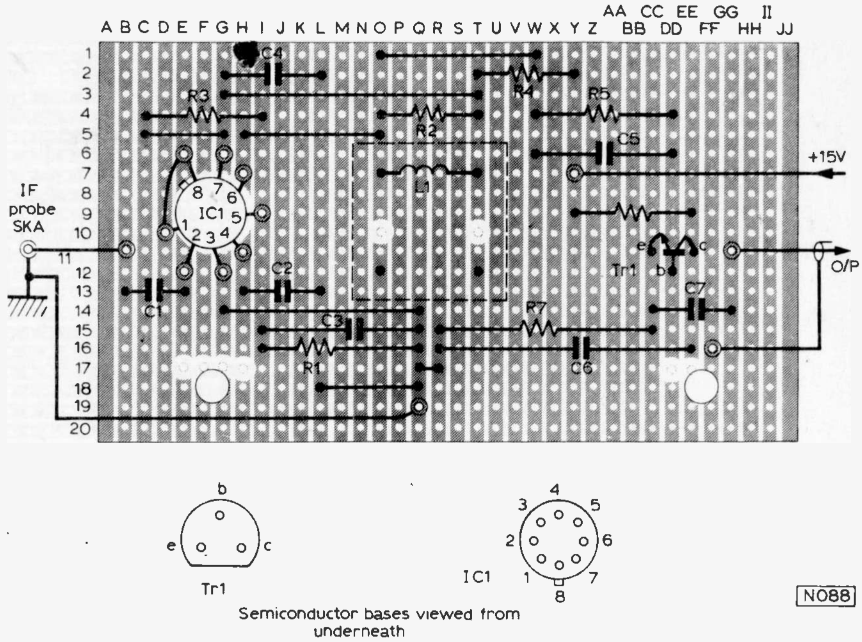


Fig. 8: Layout of the I.F. Preamplifier board, viewed from the component side. The copper strips are broken at the following locations: E17; F17; G17; H17; O10; T10; DD17; EE17. In addition, tracks E, F, G and H are broken under the i.c. by the hole drilled to mount the i.c. holder.

Input attenuator and preamplifier

The input and preamplifier circuit is described with reference to the circuit diagram Fig. 9. The probe socket is connected through an isolating capacitor to a three-position switched attenuator providing 0, 20 or 40dB attenuation. When the selector switch is in the AF/VF signal position, the attenuator output is connected to the gate of the field effect transistor Tr3 with over-voltage protection provided by two diode-connected transistors Tr1 and Tr2. On the Internal and IF positions of the selector switch, the f.e.t. gate is connected to a signal from the internal video amplifier.

The source-follower load includes potentiometer VR1, the Y Gain control, which provides continuous variation of signal level over a 10:1 range. Tr4 and Tr5 form an inverting amplifier with low impedance antiphased outputs to enable either positive or negative polarity inputs to be accepted. The signal from the Invert switch, S3, is taken to the sample and hold circuit, or directly to the Y amplifier on the Field position of the Line/Field switch. Also from this point is taken a signal feed to the video amplifier input to lock the oscilloscope timebases.

Sample and hold circuit

Since the sample and hold circuit is mounted on the same circuit board as the preamplifier, it will be described next so that the whole board can be assembled at once. The sample pulse waveform generating circuits will be described next month.

With the Line/Field switch set for the display of line waveforms, the video or probe waveform (as selected by S2) is fed via emitter followers Tr4 or Tr5 to the drain of the sampling f.e.t.

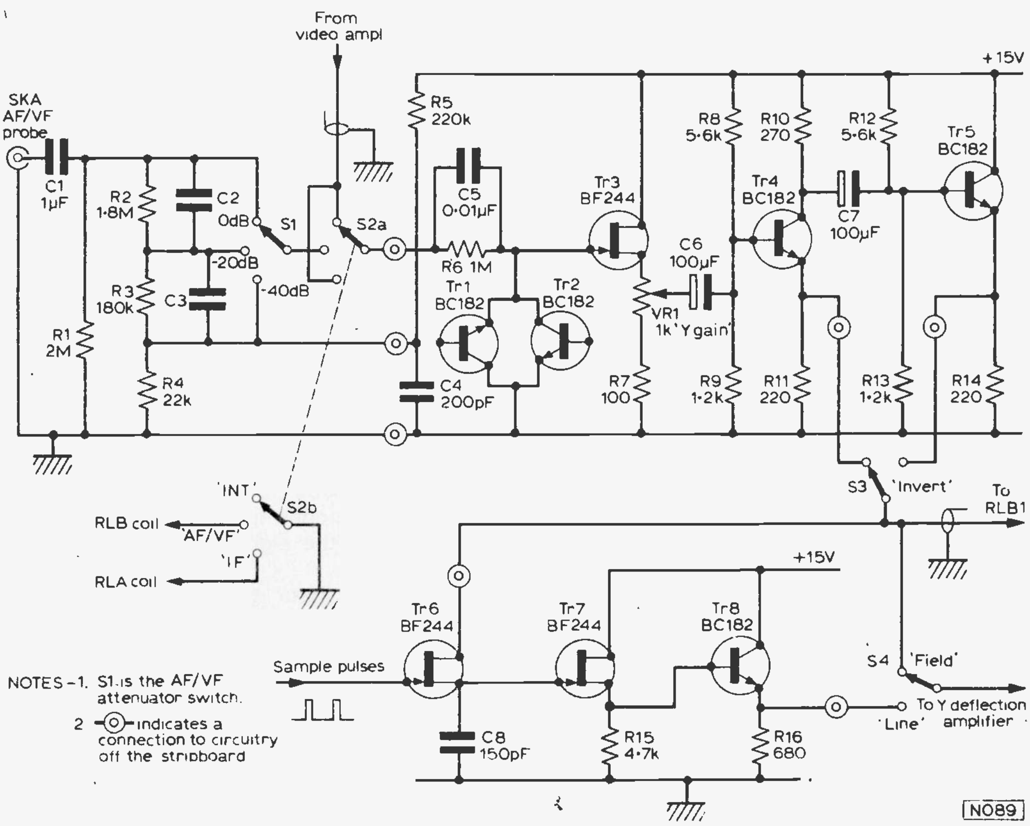


Fig. 9: Circuit diagram of the Input Attenuator and Preamplifier and the Sample and Hold circuit. Capacitors C2 and C3 are selected for optimum pulse response. In the prototype, C2 consisted of two insulated wires, twisted together for 30mm (1·25in), whilst C3 was a 36pF silvered mica capacitor.

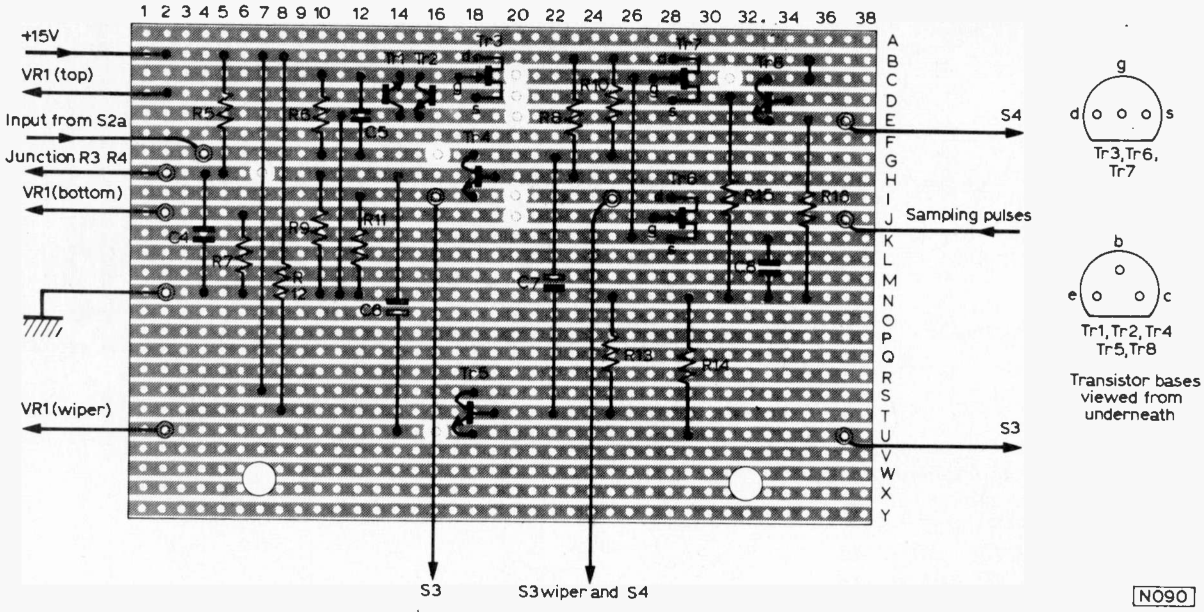


Fig. 10: Layout of the Preamplifier and Sample and Hold board, viewed from the component side. The copper strips should be broken at locations C20, C31; D20; E20; G16; H7; I20; J20; U16.

Tr6. On the gate of this f.e.t. is a sampling pulse about 0·5 to 1·0μs wide, which enables the incoming waveform to be sampled once during every line. This sample pulse moves progressively along the line throughout the field period, producing a series of about 300 samples which make up a line strobe signal at 50Hz repetition rate, when displayed on a field frequency timebase. The signal is developed across the hold capacitor C8, and is fed to the high impedance input of a second f.e.t. Tr7, connected as a source follower. From here it is fed through emitter follower Tr8 to the Y deflection output amplifier.

Construction of preamplifier & sampling circuit

The input attenuator consists of a 3-position single-pole switch with the attenuator components mounted directly on the switch wafer. The output from the switch wiper is taken to the input section of the selector switch, mounted next to it. The layout and wiring details for the circuit board are shown in Fig. 10. When completed, the board is mounted behind the front panel between the 'Input' and 'Display' controls, using two small brackets. The component side of the board should face towards the right.

The switches and +15V supply are connected to the board as shown in Figs. 9 and 10. The remaining wiring from the receiver to the various switches on the front panel should now be completed (see Fig. 1). The screens of the coaxial cables connecting the vision signals to and from the receiver should be connected to an earthed solder tag by as short a lead as possible. The relay coil leads from the receiver are connected to the appropriate switches, which earth them to energise the relay. The mains on/off switch is wired into circuit. We should now be in a position to make an electrical check of the work so far.

Testing

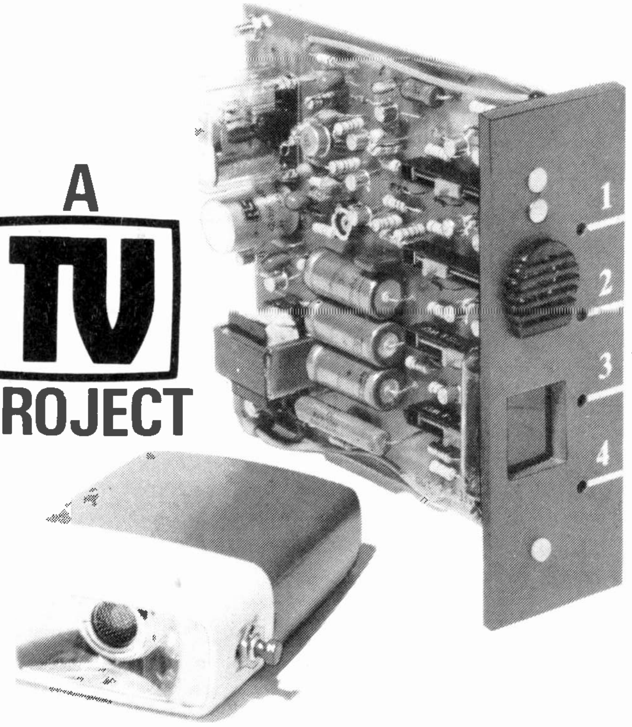
The first test is to check that the receiver is working normally on pictures. Set the scan switch on the receiver to Picture, the Input Selector switch to Internal, and tune the receiver to a transmitter. Check that a normal locked picture is obtained, rotated 90°.

Set the scan switch to Oscilloscope. A single horizontal line should be obtained across the centre of the c.r.t. Set the attenuator to 0dB, the Input Selector switch to AF/VF, Y Gain to maximum and, using a X1 probe in the a.f. probe input, connect to the loudspeaker transformer secondary. A display of the sound waveform should be obtained on the face of the c.r.t. Check the operation of the Attenuator switch, Y Gain control, and Normal/Invert switch.

Next return the scan switch to Picture and set the Input Selector to IF, which should remove the signal from the c.r.t. Using a X10 attenuator probe in the IF Probe input, connect to the receiver r.f. tuner output. Picture and sound should be restored. If necessary tune the 2μH load on the i.f. amplifier board for best picture.

Next month we conclude this series with a description of the Sample Pulse Generator, plus some notes on using the completed oscilloscope.

A TV PROJECT



ULTRASONIC REMOTE CONTROL

PART 1

A. WILLCOX

This system is a development of the author's circuit for a Digital Touch Tuner, published in our October, 1974 issue (page 538). The description of the common parts of the circuits is repeated here, partly because of the non-availability of back numbers of the magazine. The opportunity has also been taken to expand upon the description of the shift register and of the silicon controlled switches used therein, as a result of several queries about their operation which arose following the previous article.

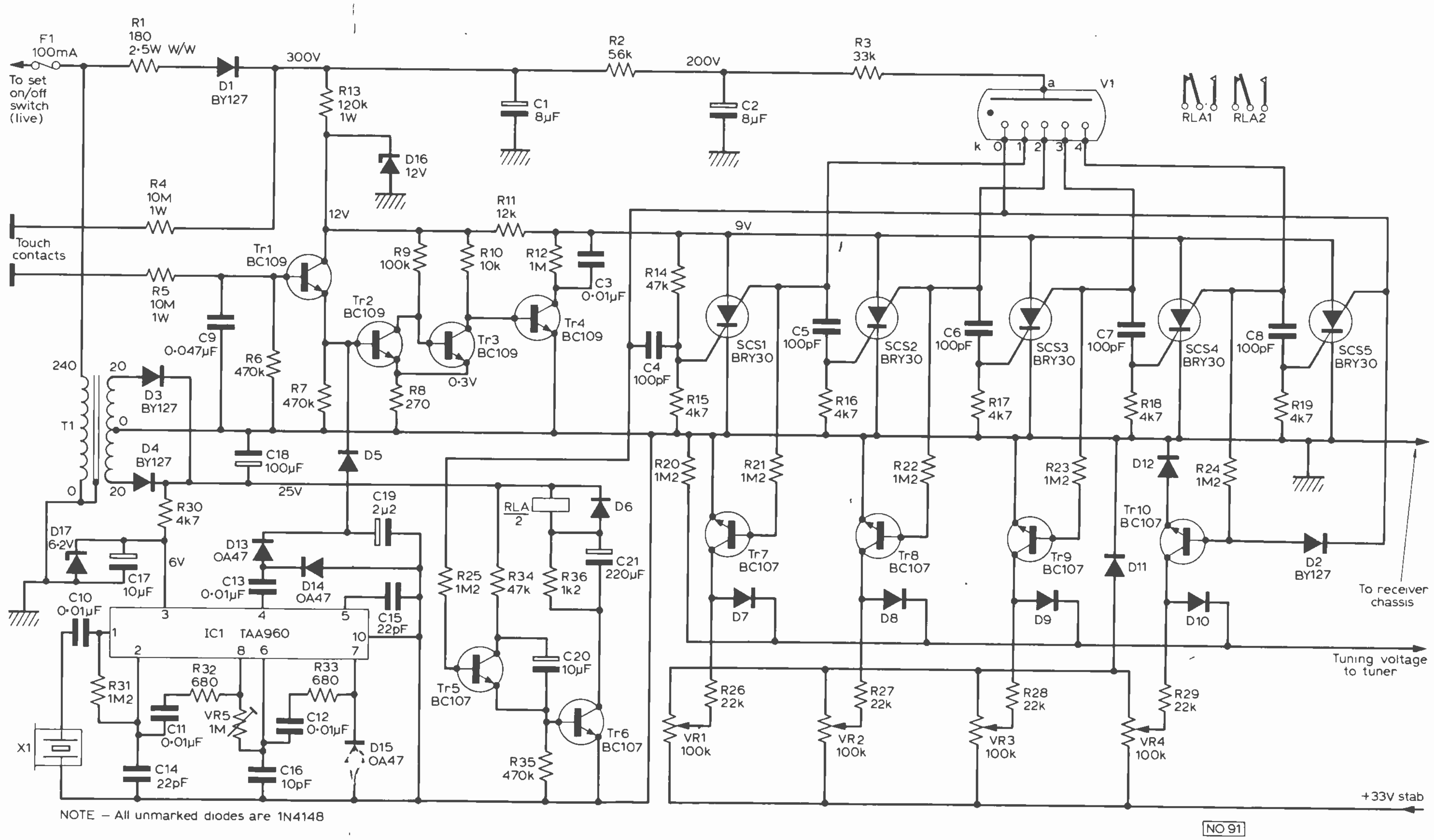


Fig. 1: Circuit diagram of the control unit, including the ultrasonic receiver.

WE have been familiar with remote control of channel selection on some continental colour TVs for some time now, and among British TV manufacturers Rank and Philips have taken the lead by introducing this refinement on their latest range of colour receivers. No doubt there are many people who would like this facility on their existing set, and it was to fill this need that the unit to be described was constructed.

A varicap tuner unit is required in the TV, but if such a unit is not already present it is a simple matter to fit one. It was intended that the control unit should be sited on the front panel of the set, and if a mechanical tuner is being replaced, use can probably be made of the space vacated. If however there is insufficient front panel space, or if you are reluctant to carry out a carpentry job on the cabinet, then one solution would be to house the unit in a small cabinet placed on top of the TV. If this is done some ventilation should be allowed, and the normal safety precautions should be taken to insulate the unit, bearing in mind the fact that the chassis has a direct connection to the mains supply.

An ultrasonic transmitter and receiver are employed for the remote control link, and this is supplemented by a pair of touch contacts on the front panel for direct operation. The unit switches sequentially through the stations each time the transmitter or touch contacts are operated, the station number being displayed on the indicator tube. There is also a receiver standby facility included in the design which comes into operation when station number '0' is selected. On stations Nos. 1, 2, 3, and 4 the standby relay contacts are closed; on station No. 0 they drop out after a few seconds' delay. This delay is introduced to avoid the circuit switching off the TV when No. 0 is passed whilst changing stations.

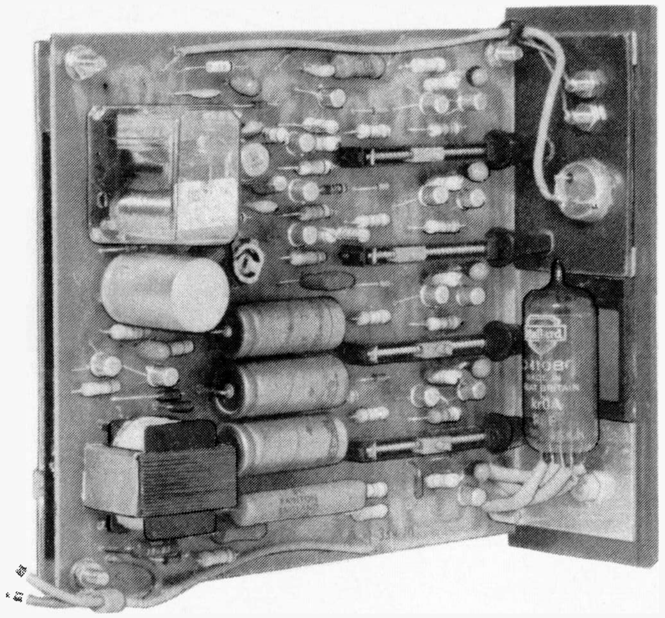
In order to reduce the number of connections to be made to the TV set, the tuning potentiometers are included on the circuit board, and a self-contained power supply is incorporated. The complete circuit diagram is shown in Fig. 1. The TAA960 integrated circuit and associated components form the ultrasonic receiver, the output of which is fed into the touch amplifier circuitry Tr1 – Tr4.

Whenever the touch contacts are bridged, or a signal is received by the ultrasonic receiver, a negative pulse appears at the junction of R11, R12. The pulses occurring at this point are counted by the array of silicon controlled switches together with the cold cathode number tube V1. Information from this part of the circuit is fed to the transistors Tr7 – Tr10 which select the stations in conjunction with the diodes D7 – D10. The receiver standby circuitry consists of Tr5 and Tr6, arranged in the Darlington configuration, along with the relay and associated components.

The Silicon Controlled Switch (SCS)

Although the SCS has been used in some TV receivers as a field oscillator, it is not in common use and possibly some readers are not familiar with it. As some understanding of the device is necessary to comprehend the circuit operation, a brief description follows.

The SCS is a four layer device, made up as shown in Fig. 2(a). Its operation is most easily understood by considering its equivalent circuit shown in Fig. 2(b). Here it is seen that the SCS is in effect an npn and a pnp transistor connected so that the collector current of the one provides the base



This view of the control unit shows the arrangement of components on the front panel.

current for the other. With the supply connected as shown and in the absence of any input to the cathode gate (Gk) or to the anode gate (Ga) the switch is effectively open circuit.

If a positive input in excess of 0·5V is applied to the cathode gate the npn transistor will start to conduct, supplying bias for the pnp transistor in the process. Collector current through the pnp transistor reinforces the base current in the npn transistor, and both transistors rapidly turn fully on. When the switch is in this conducting state the input to the cathode gate can be removed, and the switch will stay on due to the self maintaining bias arrangement. The device can also be triggered by a negative pulse applied to the anode gate, but in the present application this connection is used as an output terminal to switch to earth a cathode of the numicator valve.

In the conducting state the anode voltage (*V*a) is about 0·8 volts, and *V*ga is of the order of 0·1 volts or so, both relative to cathode. The only practical method of bringing the SCS back to the non-conducting state is to reduce the anode current below a certain minimum value (holding current, *I*h) typically 0·5mA. This can be achieved by applying a negative pulse to the anode, as in the present circuit, or a positive pulse to the cathode (k).

Numicator valve

Perhaps an even less familiar device is the cold cathode numerical indicator tube – used in the present circuit to display the station number.

Inside the gas-filled glass envelope is a single common anode and ten separate cathodes shaped so as to form the digits 0–9 plus a decimal point. The anode requires a supply of at least +170V, and a series resistor is included to limit the current to a few milliamps. If a return path is provided via one of the cathodes the tube will strike, and a glow will surround that particular cathode, showing through the glass envelope. Due to the presence of charged gas in the tube in this condition, a voltage of 20–60V appears on the other cathodes. The voltage on any particular cathode depends upon its position in the tube relative to whichever cathode is illuminated. Use is made of this voltage to operate the channel switching transistor.

Shift register

When the receiver is first switched on, the junction of R13 and D16 rises rapidly to 12V as the reservoir capacitor C1 charges to 300V. Tr4 is normally off, and so the voltage at the junction of R11, R12 (supply line to the SCSs) rises at the same rate. However, when it reaches about 7 volts the potential on the cathode gate of SCS1 exceeds the 0·5V required to cause it to switch on, and so it conducts, bringing down this supply line voltage to under 1V.

In the meantime the anode voltage on V1 has been rising comparatively slowly as C2 charges via R2. When striking potential is reached, a return path is already provided by the anode gate of the conducting SCS1, via cathode 1 of the tube. As a result, number 1 in the tube is illuminated when the receiver is first switched on.

This state of affairs continues until a signal is picked up by the ultrasonic reciever, or the touch contacts are bridged. When this happens Tr4 switches on (as described later) effectively placing the uncharged capacitor C3 across the supply line. The supply line voltage drops instantaneously to near zero as C3 begins to charge, and SCS1, now unable to receive sufficient holding current (*I*h), promptly switches off. The cathode circuit of V1 is now broken and so the tube extinguishes, the cathode voltage rising rapidly as it does so. This rise is transferred via C5 to the cathode gate of SCS2, enabling it to switch on when the supply line voltage has risen exponentially (as C3 charges via R11 and Tr4) to just over 1V. V1 is then again able to strike, and this time the return path is provided by the anode gate of SCS2 and cathode number 2. The figure 2 is now illuminated in the tube. Once the command ceases, Tr4 switches off and C3 discharges via R12 to await the next signal. Thus it is seen that each time a signal is received the position of the conducting SCS is shifted one stage along the line, or from SCS5 back to SCS1 due to C4.

It is interesting to note that throughout the cycles of operation the supply line voltage is held down to about 1 volt, and so the junction of the potential divider R14, R15 does not increase beyond 0·1 volts or so. This is insufficient to turn on SCS1 and so the current through R14 is only effective upon switch on.

To summarise then, only one SCS is on at any time, and the cathode of V1 to which it is connected is effectively at zero potential, whilst the other cathodes are at +20 –60V.

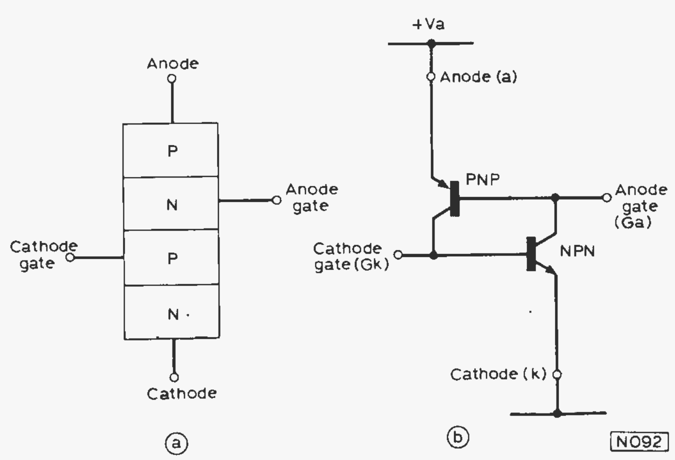


Fig. 2: The silicon controlled switch.
(a) Internal construction.
(b) Two transistor equivalent circuit.

MILLER'S MISCELLANY

CHAS. E. MILLER

The Missing Print . . .

Not the introduction to a crime story this, but referring to a set which came in for repair last week, fitted with the Pye 169 chassis. The fault was complete loss of line sync, much as would be expected from failure of a diode in the flywheel line sync circuit. But in this chassis of course sync is taken care of by the multi-purpose TAA700 i.c. This was duly replaced, without any improvement. Wearily I did what should have been my first move and dragged the set over to my strictly non-portable oscilloscope. The waveforms around the i.c. proved to be reasonably correct, but around the triode section of the PCF802 line oscillator valve they were wild.

Then I noticed that the line whistle was breaking through on to the sound output section. Aha I thought, faulty decoupling, since the PCF802 and the triode section of the PCL86 audio valve are fed from the same h.t. line. To my disappointment however, bridging a 100μF electrolytic across the smoothing capacitor concerned did nothing to help. After a lot of fruitless effort I stuck the test capacitor directly on to an h.t. point near the PCF802. Bingo, perfectly locked pictures! Tracing the print along to the smoothing block at the bottom of the chassis I discovered a 3mm gap near the capacitor's tag. It hadn't burnt away due to a short: as far as I could make out it had never been there! So how the set had managed to work for some three years until the fault developed is anyone's guess!

Pricey IC

Suppose that the line sync fault had been due to the i.c. packing up however. The trade price of the TAA700 is over £4, so the final cost to the customer, including time and transport, would be around the £10 mark. Compared to the cost of a couple of discriminator diodes, or even a new sync separator valve, it seems that progress is a costly luxury!

Grounds for Complaint

Whilst the above mentioned Pye set was in the van on its way back to the owner it was unfortunately scratched due to the carelessness of someone who shall remain nameless (because it was I). It was far too late to return to the workshop to effect a repair and there was nothing in the van in the way of wood dye or scratch remover, though there was an ancient tin of clear wax polish. Then my part-time aerial erector came up with an idea.

"You've a jar of coffee in the lunch box: dip your finger in and rub some in."

In desperation, I tried it. To my astonishment it worked perfectly: the coffee matches the unpolished cabinet wood exactly! A rub over with the clear wax, more to mask the coffee smell than anything else, and the job was complete. For the record, it was Maxwell House. But be sparing, or when the set warms up you'll have that roasted fresh flavour coming from it!

A Peep into the Past

One of the rewarding aspects of writing a column such as this is the interesting correspondence it triggers off from time to time. Following my comments on early EMI television sets some time back I received a letter from a Mr. Easy of Brighton who actually owns one of these sets. I was able to offer some suggestions towards putting it in service again, after which Mr. Easy very kindly lent me his copy of *The Broadcaster Trade Annual* for 1937.

It makes fascinating and in many respects surprising reading. For instance those who think of "hi-fi" as being a comparatively modern phrase will find that Shaftesbury Microphones Ltd. offered "High Fidelity . . . amplifiers . . . to any output", whilst Rola had a 12in. loudspeaker advertised as "...a real High Fidelity unit".

In the chapter devoted to Patents we discover that push-pull amplifiers had first been put on the file back in 1915, amplified a.g.c. appeared in 1923, and in the early 30s Mr. A. T. Witts, in conjunction with Marconi's, patented a remote tuning system using a potentiometer to vary the pull of a solenoid which in turn operated the tuning capacitor!

Naturally space is given over to reviewing the vision *(sic)* sets of the day. Marconiphone and HMV both had 22 or 23 valve sets giving 10 × 8in. pictures, with or without sound radio, at 120 and 95 guineas respectively. This provides an interesting comparison of values with today's colour sets at less than double the price.

Home demonstrations of EMI's early sets had to be attended by one of their own engineers, at a cost of three guineas which was refundable if a sale resulted. As their two brand names were nominally independent, an irresistible mental picture is conjured up of these engineers carrying two sets of overalls in their van, each with an appropriate badge! This is not so far-fetched however, for right on into the 50s a request for spares for an HMV model from a non-dealer would be met by a blank refusal though if you took the trouble to order for the equivalent Marconiphone set the parts and information were freely forthcoming!

Out of Focus

A fault which was new to me occurred recently on a set fitted with the Thorn 3500 chassis. After running for about an hour the focus suddenly drifted right off. If the control was operated sharply back and forth the picture could often be brought back to normal. I tried a different focus panel without effect, then a new tripler, but the fault persisted. A 'phone call to Thorn's service department saved me further heartache. Apparently the spark gap on the tube base between the focus pin and earth is rather too narrow, allowing a slight corona discharge to occur. The cure is to file it just a couple of mm wider and smear it with silicone grease.

Road Safety Note

Falling from a cycle, Hertz.

★ Components list

RECEIVER

Capacitors:

C1, C2	8μF 350V electrolytic
C3	0·01μF polyester
C4 – C8	100pF 160V ceramic or polystyrene
C9	0·047μF L.V. disc ceramic
C10 – C13	0·01μF L.V. disc ceramic
C14, C15	22pF polystyrene
C16	10pF polystyrene
C17	10μF 16V tantalum bead
C18	100μF 63V electrolytic
C19	2·2μF 35V tantalum bead
C20	10μF 25V tantalum bead
C21	220μF 40V p.c. electrolytic

Resistors: (all ±5%, $\frac{1}{2}$W unless otherwise stated)

R1	180Ω 2·5W W/W
R2	56kΩ
R3	33kΩ
R4, R5	10MΩ 1W
R6, R7, R35	470kΩ
R8	270Ω
R9	100kΩ
R10	10kΩ
R11	12kΩ
R12	1MΩ
R13	120kΩ 1W
R14, R34	47kΩ
R15 – R19, R30	4·7kΩ
R20 – R25, R31	1·2MΩ
R26 – R29	22kΩ
R32, R33	680Ω
R36	1·2kΩ

Variable resistors:

VR1 – VR4	100kΩ helical potentiometers
VR5	1MΩ min. horizontal preset

Semiconductors:

Tr1 – Tr4	BC109
Tr5 – Tr10	BC107
SCS1 – SCS5	BRY30 (Mullard)
D1	BY127
D2	BY127 or 1N4004
D3, D4	BY127 or 1N4002
D5 – D12	1N4148 or similar silicon diode
D13 – D15	OA47 or similar germanium diode
D16	BZY88 C12V 400mW zener
D17	BZY88 C6V2 400mW zener
IC1	TAA960 (Mullard)

Miscellaneous:

V1 ZM1080 (Mullard) or Cold cathode number tube 585-330 (R.S. Components); RLA 2p.c.o. 700Ω 27V coil (R.S. Components Type 43); T1 20–0–20V 30mA sub-miniature (R.S. Components); F1 100mA fuse and in-line holder; X1 Ultrasonic transducer SE05B–40R (see note); Copper-clad laminate 135 x 122 mm (5·3 x 4·8 in); Aluminium, plastics for front panel, etc.

NOTE The ultrasonic transducers are available from Hall Electronics, 48 Avondale Road, Leyton, London E17 at £7.00 per pair, including post, packing and VAT.

TRANSMITTER

Capacitors:

C22, C23	1000pF ±5% polystyrene

Resistors:

R37	3·3kΩ	R42	10kΩ
R38, R39	330Ω	R43	220Ω
R40, R41	15kΩ	All ±5% $\frac{1}{4}$W.	
VR6	1kΩ min. horizontal preset		

Semiconductors:

Tr11 – Tr13	BC109

Miscellaneous:

S1 Min. push-to-make; X2 Ultrasonic transducer SE05B-40T (see note); Pocket torch case and $4\frac{1}{2}$V battery (Ever Ready); Copper-clad laminate 63 x 23 mm (2·5 x 0·9 in).

Channel selection

Cathodes 1, 2, 3 and 4 are connected to the bases of Tr7, Tr8, Tr9 and Tr10 respectively, and so one of these transistors will be biased to cut-off, while the other three will be turned fully on. If for example station number 2 is selected Tr8 will be switched off, and whatever potential has been selected by the tuning potentiometer VR2 will be passed on to the tuning line via D8. The voltages selected by the other three potentiometers however will be bypassed to earth by their respective transistors, and the associated diodes will be reverse biased.

Standby circuit

On stations 1, 2, 3 and 4 cathode 0 of V1 is at 20 – 60V potential, and so bias current flows through R25, turning on the Darlington pair and energising the standby relay RLA/2. When 'number 0' is selected, however, Tr5 will switch off. Bias for Tr6 is still preserved for a second or two whilst C20 charges, and then Tr6 switches off, releasing the relay.

It is well known that considerably more current is required through a relay coil to attract the armature than is necessary to hold it in thereafter. In order to reduce the current demanded from the sub-miniature mains transformer, use is made of this fact by the introduction of R36 and C21. The relay holding current is set at only 13mA by R36 and the coil resistance, while sufficient pull-in current is ensured by C21 as it initially charges when Tr6 is switched on.

When channel 0 is selected the tuning line would be disconnected from the pots, leaving the reservoir capacitor on the tuner to discharge via R20. The result would be that unpleasant off-station noise would occur while waiting for the relay to drop out. In order to avoid this it is arranged that station No. 4 remains selected at this time. This is achieved by removing bias from Tr10 via D2. The diode D12 in the emitter of Tr10 is introduced to ensure that the sum of the forward voltage drop of D2 and the Ga voltage of SCS5 does not exceed the voltage required to turn on Tr10.

Touch circuit

Transistors Tr1 and Tr2 are normally off, and so Tr3 is switched on by bias through R9. When the touch contacts

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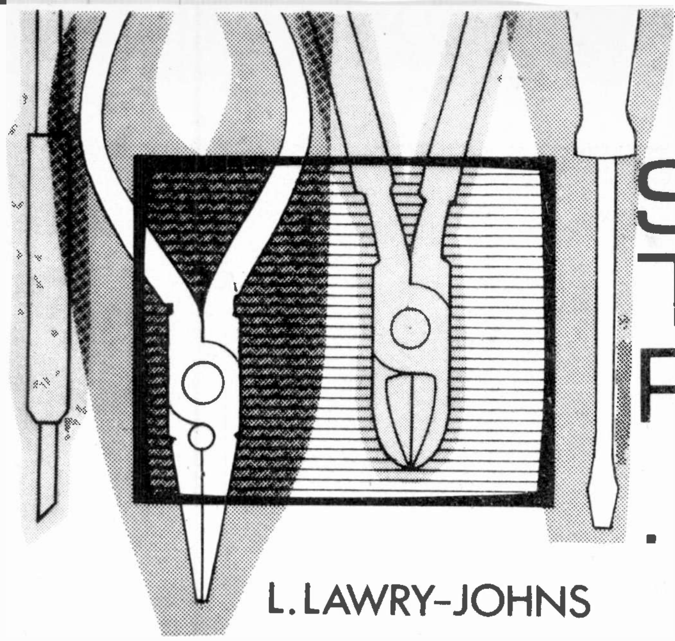


SERVICING TELEVISION RECEIVERS

.... COMES OF AGE!

L. LAWRY-JOHNS

It doesn't seem so long ago that we started this series of articles, and when all things are considered twenty-one years is not really a long time. The fact that our poor old eyes are beginning to get a bit bleary when we look at some printed panels has to be accepted however, and on pondering we can say that there have been a few changes since we were heaving those old Cossors and HMVs about (if you think colour sets are heavy, you should have tried carrying the early TVs up the garden path).

What did we start with? Oh yes, it was the HMV Model 1807. We covered the 1803 and 1805 later in the series, though these had been around much longer, principally because the 1807 was a much more widely distributed model and had more common faults.

Resistors

However much things have changed, they have not always changed for the better. Whilst the 1807 had its share of faults, one thing it did have was a reliable mains dropper. Which sets in recent years have had one of these? Just look back over the past ten years, say since dual-standard sets became common: almost every chassis has had a dropper that fizzled out for some reason or another.

In the case of GEC/Sobell sets it is always the h.t. end that goes – in fact about 80% of these receivers have had new dropper sections during their life. Similar remarks apply to Bush sets and to a lesser extent to those from Philips.

Look at Thorn receivers: the single-standard 1500 chassis (probably the most widely used of all) has its share of common faults but surely the most frequent one is failure of the R111 (148Ω) section of the dropper – this time the heater section. We always fit a 140Ω RS section rather than a complete new dropper which would only fail in exactly the same way after a time. Even the good old Pye 11U series suffered from the same defect (heater section failure). as did the Philips 210 chassis. Isn't it passing strange that this item, which was so reliable 25 years ago, has been so "cost improved" that its failure accounts for a good percentage of our servicing income?

It may be said that all this is irrelevant in these days of all-transistor colour sets, but what about the large 2Ω wirewound resistor (R4) on the power supply module of the Thorn 2000 chassis? You would think that an item of this size would last forever, but we often find it open-circuit. So we are wondering about the latest 8500 chassis and its variants. Apparently Big is not necessarily Beautiful!

Mind you, set manufacturers have done a wonderful job of keeping prices down. Television and radio receivers cost no more now (almost anyway) than they did 40 years ago. With inflation ripping away at a frightening pace in a country where people are paid not to work by the people who do work and where (most likely) the same people are paid to produce children by the people who sensibly restrict the size of their families, this is a very good record.

What you gain on the swings you lose on the roundabouts: but would it have increased costs so much to have used adequately rated components? Look at the 18kΩ resistor used in the EH90 sound detector circuit in GEC group dual-standard chassis. Early models used a wire-wound resistor which just didn't fail. Later models were fitted with a carbon type which failed in practically every case, thereby causing other damage. What a pity. Look at R44 (47kΩ) in the 1500 chassis (sync separator screen grid feed resistor): it really does have to be changed for a larger type with every passing day.

Capacitors

If you think we have gone on rather about resistors, what about the capacitors used in certain makes? The majority of the little horrors that cause trouble are round and black and are not made in this particular island. They are mainly electrolytic, and are found in quite a few makes of receiver (not only TV sets). Philips don't (as yet) seem to use them, which probably accounts for the fact that you don't seem to get much capacitor trouble with these sets. Readers may remember us saying a month or two ago that we had some very intermittent trouble (loss of line timebase operation every few weeks) on a Pye hybrid colour set. In the end this turned out to be due to intermittent leakage in the PCF802 line oscillator valve h.t. supply decoupling capacitor (16μF) which was a reliable type in early models but which was later changed in type and became a black horror.

Speaking generally, we are experiencing more trouble with capacitors – electrolytic and otherwise – in all applications than hitherto. Now to put one or two potentially unreliable capacitors in a black and white set in order to save a few pence per set is one thing: to put a large number in a colour set is another! We know that set designers are responsible to cost conscious accountants, but they surely don't have to go bloody mad and get their components from the cheapest source of supply every time.

Some of our manuals are now prettily decorated with little circles around capacitors which have been found to fail regularly. They improve the appearance of the circuit no end!

Circuit Diagrams

Have you noticed how easy it is to follow the circuit diagram of a home produced set compared to those of imported receivers? Surely it isn't just a matter of what one gets used to. It seems that although the designers of foreign sets are quite regular chaps, the service sheet draughtsmen should be detained for an unspecified period in the maze at Hampton Court. Heaven forbid that our circuits should ever be made to look like theirs for the sake of international standardisation. We know that the Chinese are very good at puzzles, but it appears that the puzzle inventors in Japan are all engaged in producing circuit diagrams which would defy the united endeavours of the whole CIA.

We have a cat by the name of Trog whose job it is to sit on the bench and help us repair the sets. Her paws are constantly on the go at the pictures on the screen of a test set, and she is very good at tennis. When we are trying to trace out a circuit however her paws are usually ahead of our finger or screwdriver blade, and in the case of imported sets she stands a better chance of arriving at the right place than we do!

A Better Deal for the Dealer

We hear an awful lot about consumer protection nowadays: the customer seems to be protected at every turn by this and that piece of legislation, the dealer being responsible for everything he sells. This is how it should be up to a point, and at least may help to curb the growing trend for complicated electronic equipment to be sold in supermarkets, chemist shops, and so on.

The dealer does seem to get the raw end of the deal however as far as servicing recently sold equipment is concerned. When the customer has had his new set for only a few weeks he certainly does not expect to have to pay for service, and most dealers would not charge anyway. But the job still has to be done, sometimes at considerable expense even though the item that has to be replaced costs only a few pence. The expense is incurred in keeping stocks of spares, some of which may never be required, loading this stuff on to a van (which is no small item itself in the balance sheet), attending the customer's home where the fault may or may not appear, tracing it when it does, putting it right and then going on to the next non-paying job.

Contrary to the views of the majority of people, the average small dealer does care about his customers and his reputation. Although the manufacturer issues a carefully worded guarantee (which the customer never reads anyway) it is the dealer who smoothes out the troubled waters and bears the brunt when all is not well, leaves the customer happy (we hope) – and the manufacturer blissfully unaware that his product has been the cause of a minor rumpus. Admittedly the dealer makes a fair profit at the point of sale, but with margins being cut and overheads shooting up in a frightening manner – due to nationalised industries which no matter how inefficient they are can always fall back on the government to make up their deficits, political leaders whose only answer is to put up taxes and thereby increase the cost of living still further, plus the antics of local and county councils – that profit is difficult to find at the end of the accounting year (he said having just returned from his accountant's office feeling a bit gloomy).

With all this and VAT, it is no wonder that the small dealer is a vanishing breed. So if you have one around you – assuming you are not one yourself – be kind to him. He may not be there much longer to help and advise you on that piece of equipment you got from a discount warehouse because it was a few pounds cheaper than the same thing in his window.

Sorry to ramble on a bit: we don't do it very often. Having talked only about specific TV models all these years, and about putting them right when they go wrong, it makes a change to have a general natter and a moan about this and that. Once one has moaned and groaned about everything in general however, one realises one hasn't too much to complain about really and feels rather better.

Let's Get Back to TVs

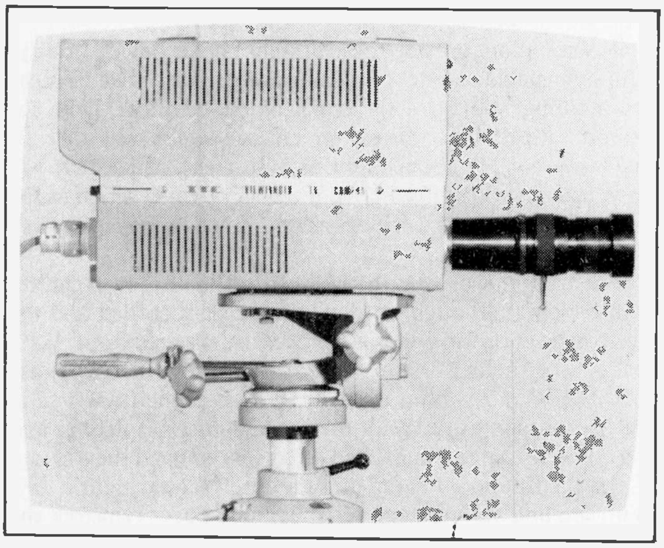
A snag about writing these articles is that having "dealt" with a particular model one immediately has a rush of these sets coming in with a fault one didn't mention. Take for example the Philips G6 colour chassis which was the last one we went on about (July and August). Since then we have had several suffering from the same fault which in the first case was awkward to track down because it was intermittent.

The trouble was that the mains fuse FS1107 (top centre) kept blowing although no shorts could be recorded and the set would work for a time after the fuse was replaced. With a fuse of higher rating fitted, the 10Ω thermal fuse R1073/FS1115 sprung open to show that the fault was in the line output stage. With the thermal fuse resoldered and the correctly rated mains fuse fitted we removed the top cap of the PY500 boost diode and the fuse blew straight away. With the line output stage screening box cover removed the fuse didn't blow. This took us to the line shift control R1070 and its shunt capacitor C1024. Close examination showed that one end of this capacitor was tracking across its insulating sleeve to chassis. All that had to be done was to release it from its clamp and reinsulate it. Since then we have had three more with the same fault, each put right in minutes. Considering that the fault has started to occur on sets that have been in continuous use for over seven years, it serves to show how common faults can take some time to put in an appearance.

We have often wondered whether we should run a first article on a particular chassis, say within two years of its introduction, and then follow this up after a further couple of years with a re-run listing the faults we have encountered subsequently. This is open to discussion of course, as is a suspicion that has recently been exercising our mind – that some of the common faults encountered in one part of the country are not necessarily experienced in other parts. For example, George Wilding has said that line output transformer failure is seldom the cause of receiver breakdown. Now George lives in the west country (south west to be more exact), but we in the south east have a very high proportion of line output transformer failures. Could it be the climate, or perhaps the more simple fact that our average mains supply is over 240V whereas it could be a little lower elsewhere? Even with unit audios of various makes we find that the mains transformer is inclined to suffer from shorted turns on the primary winding. We have always assumed that this is generally experienced everywhere, but perhaps this is not so? Setmakers' service departments could possibly tell us more about possible geographical fault patterns or whether such a suggestion is nonsense.

Well, we've had our little luxury of a gossip and a moan, to make a change. Back to the bench now to root out all those awkward faults to include in the more usual style of servicing article. Cheers!

CCTV



PART 18 **Peter GRAVES**

FOR installations such as those used for security surveillance, industrial process supervision, document viewing and so on, mixing – that is, the electronic superimposition of two or more video signals – is not normally required and a simple switch box (described in a previous article) is sufficient to select one of a number of signals for viewing. CCTV studios, used for making educational or training programmes for direct viewing or recording, call for a much higher standard of presentation and simple switching between cameras is often not enough. Audiences are preconditioned to broadcast television and expect a slick technical production.

The introduction of special effects (mixing is a simple example) can enhance the production or provide for the better understanding of the programme material. For instance, split screen effects – covered later – enable comparisons to be made directly between the pictures from two cameras and greatly increase the quality of the final product. Although cost precludes the type of equipment used by the BBC or IBA, satisfactory results can be obtained from the simpler equipment currently available on the CCTV market.

First, let's discuss some of the terminology of signal selection and processing. Cutting is the process of switching between video sources – these need not be cameras and can include video recorders and off-air receivers. An off-air receiver is a high quality domestic TV front end giving a standard level video output and sound. These signals can be routed round the distribution system of an establishment using CCTV in the same way as programmes from an internal studio. The word cut can also be used as a verb, the producer can say: "cut to camera 1", meaning switch to camera 1. Mixing is described above. The two pictures being mixed must be synchronised together and the effect, roughly, is that of a double exposed photograph although, as we shall see later, the degree of superimposition can be varied with a mixer. A mixer is the equipment used for mixing; in the usual type of mixer for CCTV work it is also possible to cut between signals.

Mixing and cutting

Before we look at the operation of the mixer a little more background is needed, this time dealing with the different types of cuts and mixes that can be carried out on a mixer. A cut, being just switching between signals, takes place in a very short time. The very best equipment uses vertical interval switching, the actual switching taking place during the vertical blanking period so that there is no disturbance to the output viewing screen by unwanted switching transients. In practice, an ordinary bank of switches does the job almost as well and is simpler and cheaper. Fig. 1(a) shows in diagrammatic form a cut between two video pictures called picture 1 and picture 2 and also the appearance on the monitor looking at the output. Alternatively, the picture can be cut to or from blacks. In this case one of the pictures carries no video information but just syncs, to keep the monitor's circuits locked with the screen blank (Fig. 1(b)).

A mix (also called a lap dissolve, cross fade, or simply a dissolve) between two inputs starts with the first at a maximum and the second at zero amplitude (video wise). The first input level is then reduced while, simultaneously, the level of the second signal increases from zero up to a maximum. The effect is shown in Fig. 1(c). Again, the signal can be faded to blacks or faded up from blacks. An alternative type of mix is the fade-in, fade-out

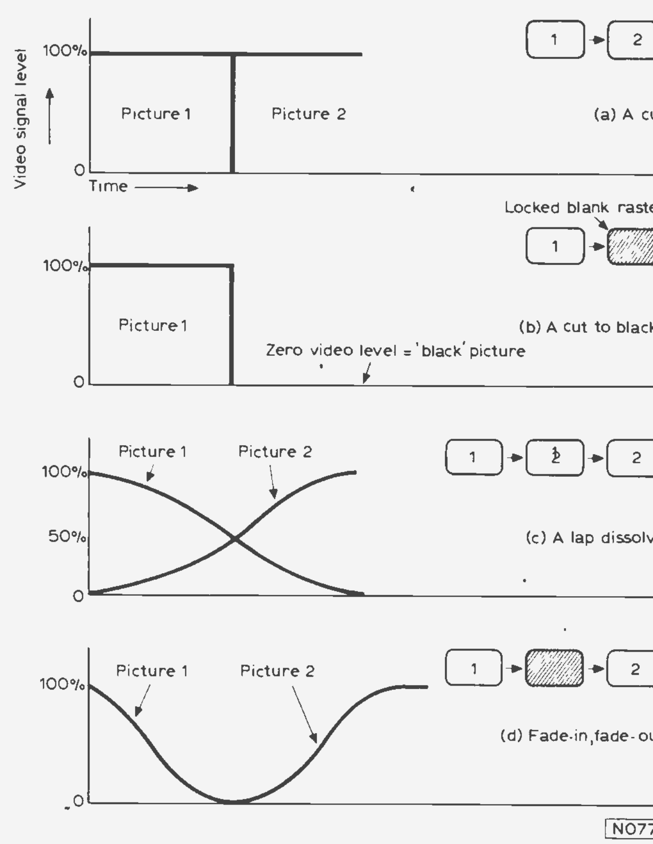


Fig. 1: Various forms of cuts and mixes.

(Fig. 1(d)) where the first video signal is momentarily faded to blacks then the second signal is faded up from blacks.

Mixing audio signals is comparatively easy, Fig. 2 shows a very simple audio mixer that will do the job. Composite video signals cannot be mixed in this way as both the video and synchronising information will be attenuated together as the faders are reduced – with deleterious effects on the locking of monitors fed by the mixer output! A mixer for use with composite input signals must have a sync stripper (similar in operation to a sync separator used in domestic circuits), the sync from one channel must be routed round the mixing stage and added back on to the output video signal to give a composite output. Blacks are generated by feeding one of the mixer inputs with syncs only, derived from the sync pulse generator via an attenuator to reduce the 2V SPG output down to the video level. It is often easier to mix non-composite signals (video information and blanking only) and to add the syncs at the output of the mixer after the actual mixing has been carried out.

A video mixer

A simplified diagram of a typical mixer for CCTV work using non-composite signals is shown in Fig. 3. At the left is a switching matrix, enabling any input to be routed to any of the three output lines (*A*, *B*, or *PREVIEW*). The output lines are sometimes referred to as buses (short for busbars), a general term for a common line. The crosses at the junctions of the lines denote normally-open push buttons; depressing the button will connect the appropriate horizontal output line to the vertical input line. Some mixers have buttons fitted with lamps, switched by auxiliary contacts so that the depressed button lights up. Disregard, for the present, the row of buttons marked *PREVIEW*. The bank of buttons marked *A* is mechanically interlocked preventing more than one input being selected at a time: once depressed the button stays down until another button is pressed. The *B* and *PREVIEW* banks are also interlocked but each bank is independent of the others.

The two faders, although having separate controls, are mounted together so that they can be operated simultaneously. A sketch of the front panel of the mixer is shown in Fig. 4 and the faders are wired so that when both are at the top the *A* channel signal is at a maximum and the *B* channel is at zero and the other way about at the bottom. The outputs from the faders are combined and passed to an output stage where the final syncs are added.

The fader is used in a number of ways, first for cutting between two inputs. Suppose both faders are at the top of their travel, so that the signal selected by the *A* bank of buttons is present at the output alone (since the *B* fader is at zero). Cutting between inputs is then just a question of punching the button on the *A* bank corresponding to the desired signal. If the faders had been both at the bottom (*B* output at maximum, *A* at zero) then the signals would have been cut in with the *B* buttons as desired.

A mix uses both rows of buttons and the faders: suppose that both faders are, again, at the top and that input 2 has been selected on the *A* bank of buttons. Then, as described above, input 2 will appear at the mixer output. If it is then desired to mix from input 2 to input 3, input 3 button is pressed on the *B* bank, this will not affect the output picture since the *B* fader is at zero. The two faders are then slid slowly (or quickly depending on the rate of mix required) from top to bottom of their travel,

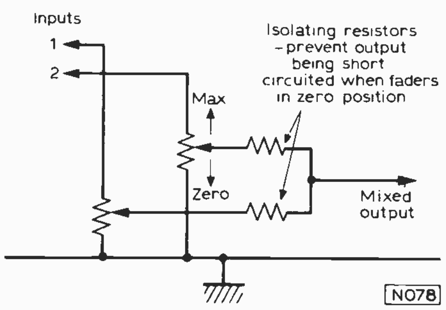


Fig. 2: Circuit of a simple audio mixer.

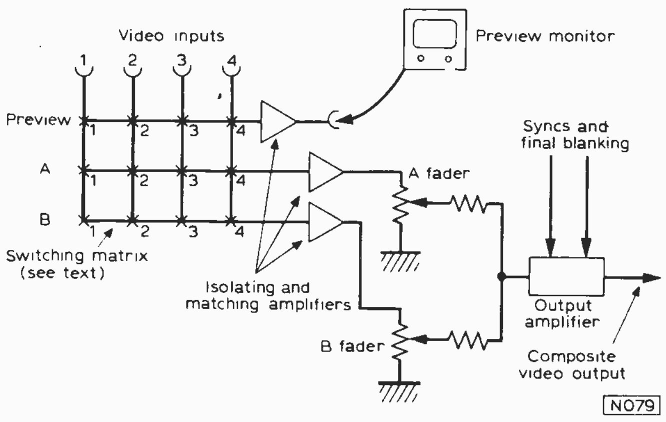


Fig. 3: Simplified circuit of a video mixer.

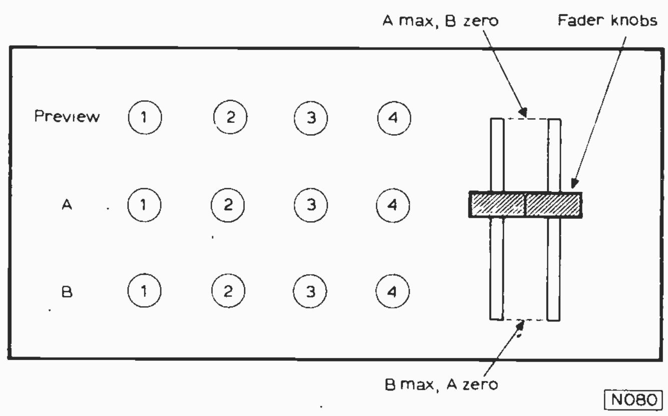


Fig. 4: Video mixer front panel layout.

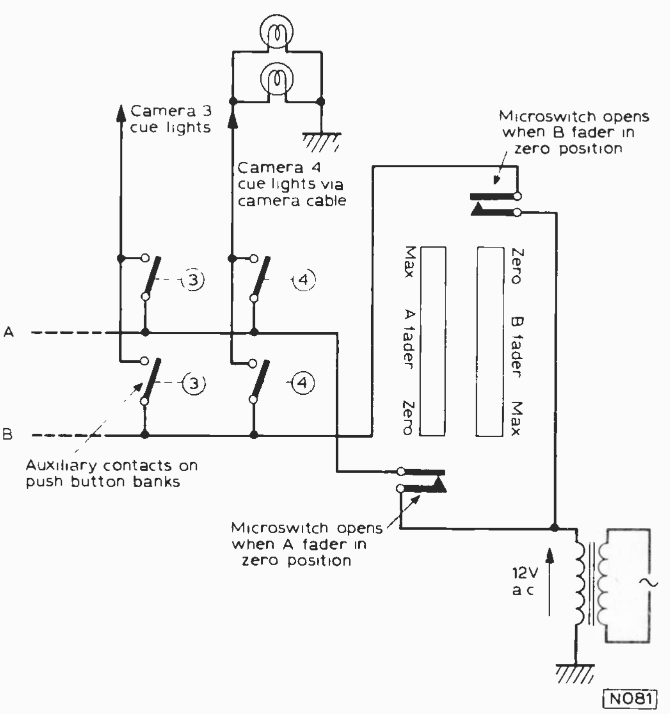


Fig. 5: Cue light circuit arrangements.

progressively increasing the amount of signal from the *B* bank while decreasing the signal selected on the *A* bank. Halfway along the fader travel there will be 50% of each picture visible and they will appear to be superimposed. The faders can be stopped at any point in their travel to produce any desired degree of superimposition. If a full mix (that is, faders go from one end to the other) is carried out another mix can be carried out by selecting the next picture on the *A* bank buttons and returning the faders to the top. Alternatively, the next picture can be cut to by pressing the correct button on whichever bank of buttons is in use.

Cueing lights

Studio cameras are fitted with cueing lights so that the performers can see that a particular camera or cameras is on-air, that is, switched to the output of the studio. Normally, a camera is fitted with two lights wired in parallel, one on the front of the camera under a coloured cover and the other at the rear, alongside the camera monitor for the camera operator. The lights are controlled automatically by auxiliary switches on the mixer banks and also by microswitches operated by the faders so that, during a lap dissolve, both the cameras in use have their cue lights on. Power is supplied from a small transformer in the mixer (12V a.c. is typical) and the lamps are fed through the camera cable (Fig. 5).

The bank of buttons marked *PREVIEW* enables the mixer operator to view any inputs without having to put them "on-air", in this way he can select and inspect the next picture needed. Normally the most important inputs have their own monitor so that the production team face a bank of monitors carrying major inputs, a preview monitor on which any input can be punched up and an output monitor to check the final signal.

To understand what an insert is, consider two photographs of the same size laid on top of each other with both pictures face up. In the top one a hole (rectangular for convenience) is cut so that

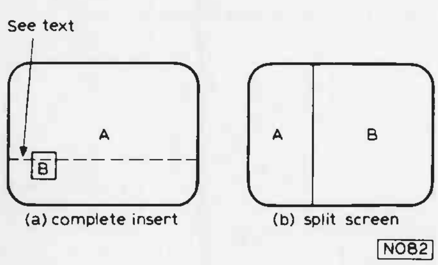


Fig. 6: Two types of insert and their appearance on the screen.

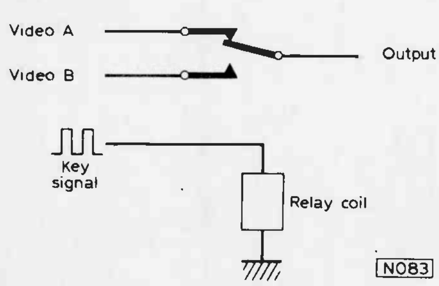


Fig. 7: An elementary split screen effect generator.

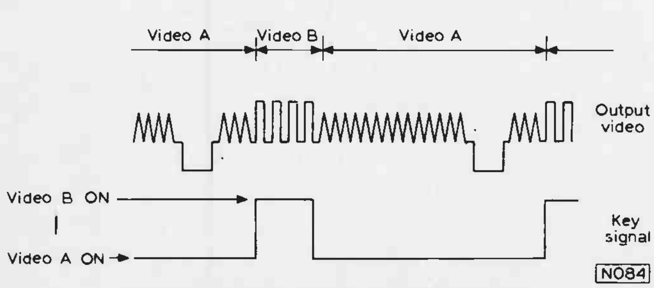


Fig. 8: Keying in an insert at line frequency.

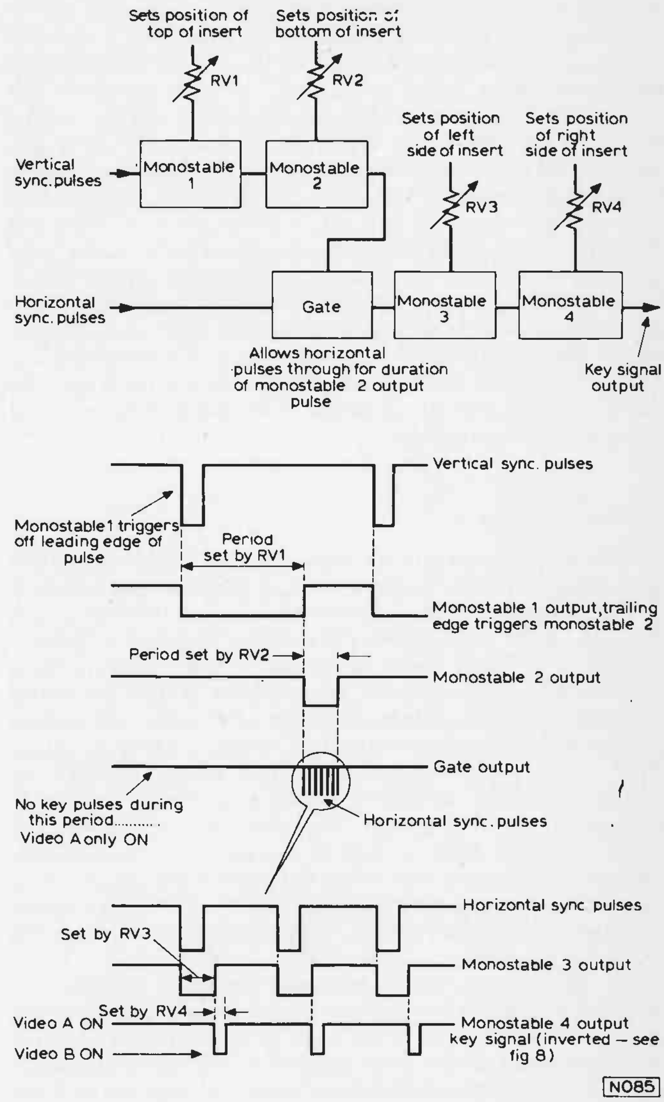


Fig. 9: Generating the box insert of Fig. 6(a).

part of the lower one can be seen. Now, translate this into television terms; suppose we are viewing a race picture *A*, Fig. 6(a), and we also wish to view simultaneously a clock for timing purposes. A second camera views the clock and that part of the picture is "let into" the *A* picture electronically. Note that although the cameras are synchronised together there is no superimposition of the two pictures, no part of the *A* picture appears in the *B* area and vice versa. Part of the *A* picture and a great deal of the *B* picture (in this case) is not used. A second example is the split screen effect, Fig. 6(b), useful for comparing two pictures on the same screen.

Key signal

As this is a simpler example its circuit requirements will be considered first. An elementary way of achieving the effect is shown in Fig. 7; a key or switching signal is generated which energises the relay, changing over the contacts. Taking any line of the picture, the line starts and picture *A* is displayed; at some point (the same point on each line) the relay is energised and picture *B* is displayed until the end of the line when the relay is de-energised during the line blanking period ready for the *A* picture at the start of the following line. As the changeover takes place once every line (of 64μS duration on a standard 625-line system) a mechanical relay is not practical as it cannot operate fast enough. Even a fast reed relay requires around a millisecond or about 15 TV lines to change over! An electronic switch must be

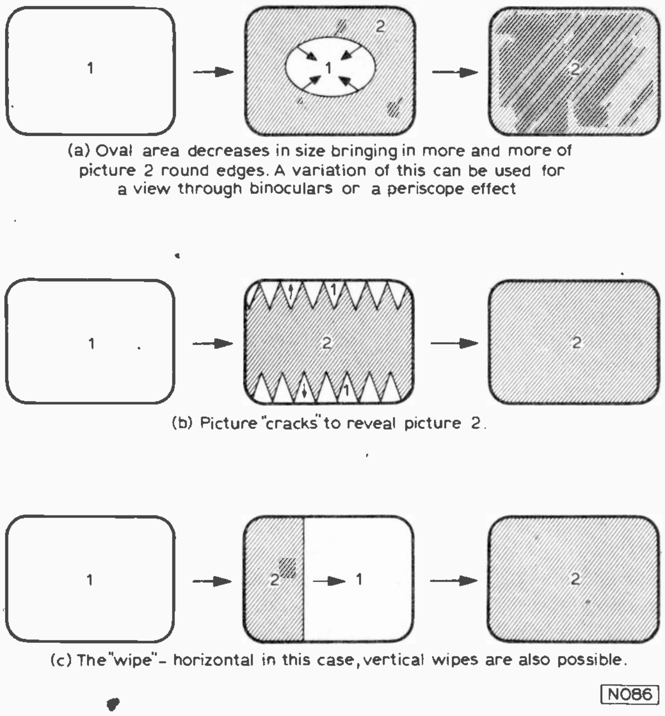


Fig. 10: Some of the more sophisticated effects produced by insert techniques. These are seldom encountered in CCTV.

used and this could use transistors, f.e.t.s, or diodes. The insert amplifier is fed with syncs from the same SPG as the cameras and develops the keying signals using the sync pulses together with monostables (described in an earlier article) so that the pulses occur at the correct times. To achieve the insert of Fig. 6(a) the keying signal must be of the form shown in Fig. 8 along the line shown dotted on Fig. 6(a). Above the insert area and below it only picture *A* is on, so that no keying pulses are present during these periods.

A monostable triggered by the vertical sync pulse determines when the top edge of the insert period will occur, another determines the length of time (that is, how many lines occupied) the insert will be present. This switches on a third monostable which generates the pulses at line frequency shown in Fig. 8 via a gating circuit (Fig. 9). The width (the length of time the pulse lasts) of any of the pulses can be simply and continuously varied by altering the component values of the monostables so that the position and size of the insert can be altered at will.

Complex shapes

Other shapes can be generated by more complex equipment, the rectangular insert of Fig. 6(a) could be made triangular by progressively increasing the length of the keying pulse for the time of the insert and almost any shape is possible. More sophisticated mixers use similar effects to obtain slick changeovers between pictures, and some examples are shown in Fig. 10. These are spectacular but so rarely used in CCTV work that the cost of the extra equipment is not justified.

Keying signals can be generated from the video output of a camera. Suppose one camera is looking at a white box and another camera is looking at an identical box against a dark background. The transition from white box to dark ground can be detected (by the change in level of the video signal from the second camera) and the resulting signal used as a key to switch in a third camera so that its picture will appear as an insert on the box in the scene of the first camera. There are endless combinations of this type of effect and it is exploited in colour television where a colour signal can be used as the key (chroma keying), the pictures on the screen behind newscasters is an example. The insert occurs only on the particular colour of the screen behind them and not on their faces or clothes.

Service Notebook

G.R.WILDING

Sparking Noises

The trouble with a KB colour receiver fitted with the CVC5 chassis really started some months ago with the overnight cooking of the Christmas turkey! The set was near the kitchen door, and after being for several hours in conditions of very high humidity it was found on switching on the following morning that sparking noises came from inside the e.h.t. compartment. Fortunately it turned out to be only from the high-voltage 210pF capacitor which decouples the focus supply, and on bending the leads of this component so that it was farther away from all metalwork no further trouble was experienced. Until recently that is, when the owner complained of really severe sparking from the same area.

On removing the e.h.t. cover we found that there was arcing, or more truly high-voltage tracking, from this 210pF capacitor along the top side of the tripler unit to chassis. The capacitor is soldered to a tag bolted about half way along the top edge. This tag is simply a holding point, the focus voltage being taken from the slider of the focus control. As a result of the extensive arcing and tracking the top edge of the tripler had become sticky and carbonised. It was impossible to wipe clean, so as the tripler itself was in order we snipped the top edge of the unit off bit by bit along its length. A clean rag dipped in meths then removed the sticky feel from the main body of the tripler, and after doing this we mounted a small section of tagstrip inside the e.h.t. can to provide a soldering point for a new 210pF capacitor and the lead from the focus control. We used ordinary tagstrip, but because of the high voltages involved made the connection to the fourth tag from the chassis end and removed the intermediary tags. This provided a complete cure, and we don't expect any more tracking to develop.

Overloading

A dual standard set fitted with the ITT/STC VC4 chassis was used on u.h.f. only. Ample sound was obtainable, though accompanied by really excessive vision buzz, but any attempt to tune in the picture produced only very dark modulation of the raster with neither line nor field sync. The contrast control was found to have no effect, this fact, together with the sound and vision symptoms, indicating that gross overloading was present due to non operation of the a.g.c. circuit.

Our first suspicion was that the PCF80 pentode sync separator might be at fault, failing to produce the usual negative grid bias which of course is used to provide the a.g.c. potential. On removing the aerial plug however a grainy but perfectly lockable picture was obtained, with buzz free sound (the local transmitter was only some three miles away). On studying the circuit diagram we found that the sync separator's negative control grid voltage is applied to the a.g.c. rail via a 1MΩ resistor (R64), the negative voltage being backed off by a small positive potential from one or other of the contrast controls (separate controls being used for 405 and 625). The resulting potential is then fed to the tuner via a 2·2MΩ resistor and to the EF183 common vision and sound i.f. amplifier via another 2·2MΩ resistor, the latter feed being controllable by an a.g.c. preset control which is fed from the control grid circuit of the line output valve. Both the tuner and the i.f. a.g.c. feeds have clamp diodes shunted across them to prevent the rails going positive, and although such diodes on very rare occasions go open-circuit if either had done so in this case a.g.c. would still have been applied to the other controlled stage.

In view of the severity of the overload, probably caused by complete absence of negative a.g.c. voltage, we decided to check the common 1MΩ supply resistor R64 from the sync separator control grid. Even with the aerial plug still disconnected there was almost −18V at the control grid end of this resistor, but a slight positive voltage at the other end. Then, on shunting the meter across this resistor, normal contrast control was obtained and a good picture was still present when the aerial was reconnected. R64 was open-circuit of course, due we found to one of the lead-out wires having been given an excessive pull, probably during assembly.

Instances of lack of gain due to an open-circuit or increased value resistor failing to apply sufficient back-off voltage to the a.g.c. rail from the contrast control(s) are common, but this is the first time we have come across a resistor applying the negative voltage to the a.g.c. rail being at fault.

Transistor Working Voltages

As with valve voltages, transistor working voltages are of course mean values. For example, although alternately cut-off and then saturated for equal periods the transistors in a bistable circuit will show collector voltage readings of roughly half the supply line voltage. Sync separators and pulse amplifiers show high collector voltage readings since they are cut off during most of the line period, conducting only when the sync pulses are present. Some a.g.c. amplifiers which are fully conducting under no-signal conditions then show collector-emitter voltage readings of only a fraction of a volt. Clearly therefore the collector-emitter voltage gives a very good indication of how hard a transistor is being driven, since increasing the forward bias reduces the collector voltage and increases the emitter voltage – assuming of course that feed resistors are present in both circuits. Thus if transistor voltages are found to be incorrect, the direction of change shows whether the cause is increased or decreased forward base-emitter bias.

In the usual operating region, above the knee in the characteristic, quite large changes in supply line voltage produce only small changes in collector current. The forward base-emitter bias for most signal amplifying stages is obtained from the junction of a potential divider connected across the supply. As positive l.t. and h.t. rails are mainly used in TV sets the emitter of an npn transistor will be returned to chassis. Its emitter voltage will be low therefore, its base voltage 0·5-0·6V higher, and its collector voltage anything up to the rail potential depending on the d.c. resistance of the load.

Where, as is usually the case, an emitter resistor is included in the circuit, even really excessive forward bias will not unduly increase the base-emitter voltage since the heavy emitter current will result in a proportionate voltage being developed across the emitter resistor.

If the collector voltage is lower than specified, indicating excessive collector current, the cause could be abnormal leakage current through the transistor, particularly if it is connected as a common-emitter amplifier since the leakage current is then amplified as a result of the working current gain. For silicon transistors however, excessive collector current/low collector voltage is much more likely to be the result of excessive forward bias. This in turn can be caused by one or more of the following faults: (1) a leaky base coupling capacitor where this is fed from a point at higher voltage; (2) an open-circuit or dry-jointed lower

Service Notebook 2

resistor in a potential divider network providing base bias; (3) a reduced value upper resistor in such a potential divider network; (4) a reduced value emitter resistor or leaky shunt electrolytic capacitor.

High collector voltages on the other hand indicate reduced forward bias, generally the result of an increase in the value of the upper resistor in the potential divider base bias network.

Sync separators and some types of oscillator develop a small reverse bias under normal operating conditions of course (i.e. oscillators operating under class C conditions). The voltage changes produced in such stages when they are not working are symptoms of, not causes of, the fault condition. Thus lack of video input to a sync separator, or failure of an oscillator to work, will reduce the collector voltage below normal due to the increased collector current flowing.

Weak Picture

Due to local conditions only v.h.f. transmissions could be received on a KB model fitted with the VC3 chassis. Sound was good, but the picture was so weak it could only just be locked. Since the sound was o.k. we assumed the common vision and sound stages to be in order and replaced the PCL84 video output valve and EF184 vision i.f. amplifier. This did not improve matters, so suspicion centred on the vision detector diode which, as usual, is mounted in the final i.f. transformer can. External tests can be used to check it with adequate accuracy however, by means of resistance measurements between the control grid of the video amplifier and chassis. The circuit – drawn as it is in the 405-line position but omitting the switching for clarity – is shown in Fig. 1. The various paths to chassis are the very high resistance one via the pentode's grid leak resistor R53, and another via the grid stopper resistor R50 and either D6 or its load resistors R47 and R48 – disregarding the coils. A good diode will read about 400Ω when forward biased and a very high resistance – above 1MΩ – when reverse biased. Thus with the meter in the position shown and the leads connected so that D6 is forward biased one would expect to read about 800Ω (R50 plus D6), while on reversing the leads so that D6 is reverse biased a reading of around 3kΩ would be expected (R50 plus R47 and R48). What we actually found however was a reading of about 1kΩ in one direction and about 2kΩ in the other.

On disconnecting the transformer leads and removing the can the GD12 was found to have a forward resistance of about 400Ω

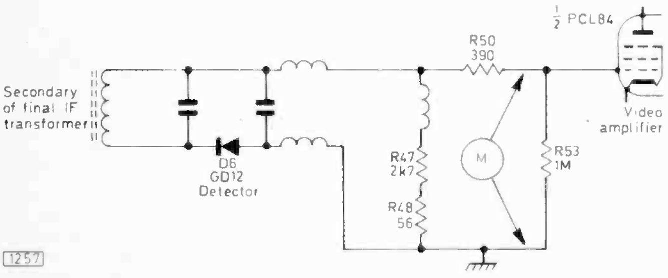


Fig. 1: Checking the forward and reverse resistance of the vision detector diode by means of a meter connected to the control grid of the video output valve. The circuit is as used in the ITT/STC VC3 dual-standard chassis, with the switching omitted for clarity. This test on the detector diode cannot be made with the set switched to 625 lines since the detector diode is capacitively coupled to the video output pentode on this system.

but a reverse resistance of only about 2kΩ. This low reverse resistance was clearly the cause of the very poor detection efficiency, and on fitting a new diode first class contrast was obtained. This is a rare fault to come across with a detector diode: it is far more common for the forward resistance to go high.

Poor Field Linearity

Poor field linearity, especially towards the top of the screen, was the trouble with a GEC 2040 colour receiver. A new PL508 field output pentode produced negligible improvement, which was not unexpected since a low-emission or slightly soft field output pentode will affect mainly the bottom of the picture. One must always work on the assumption that the valves are up to standard however. Reduced bias due to a reduction in the value of the cathode bias resistor, a leaky cathode decoupling electrolytic capacitor or a leaky grid coupling capacitor will also affect mainly the bottom of the raster.

The overall and top linearity controls – which are connected in a conventional anode-control grid feedback loop – were found to be operational, but adjusting them failed to produce a good vertical shape. Both controls are fed from the anode of the PL508 via an 0·1μF capacitor (C525), which must be a suspect in cases of poor linearity. Even a slight leak would reduce the PL508's working bias however, resulting in bottom cramping, while if it had gone open-circuit there would be excessive height (i.e. no feedback) and loss of any effect from the controls. C525 could be discounted therefore in this case. The only other capacitor in the feedback network is C522 (0·022μF) which is connected to chassis to provide integration of the feedback waveform. This seemed a likely suspect, and after replacing it and readjusting the preset controls a very good raster was obtained.

No Raster

Sound but no raster was the fault on a single-standard Bush monochrome receiver. The presence of sound meant that the line output stage was operative, since in the chassis concerned (A774) the 20V l.t. rail is obtained by rectifying the line scan waveform tapped from a winding on the line output transformer. There was no e.h.t. at the c.r.t. cap however, though there was more than usual a.c. at the anode of the DY802 e.h.t. rectifier. A faint blue glow was then noticed in the rectifier, but a replacement was found to glow in a similar manner. It was then apparent that the heater wasn't warming up, indicating either a defective valveholder, a dry-joint, or complete disconnection from the one-turn heater winding on the transformer. We removed the screw securing the rectifier valveholder to its housing and eased it out, together with the leads. Everything appeared to be in order. On unsoldering one end of the heater winding however it was found that wobbling the DY802 resulted in contact being made through the valveholder at certain points only. One side of the DY802 heater is connected to pins 2, 5 and 8 while the other side, also the cathode, is connected to pins 1, 4, 6 and 9. In this particular set one end of the transformer heater winding was connected to pin 2 only. Since it is difficult to make a good job of closing the valveholder pin grips we linked pin 2 to pins 5 and 8 while the other end, which was connected to pins 1 and 9, was also linked to pin 4. This ensured certain supply to the heater and on subsequent testing no amount of DY802 wobbling about would break the valveholder connection.

CEEFAX/ORACLE

reception techniques

PART 3

Steve A. MONEY T. Eng. (CEI)

A TYPICAL page of text as received from a CEEFAX/ ORACLE transmission contains 24 rows of characters and/or graphic information. This data is received one row at a time and, for a correct display of the page, each of the rows of text or graphics must be displayed at its proper position on the television screen.

Row addressing

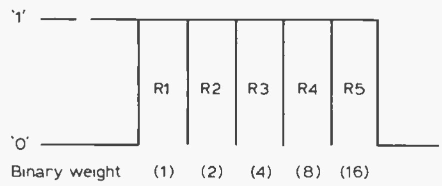
In sorting out the rows of data the decoding system is presented with a problem analogous to that facing the postman delivering letters to houses in a street. To assist the postman in his task each of the houses in the street is allocated its own individual number, or in some cases a name, which is known as the 'address' of the house. This address number is normally displayed on the front of the house so that it is easy for the postman to identify any particular house in the street.

Each of the rows of data in the teletext page is similarly allocated an 'address' number. For the top row of the page the address number is 0 and the following rows are numbered sequentially from 1 to 23.

Going back to our postman we find that each of the letters in his bag is labelled with the address of the particular house to which it is to be delivered. Now as the postman comes to each house he simply has to pick out any letters which carry the same address as the house and deliver them. In much the same way as the letters in the postman's bag, each of the rows of data transmitted on the teletext system contains an address code to enable the decoder to identify which row of text is being received.

Of the 45 data words in a line of teletext data only 40 are used to convey the characters and graphic symbols. The remaining five words at the start of the line are used for synchronisation and row addressing. The first three words, as we have already seen, contain the clock run in and framing code whilst words 4 and 5 are used to carry the row address code and a magazine identifier code.

A five-bit binary code group is used to convey the row address information as shown in Fig. 11. Each of the data bits is given a binary 'weight' value, where bits R1 to R5 represent the values 1, 2, 4, 8 and 16 respectively. To find the address which corresponds to any particular combination of the bits R1 to R5 we simply have to add up the weight values of all those bits which are at the high or 1 level. As an example let us suppose that bits R1, R3, and R5 are at 1 whilst bits R2 and R4 are at 0. The resultant address will now be 1 + 4 + 16 = 21



Row	R5	R4	R3	R2	R1
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1

N060

Fig. 11: Row address coding.

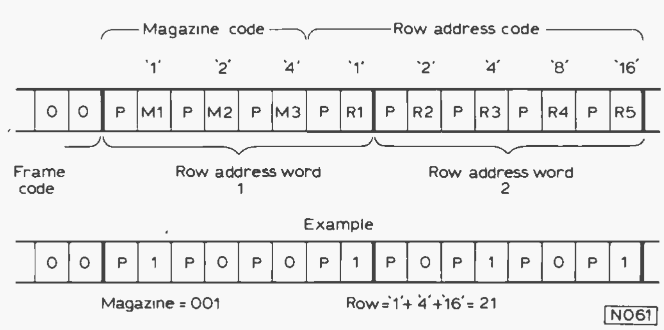


Fig. 12: Row address word format.

In practice the row address code bits R1 to R5 are not transmitted together in a group but are distributed through the two address words as shown in Fig. 12. It will be noticed that of the 16 bits in the two data words eight are labelled P. These bits are known as Parity check bits and are intended to provide some degree of error protection to the address code data when noise or interference is present on the signal. If appropriate circuitry is included in the decoder these extra bits enable errors in the received address code to be detected and in some cases corrected. Later in this series we will be taking a more detailed look at these protection bits and their use but for the moment, since they do not contain the address information, we shall ignore them.

Having eliminated the parity bits we are left with eight message bits of which the five labelled R1 to R5 carry the row address code and the remaining three, M1 to M3, are used to identify which 'magazine' the page of data belongs to. During the test transmission period it is likely that the magazine identifier code will be 000 or 001.

Row Address detection

When a row of data is received the decoder must be able to select the particular group of bits used for the row address and then use the decoded address to control the processing of the text data that follows.

In last month's article we saw how eight-bit data words were converted from the serial form, in which they were received, into parallel form. Thus on the main data bus in the decoder unit we have eight bits of each word available simultaneously on eight separate wires, with the words presented in sequence as they are received. Each word will be held steady on the data bus for eight clock periods (about $1{\cdot}15\mu s$). Now if we can arrange that the data bus lines are interrogated at the time when the first of the row address words is present we can transfer the address data into a separate register in which it can be held for later use. Similarly the second address word can also be interrogated and its data transferred into another register.

To carry out the interrogation and transfer operations successfully we must be able to select accurately the times at which the appropriate words will be present on the data bus lines. This is where the detected framing code comes in. When the framing code is detected it will be transferred on to the data bus. Eight clock-pulse periods after this time the following words will appear on the data bus. Therefore if we count off clock pulses from the time at which the framing code was detected we can determine when each of the following words will be available on the main data bus wires.

A typical circuit arrangement for a row address detection system is shown in Fig. 13. First the data from the main data bus passes through an error detection and correction circuit, shown here as a dotted box. In a later article we shall discuss the circuits used here. All eight bits of data are fed into this circuit but only the four message bits come out. An additional output is provided to indicate if the data is in error. The four output data lines are routed in parallel to two four-bit registers labelled AR1 and AR2 where the data is applied to the *D* inputs of the flipflops in the registers. Register AR1 accepts and stores data when the pulse T1 is applied to its clock input. Similarly register AR2 is loaded by the T2 clock pulse.

Word Clock

The master timing clock of the decoder is divided in frequency by eight to produce a clock which occurs once per word period. The counter which carries out this frequency division is reset by the framing code detection pulse so that the word clock starts from the time at which the framing code is detected. To produce the delayed pulses for loading

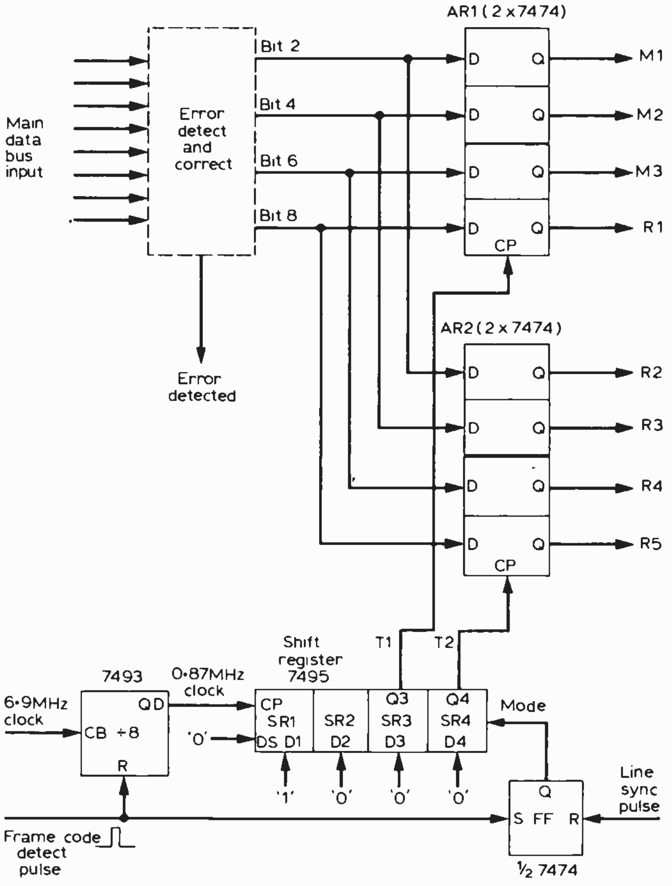


Fig. 13: One form of row address detection circuit.

the row address registers a shift register is used. This shift register contains four stages SR1 to SR4. In the 7495 type shift register a mode control is provided which allows the register either to be directly loaded by applying data in parallel to its *D* inputs, or to operate in a serial shift mode where the data moves along the register one stage at a time when a clock pulse is applied. The flipflop FF controls which mode of operation is selected. Flipflop FF is reset by the line synchronising pulse and in this state it puts the shift register into the parallel loading mode. The data inputs to the shift register stages are set so that stage SR1 sets to 1 and the other three stages go to 0.

When the framing code word is detected flipflop FF is set and changes the mode of the shift register to the serial shift condition. The next clock pulse applied to the shift register will cause the 1 state to move from stage SR1 to stage SR2. Since the serial data input to the register *(DS)* is set to 0 the first stage SR1 will now go to 0. Now each time a clock pulse is applied to the register the 1 state will move along the register one stage passing through SR3 then SR4 and finally dropping out at the end of the register to leave all four stages in the 0 state.

When the stage SR2 goes to 1 the framing code word will be on the data bus whilst SR3 and SR4 will go to 1 when the first and second address words respectively are present on the data bus. Output pulses T1 and T2 from stages SR3 and SR4 will therefore be correctly timed to control the transfer of data from the data bus into the registers AR1 and AR2.

Once the row and magazine address codes have been loaded into registers AR1 and AR2 they will remain there until a new row of data is received. These address codes will later be used to control where the row of data is placed

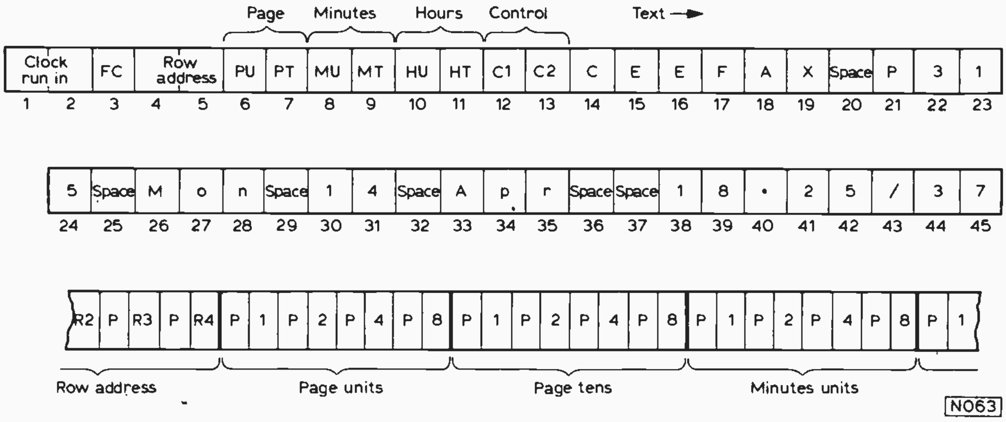


Fig. 14: The Page Header row layout.

in the page memory and consequently where the row of text or graphics is displayed on the screen.

Page addressing

Up to 100 pages of information can be transmitted in one magazine on a single television channel but the decoder can only deal with one page at a time since the screen will be filled with the data from one page. The viewer selects which page he wants his decoder to accept and display. To cater for other viewers who will no doubt wish to view other pages, the data for all of the pages in the magazine are transmitted in sequence continuously. As a result the decoder must be able to select a particular page of data out of the transmitted sequence and display it.

Let us go back and take another look at our postman with his bag of letters. During his round he may deliver letters to houses in a number of different streets, so in addition to the house number each of his letters must also tell him which street the house is in. To save himself a lot of extra walking he will then put all of the letters addressed to the same street in a bundle with the house numbers arranged in numerical sequence.

The teletext signal also carries the equivalent of a street address. This is the 'page' address which will allow the decoder to discover which page it is receiving. Like the postman's bundle of letters for each street, all of the rows for a particular page are sent in a group in numerical sequence. This simplifies the addressing since the page address need only be sent once at the beginning of each page.

Page Header row

The page address is sent out in the first row of the page. Unlike the other rows of text on the page this row (row 0) contains only 32 displayed characters instead of the usual 40. This has to be done in order to fit in the page address information. This row, which is called the Page Header row, has the layout shown in Fig. 14. Here the eight words following the row address data are used to carry the page address, a time code and some control codes.

Apart from the page number the text displayed on the header row is the same for all of the pages. Following the system name, CEEFAX or ORACLE depending on the channel selected, come the page number, day, date and the time in hours, minutes and seconds. The page number has three digits the first of which indicates which magazine is being received. Thus p315 indicates page 15 of magazine 3.

Normally the displayed time will only change about once every 25 seconds when the selected page is received. In some decoders the header row for every page may be displayed so that the time readout is updated every quarter of a second.

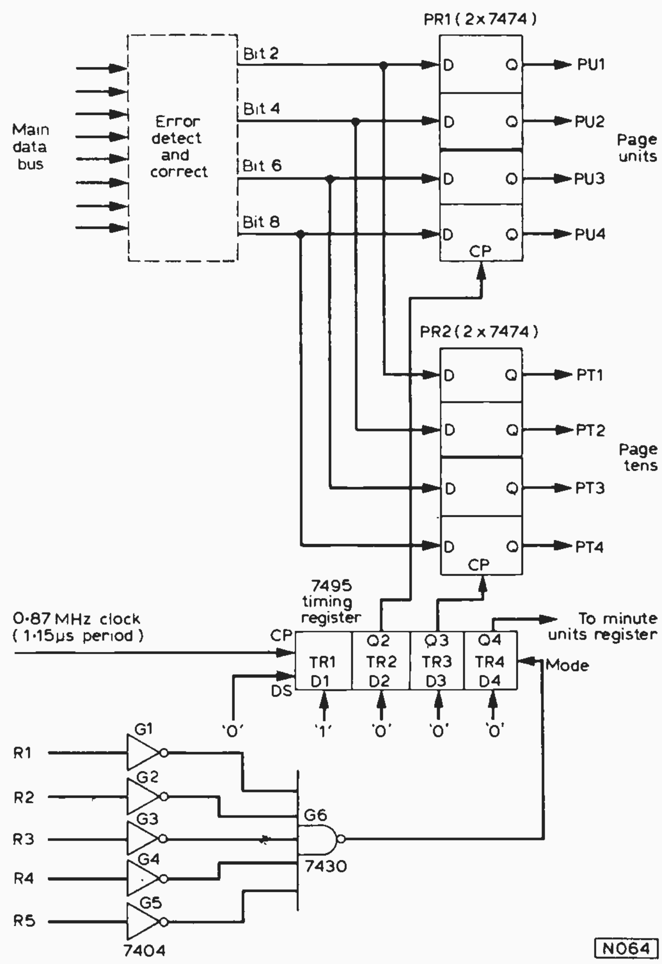


Fig. 15: A page address detection circuit.

Page Address

For the convenience of the viewer page addresses are in decimal form starting at 00 and going up to 99. In the header row two words are used for the page address, one for the tens and the other for the units. Parity bits are used for protection of the page address in the same way as for the row address, so four bits of each word are used for the address and four for error protection. The four message bits are coded in binary form to represent the numbers 0 to 9. This form of coding is known as Binary Coded Decimal. The same form of coding is used for the following six words which carry the time and control codes.

In the decoder the page address words are extracted and compared with the page number selected by the viewer. When the page address matches the selected page number the following 24 rows of data are accepted and stored by the decoder and the corresponding text is then displayed. In some decoders the time code may also be used to select the pages since some pages of information may only be sent out at certain times of the day.

Page detection

Let us now consider the process of decoding the page address. A typical logic arrangement for this is shown in Fig. 15. In some ways this arrangement is similar to that used for selecting out the row addresses. As in the case of the row addresses the data is first of all passed via an error detection and correction system which may well be the same one that is dealing with the data for the row address detection.

Since the page address is only transmitted during row 0 we must first of all detect when row 0 is received. A simple NAND gate is fed with the row address bits R1 to R5 from the row address registers AR1 and AR2. Since we need all 1 inputs to the NAND gate to produce an output the row address inputs are inverted before they are applied to the NAND gate inputs. Now when row 0 occurs the bits R1 to R5 will all be at 0 and the inputs to the NAND gate G6 will all be at 1 due to the action of the inverters G1 to G5. The output of G6 will go to 0 during row 0.

Having detected row 0, the next step is to select the two words carrying the page address and transfer them into two separate registers for later use. A shift register is used for timing in the same way as for the row address. The shift register is clocked by the same 1·15μs clock that drives the row detection timing shift register.

The row 0 signal from the output of gate G6 controls the mode of operation of the timing shift register. When another row address is detected the timing register is set for parallel loading and stage TR1 is set to 1 whilst all the other stages are set at 0. When row 0 is detected the mode changes and the timing register now starts its right shift operation. The 1 state moves along the register one stage at a time as each clock pulse is applied. We can now pick off pulses from the outputs of the shift register to control the transfer of the two page address words into the registers PR1 and PR2. After the two words have been transferred to their appropriate registers they will remain there until the next row 0 is detected. By extending the length of the timing register and adding further storage registers the time and control code words can also be selected and stored.

Page selection

Having extracted and stored the page address the next step is to see if the page being received is the one that the viewer has requested. Normally the viewer control will consist of two ten-position thumbwheel switches, one for 'tens' and the other for 'units' of the page number. The basic circuit arrangement for detecting a match between the selected page and the one being received is shown in Fig. 16.

Let us examine the action of the page units circuit. The four bits of the page units code are applied to the inputs of a 7442 binary-to-decimal decoder device. This integrated circuit has ten outputs labelled 0 to 9 and one of these goes to 0 according to the binary code applied at the input. Thus if the binary input code has the value 6 then output number 6 will go to 0. Each of the ten outputs of the 7442 connects to its corresponding pole on the units selector switch. Now assuming the input is still 6 we can only get an output at the

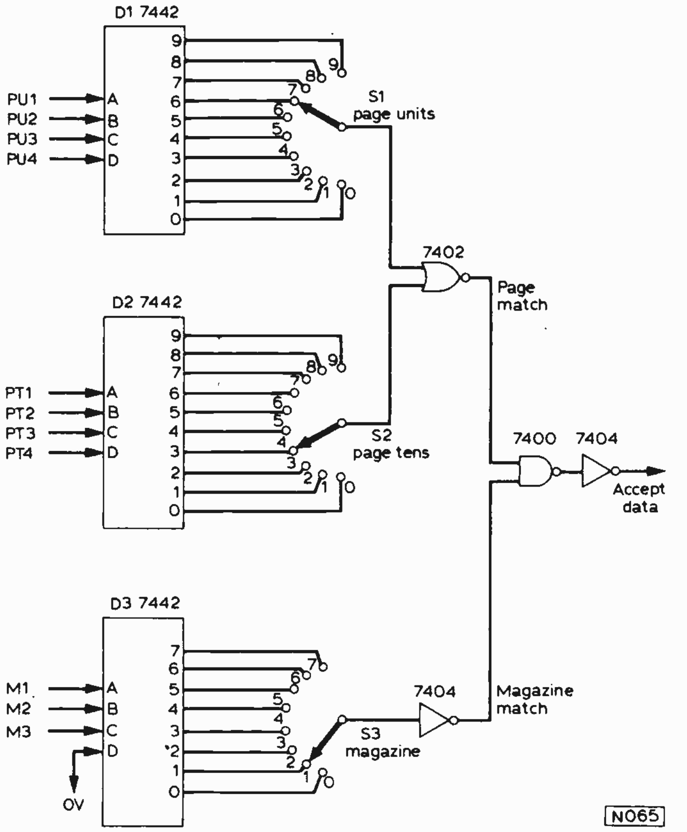


Fig. 16: A page selection circuit.

wiper of the switch when the switch is also set at position 6. In this way we will only get an output from the switch when the received address code is the same as the number selected by the switch.

A second 7442 and decade switch are used to detect a match between the 'tens' switch position and the received 'tens' address code. The outputs from the units and tens switches are gated together in a NOR gate so that only when both are matched correctly will there be a 1 output. When a page match condition is detected the following rows of text data are accepted, stored and displayed.

Magazine selection

Although during the present trial period only one magazine is likely to be transmitted on any one channel, it would be possible in the future to have up to eight such magazines on a channel either by using extra lines for the data signals or by increasing the delay time before the selected page can be accessed.

The magazine can be selected by adding a third bank to the page selection switch to give effectively a hundreds position. This is shown in Fig. 16 and it will be seen that the magazine address match is detected in much the same way as a page address. The magazine match signal is gated with the page match output to produce an overall data acceptance signal which will control whether the data is to be accepted and displayed or simply ignored. If there is only one magazine on the channel however, there would be no need to fit a magazine code detection system.

Next month

In this article we have seen how the row and page addresses are dealt with to enable the decoder to decide if it has to accept the received data or not. Next month we shall take a look at the page memory which will store the page of data to be displayed.

ULTRASONIC REMOTE CONTROL

continued from page 527

are bridged a small current flows through the high value isolating resistors R4 and R5. This current is amplified by Tr1 sufficiently to turn on Tr2, which removes bias from Tr3. With Tr3 off Tr4 is free to conduct, and the voltage on the supply line drops due to the charging current to C3. Thus the negative pulse is provided to operate the shift register. The Schmitt trigger configuration of Tr2 and Tr3 ensures the rapid switchover necessary for Tr4 and C3 to function correctly.

Ultrasonic receiver

The transducers used for the ultrasonic link are a crystal type measuring only 14mm diam. These are supplied as a pair – types SEO5B–40T and SEO5B–40R. The 40T has an impedance of 200Ω and is used in the transmitter, while the 40R is a high impedance device and is employed in the receiver. The Mullard TAA960 used in the receiver consists of three identical amplifiers integrated in a single silicon chip (Fig. 3). One of the amplifiers has an additional emitter follower stage, with an output resistance of 500Ω

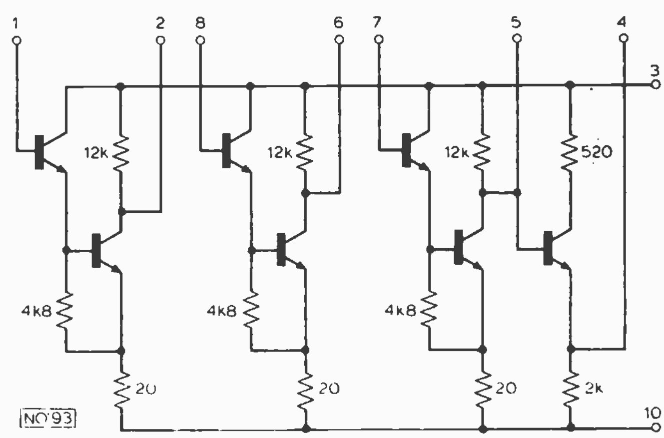


Fig. 3: Internal circuit of the TAA960 i.c.

When an ultrasonic signal is received by the transducer a 40kHz sine wave is produced at its terminals. This is fed to the input terminal of the i.c. at pin 1. C11 and C12 are the interstage coupling capacitors, and VR5 functions as a preset gain control. To improve noise immunity the Darlington pair in the final stage is unbiased in the absence of a signal from the transmitter. The incoming signal is d.c. restored by D15, and only waveforms exceeding 1Vp-p at this point overcome the two *V*be's of the pair and effect an output. The output from the ultrasonic transmitter is sufficient to meet this requirement when directed at the receiver from distances in excess of the normal viewing range.

When a signal is being received the 40kHz output at pin 4 is coupled into the diode pump by C13. When the charge on C19 rises above 1·2V Tr2 is turned on via D5, and the remainder of the circuit then operates as described above. The capacitance of C19 is greater than would be normal in order to slow down the response somewhat, further improving the unit's immunity from spurious interference. The diode D5 serves to isolate this capacitor from Tr2's base when the touch contacts are operated.

In Part 2, next month, the circuit of the Ultrasonic Transmitter will be given, plus full constructional and installation details.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

Now that mid summer has come and gone it seems that Sporadic E has similarly reached its peak and gone into a decline. Reception via this mode at the end of June has become less frequent, and there have been lapses of several days between good openings. Fortunately however several occurrences have more than compensated for the decline in SpE conditions.

The most striking event has been the appearance of that long sought after exotic signal, Jordan channel E3 (Amman). Three different people have seen it in the UK, on two dates!

Increased Trops

The prolonged heatwave over much of the UK brought with it a fantastic increase in Tropospheric activity. Since this occurred at the end of June I have had no reports from others at the time of writing, but even in my valley location two new West German u.h.f. transmitters have been received and there have been sustained signals from the DFF (East German) transmitters on channels E5 and E6.

Local Conditions

Due to the amount of material to pass on this month I must unfortunately drop the reception log, but a brief summary of how things have been here follows. Good SpE openings were noted on the 1st, 2nd, 3rd, 5th, 6th, 7th, 8th, 11th, 15th, 16th and 24th (including TVR – Rumania). During the opening on the 24th RAI (Italy) was observed on test card on channels 1A and 1B. At 1015 the ch. 1B test card faded to be replaced by a feature film, the ch. 1A signal continuing with the test card. There were excellent Tropospheric conditions on the 25th and 26th. Apart from Band III activity – including sustained East German Band III signals – many West German u.h.f. stations were received.

Reception of Jordan TV

We have received two letters from Andrew Papaeftychiou in Cyprus. The first told us that Amman is using "European style" rather than the more expected Arab dressed announcers, and that Lebanon ch. E4 often comes on air early if there is a likelihood of shooting and other troubles.

As if on cue, two letters arrived on the next post, one from Clive Athowe (near Norwich) and the other from Derek Waller (near Consett). Derek first received Amman at 1443 on the 18th, with Arabic music followed by a female announcer, the Koran at 1510 and a fade out shortly after. At this time Clive returned home and on switching on was presented with a weak arab signal – a man in white head-dress, dark glasses and black robe. Subsequently the programme went to childrens' cartoons (in English) and other programmes. The signal had faded by 1545 (GMT). Clive mentioned that this could have been double-hop reception, with a bounce in Rumania. Well, incredible as it may seem our Hungarian friend Hetesi Laszlo was also tuned in on the 18th and he too during this same period noted Amman – earlier using colour bars with an Arabic identification. So it appears that Hetesi in Hungary saw Amman via single hop while our UK friends saw the signal on its second hop! Clive's reception was in colour.

Over now to Hugh Cocks (Devon) who received Amman on the 21st, again during the afternoon period and on test pattern, with the colour bars received by Hetesi.

All in all then it has been quite an exciting month for exotic signal reception: our congratulations to the DXers concerned for their vigilance.

Matters Arising

Clive Athowe has noted RTVE (Spain) using a new pattern which consists of small black/white squares – as opposed to the usual checkerboard. Clive also received a programme in French on ch. E2 on the 11th at 2000, from the south. Has anyone any ideas as to the possible origin of this? Programmes in French were noted last year on this channel.

Two enthusiasts have now seen the Marconi No. 1 test card on ch. E2a/R1. The origin has been identified as ORF – since the card was seen to change to the PM5544 pattern. Sweden has also been noted using the PM5544 pattern, with a very small identification at the top – this can be confused as "TVE", so be careful!

Hetesi Laszlo tells us that Bulgarian TV is still using the old test card G. This is similar to test card C but has a large concentric white circle.

James Burton-Stewart (Buckingham) reports that NRK (Norway) is now superimposing the title and the name of the composer of the music which accompanies the test card transmitted prior to the commencement of programmes. He first noticed this on the 7th, at 1745, over the Fubk test card.

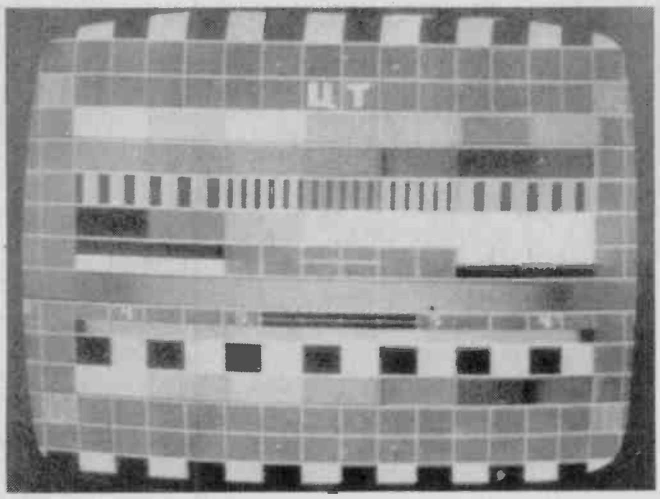
Transmitter Guide Book

The WTFDA (PO Box 163, Deerfield, Illinois, 60015, USA) has announced the publication of a new transmitter list. This is a very comprehensive guide to all stations operating in North and Central America, including coverage maps, call letters, network and offset frequency data. Other details include licensing, location, whether originating or satellite, e.r.p., mast height and information on programme sources. The cost is $5 via surface post. The publication is comb bound and approximately $8\frac{1}{2}$ x 11in. Sample bulletins for TV-DX information are available at 75c.

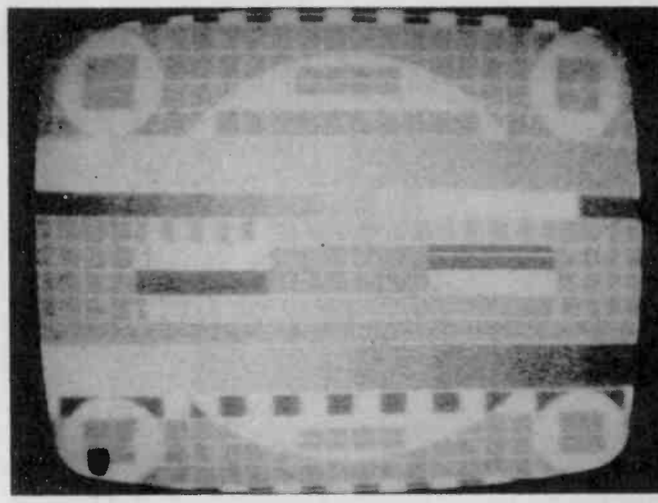
Labgear Amplifier

We recently received for evaluation a Labgear CM6036/DA amplifier. This is a very high gain unit, providing a gain of 30dB at v.h.f. and 28dB at u.h.f., with a quoted noise figure of only 4·5dB. Despite the wide bandwidth (40-860MHz), the gain is maintained within 1dB at v.h.f. and 2dB at u.h.f.

Initial results show that the unit is indeed well suited to DX-TV work, though possibly with SpE signals, and when feeding into a

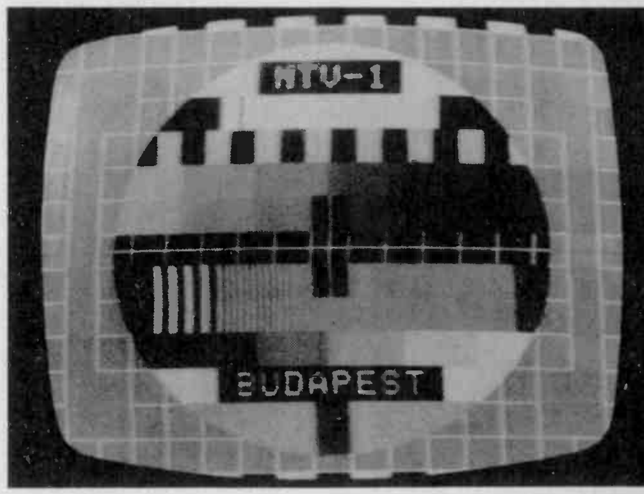


New electronic test pattern (colour) used by TSS Moscow on ch. R1. Photo courtesy Hetesi Laszlo.



New TSS test pattern seen by Ryn Muntjewerff on ch. R3. Transmitter not identified.

New transmitter identification slide used by DFF (East Germany). Photo courtesy Ryn Muntjewerff.



Latest identification seen on a PM5544 test card – MTV-1, Budapest, Hungary. Photo courtesy Peter F. Vaarkamp.

varicap transistor tuner, some attenuation may be necessary – to prevent overloading the tuner front end and the resulting cross-modulation. I found that care must be taken with the coaxial plug screening connections, since with its high gain the unit can become unstable at certain frequencies, producing spurious local u.h.f. signals at points in Bands I and III. Once the problem connection had been located using associated patching no further trouble was experienced. The unit, which is mains powered, can also provide 16V for a masthead preamplifier. The high gain would make it an ideal amplifier for winter MS (Meteor Shower/Scatter) reception.

Aerial Erection Precautions

In the v.h.f. column in the June issue of the RSGB's magazine *Radio Communications* G3VVT comments on the detrimental effects produced when the support mast passes through the director chain of a u.h.f. aerial. The presence of the mast in the director chain can (and does!) considerably alter the polar response and reduces the gain. This happens even when the support mast is at right angles to the plane of polarisation. The effect increases with increase in frequency, since the diameter of the mast becomes an increasing proportion of the wavelength. To maintain optimum performance at u.h.f. therefore arrays must be mounted at the top of the support mast or on a stand-off mast, thus keeping the director chain clear. The effect of "through the mast" mounting can be disregarded at Band III frequencies, so the arrays can be mounted directly on the support mast which, in this context, would be alloy tubing of 2in. outside diameter or less.

LONG-DISTANCE TELEVISION

News Items

USSR: It seems that a Leningrad TV transmitter has been putting out experimental stereoscopic monochrome programmes. The signals have to be received on a colour set, with the viewer wearing special glasses – monochrome receivers give a normal picture. Work is being undertaken on a colour stereoscopic system that does not require the viewer to wear filter glasses.

Holland: There are rumours that the NOS-1 transmissions from Lopik on ch. E4 are to be moved to u.h.f., possibly ch. E30. It seems that the old transmitter is ageing, resulting in harmonics, etc., and in view of this and other problems (the least of them not being SpE in summer!) a move to u.h.f. is being advocated. Fortunately it isn't likely to happen for several years.

France: Peter F. Vaarkamp (Holland) tells us that in some areas the French first chain will be duplicated at u.h.f. by the end of the year, starting with Paris and then Lille. This will enable the first chain programmes to be seen in colour. The Lille transmissions will be on ch. E27.

The EBU reports that the new Brest, Roc Tredulon transmitting mast has now been put into commission. The previous mast was destroyed by sabotage in February 1974. The new mast is 200m high and enables viewers in the Brest peninsula to see the French third chain for the first time.

Pakistan: Another transmitter has been opened, covering the Multan, Bahawalpur and Deri Ghazi Khan area. A recently constructed microwave link connects it to the national network.

Thailand: Marconi is supplying two 10kW Band III transmitters to the Thai Army's new Pak Chong TV station which is expected to be in operation in October.

Nigeria: The Nigerian North Central State Government has ordered two 10kW transmitters from Pye TVT, Cambridge. These will be sited at Funtua and T'Sanni and will operate in Band III. Transmissions are expected to start within fifteen months.

From Our Correspondents...

A. Papaeftychiou (Cyprus) tells us that on May 31st he noted extreme exotic reception, either India or Pakistan on ch. E4, consisting of a local programme in English and the local language. Behind this "turmoil", music and songs of Chinese origin could also be heard! Further excitement came with the appearance of a caption showing lions and dragons, with lettering beneath resembling Chinese. Some days later the Indian/Pakistani transmitter was again seen on ch. E4, together with programmes from Tehran.

Mark Lewis (Rickmansworth) has received a high-level mystery signal – the all too familiar PM5544 pattern but with no identification on it whatsoever – on channels E2 and E3. Has anyone any idea as to its likely origin? Mark is going to California shortly and is hoping to continue DXing whilst there: we look forward to hearing on his return of the conditions in that sunny state.

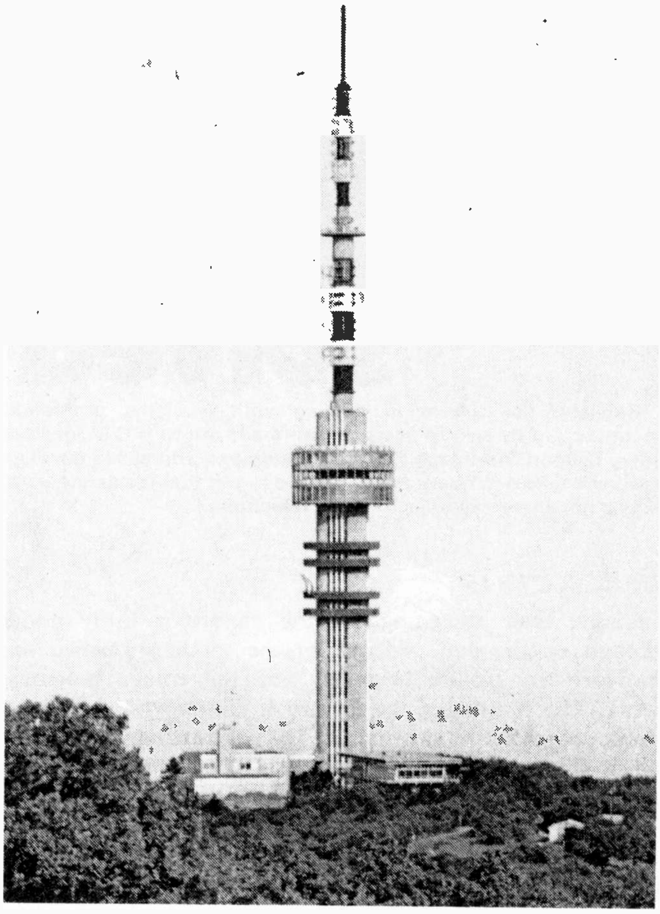
Ryn Muntjewerff (Beemster, Holland) received via Trops the TSS (USSR) 0249 test pattern on ch. R8 on the 11th from 0640-0700: the transmission then went on to a programme. A mystery ch. R30 TSS transmitter also seems to have been received. On the same morning TVP (Poland) was received in Band III!

Thoughts on Sporadic E

Following the good Sporadic E conditions in recent weeks one's thoughts tend to wander again to the reasons for this phenomenon and to what happens "up there" during an opening. Mel Wilson wrote on the subject recently in the WTFDA bulletin *VHF-UHF Digest*, and the following comments are based on his article – our thanks to the WTFDA for permission to extract details.

Is it possible to predict how long an SpE opening will last? At present the answer is no, at least until what causes these openings is understood. V.H.F. SpE is possibly caused by turbulence within a large E layer ionised cloud, and presumably there must be something responsible for such turbulence. When there is widespread v.h.f. SpE the bands tend to stay open longer. The reflecting clouds of ionisation can drift for many hours, giving signals at frequencies up to 100MHz. It appears that the m.u.f. (maximum usable frequency) can rise considerably when clouds pass through each other.

Is SpE purely a single hop or is it also a cloud-to-cloud phenomenon? With a widespread opening two-cloud propagation paths undoubtedly seem to exist – especially when higher frequencies are being received. It is likely that all signals are single-hop ones when only channels E2/R1 are open, but when reception extends to include all channels, extending into the f.m. band, it seems that much of the propagation, both of the lower and higher v.h.f. signals, must be from cloud-to-cloud. Indeed when widespread v.h.f. SpE is occurring the signals on channels E2/R1/E3, etc. often come via several paths, both cloud-to-cloud and single cloud, so that there are very deep fades in the stronger signals – RTVE Madrid ch. E2 often illustrates this point.



The Pecs, Hungary MTV-1 (ch. R2) transmitting tower. E.R.P. is 60kW. From a card sent by Hetesi Laszlo.

What percentage of the openings that reach ch. E2 will rise to Band II (TV) and Band III? The general rule of thumb is that doubling the frequency reduces the probability of reception to one tenth. Thus if ch. R1 (49·75MHz) is received in such an opening there will be propagation at 100MHz for a tenth of the time that ch. R1 is present while at 200MHz (Band III) there will be an opening for one hundredth of the time. Since most high-frequency propagation paths are of the multi-cloud type rather than single hops however the chances of enhanced reception of the very high channels is much greater (see notes on Band III SpE in the May column earlier this year).

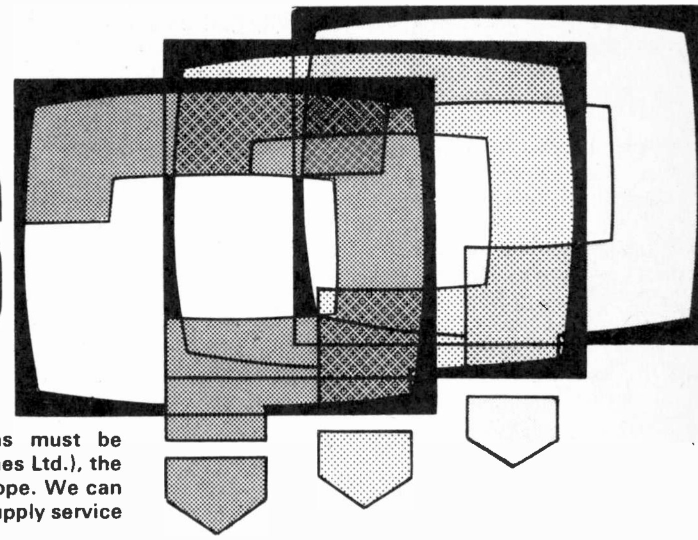
Aerials for SpE

What characteristics should a good aerial system for SpE have? The serious DXer will use more than one aerial and will have means to change rapidly from one array to another. Mount a high-gain – stacked arrangement if possible – aerial at the top of the mast, with another lower aerial having a polar response with a good null point. The higher array with its sharp beam is useful most of the time because of its gain and coverage area (the reception angle being lower). The sharp null aerial is useful for cutting down interference and for high-angle reception when the reflecting cloud is close. Both arrays should be rotatable.

Arrays can be mounted to favour reverse polarisation (it is usual to mount arrays horizontally – try vertical mounting where the local transmissions permit this).

LONG-DISTANCE TELEVISION

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 547 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

DECCA CTV19

Initially, after switching on, the picture is fairly good though on the dark side. After the set has warmed up however the picture brightens and the colour becomes weak. The bottom of the picture is darker and there is a darker band across the middle. The contrast has to be fully up at all times. The focus has been set to optimum and a new line output valve and transformer fitted.

It seems that the PL802 luminance output pentode is faulty, so the first step should be to fit a new one. If the fault persists the black-level clamp in the control grid circuit of this valve could be responsible: check the diode and transistor in this circuit (D204, TR212), also the 100μF electrolytic (C231). Another possibility is the blanking circuit connected to the cathode of the PL802: this can be checked simply by shorting across the collector and emitter of the blanking transistor (TR205, BC108).

GEC 2028

When the set was switched on it was found to be completely dead, with the 3A mains fuse blown. On renewing the fuse everything seemed normal but it was then noticed that the PY500 boost diode was beginning to overheat. This was followed by a puff of smoke from the line output transormer and the set went dead. On examination the line output transformer was found to have burnt out.

The most likely cause of the trouble is that there is an internal short in the PY500. It would be worth checking the PL509 line output valve's 10Ω, 3W cathode resistor (R61). If this is open-circuit, suspect that the line oscillator is not operating or its output is incorrect.

FERGUSON 3713

A case of no picture in one of these sets was traced to a short-circuit BDX32 line output transistor. After replacing this however the new transistor heated up and went short-circuit. The h.t. has been checked and found to be correct. We have tried replacing the line output transformer, e.h.t. tripler, timebase board, output stage tuning capacitor (C406), also the convergence board, using items from a set which is working normally, but whatever we do the line output transistor goes short-circuit about 1-2 seconds after switching on and the line timebase starting up.

An intermittent open-circuit in the tuning capacitor C406 is the most common cause of the line output transistor shorting, but you say you've replaced this. It is important to use an identical component. The only possibles left are the c.r.t. first anode supply rectifier W403, its reservoir capacitor C401, and the scan coils. Disconnecting each in turn should isolate the fault: when the defective component is disconnected the e.h.t. should return. (Thorn 8500 chassis.)

PHILIPS G24T230

When the brightness is turned up a dark patch appears in the middle of the screen. This eventually fills the entire screen. The line output valve and efficiency diode have been replaced but this has made no difference.

The fault is due to low e.h.t. Replace the DY87 e.h.t. rectifier: if the fault persists, the line output transformer is suspect. (Philips 210 chassis.)

PYE CT205

With the brightness control at a normal or high setting there are about twenty lines across the screen, equally spaced out and sloping upwards from the left to the right. The lines are not apparent when the brightness control is set slightly below normal. I assume that these are line scans getting through during the field flyback blanking period. I have 'scoped the line and field flyback blanking pulses however and they appear to be correct.

The usual cause of poor field flyback blanking on this chassis is that the blanking transistor (VT28, BC107) in the cathode circuit of the PL802 luminance output valve is weak. It is possible in addition that the c.r.t. first anode preset potentiometers are set a little too high. (Pye 697 chassis.)

DECCA CS2631

After the set has been on for about half an hour a black band about an inch deep appears across the top of the picture. The band remains there until the set is switched off.

We take it you have checked the field timebase valves (PCF80 and PL508) – by substitution. Check C407 (4,700μF) in the anode circuit of the PL508 – it is mounted on the power supply board. Check the operation of the vertical shift control (VR414), and that there is no dud spot on the height control (VR404). If the top of the picture is very cramped when the fault is present the field output transformer could be the cause of the trouble. (Decca 30 series chassis.)

GEC 2041

The fault is intermittent expansion and contraction of the field, either in the form of line bunching in small sections of the picture or the whole of the field expanding so that there is excessive height – this does not affect the convergence. Sometimes the fault does not occur at all for an evening. The timebase panel has been changed, so the components in this area can be ruled out.

The first thing to do is to check electrolytics C68 (50μF) and C67 (100μF) which smooth the h.t. supplies to the field output valve. If these are o.k. the field output transformer or the deflection yoke is probably faulty, assuming that the PL508 field output valve is up to standard.

DECCA CTV19

When the test card is displayed the dummy's jacket in the centre circle is blue instead of green: the buttons are the normal yellow. Otherwise the colour is quite good, on both test card and pictures.

You should first set up the grey-scale tracking on a monochrome display. The blue jacket effect is due to absence or lack of G –Y signal. First check the PCL84 G –Y output/clamp valve V601. If the fault persists check the resistors and coupling capacitors around this stage, also the BC112 G –Y transistor preamplifier TR610.

PHILIPS 19TG156A

The trouble with this set is line drift. There is an excellent picture for about fifteen minutes but after that the picture drifts continuously and the line hold control setting becomes critical.

The problem is associated with the two ECC82 valves (V403 and V404) on the timebase panel – one is the line oscillator, the other the flywheel sync valve. The first step should be to replace them. If the fault persists check the anode load resistors connected to pins 1 and 6 in the following order: R402 (27kΩ), R405 (220kΩ), R415 (56kΩ) and R414 (22kΩ), also R417 (330kΩ) from grid pin 7 of V404 to the h.t. rail. The multivibrator cross-coupling capacitors could also be faulty, particularly C407 (56pF).

MARCONIPHONE 4715

The colour, or monochrome reproduction, is very good when the set is first switched on. After two or three minutes however the whole picture is tinted green, though with colour showing through. After about five minutes the tint starts to fade out and within ten minutes we are back to normal, for about two hours. The colour then deteriorates a bit, with a magenta tint. The picture remains like this until the set is switched off. With the fault present the c.r.t. voltages all seem to be roughly correct. I have also checked the clamp pulse amplitude control R230.

This sort of trouble is frequently caused by deterioration of the electrolytic capacitors on the video board. We suggest you replace C227 (2μF) in the green channel clamp circuit, also C221 (1μF) which decouples the slider of the clamp pulse amplitude control and C222 (1μF) which decouples the h.t. supply to the output transistors. Check the condition of the green drive control R260, and if the fault persists suspect the green output transistor VT212. (Thorn 3500 chassis.)

FERGUSON 3713

We cannot get the dynamic blue convergence to line up with the yellow (converged red/green). Red and green convergence is near perfect. The blue verticals will not converge with yellow at each side. By moving the blue width control L503 we can get correct convergence on one side, but this makes the convergence worse on the other side of the screen. Reversing the connections to the blue lateral coil has been tried but this made matters worse. The blue horizontals will not converge because the blue tilt control does not give enough adjustment – another ¼in would be perfect. In the manual it says that to obtain optimum corner convergence the panel should be rocked slightly. It doesn't seem to move at all however. Is it fastened in some way?

Slight rotation of the convergence panel/coils is called for to equalise the blue lateral error. The coils are normally a friction fit on the c.r.t. neck. A firmer push is all that is required. When you have done this it will be necessary to repeat the red/green convergence. (Thorn 8500 chassis.)

DYNATRON TV100

The set functioned perfectly one day but on the following day gave only a very dull picture with increasing line tearing (to the right) setting in after a few minutes and with wavy verticals predominating. I have changed valves without improving matters. The set has not been used much and gave a superb picture until the fault developed. The sound remains excellent. The contrast does not appear to be at fault and I suspect the main smoothing electrolytic block.

We assume that the PFL200 video/sync valve was replaced. The fault is undoubtedly in this area, the prime suspects being R72 (12kΩ, 1W) and C70 (4μF) which supply the screen grid of the video section and C69 (200μF) the cathode decoupler. A check of the electrode voltages with a 20kΩ/V meter should reveal any changed value resistors. (Pye 67 chassis.)

PHILIPS G25K502

To get a good picture the focus control has to be turned right back anti-clockwise, also the brightness control.

The fault is common on this chassis and is due to an increase in the value of one or more of the high-value resistors in the focus potentiometer chain. You will have to check them all and replace as necessary. (Philips G6 dual-standard chassis.)

PYE CT201

The line output transformer in this set burnt out and was replaced. Since then there has been a smear across the screen. It can take the form of light or dark bands which are more noticeable on close-ups. The bands behind a caption are of the background colour but darker. If someone in a close-up raises or lowers their hand the light coloured band moves with it.

The problem is usually due to poor clamping, possibly the result of an out of tolerance replacement line output transformer delivering a clamping pulse of insufficient amplitude. First however check the PL802 luminance output pentode and the associated electrolytics, C353 which decouples its screen grid and C352 in the anode circuit. (Pye 697 chassis.)

DECCA CS2230

With the slider of the set width/e.h.t. control VR451 hard over to the left (viewed from the rear) the test card side castellations cannot be seen. The control is operative however since moving the slider to the right increases the width of the picture. Is there a simple method of obtaining the correct width?

The problem occasionally arises with this chassis and can be eliminated by increasing the value of R452A, which is connected to the slider of VR451, from 820kΩ to 2·2MΩ or thereabouts – this modification is not, incidentally, an official one. An alternative approach is to add a 2·2MΩ 2W resistor in the feed to VR451 from pin 10 (boost rail) of the line output transformer. The cause of the trouble is an unfortunate combination of tolerances in the line output stage components. (Decca 30 series chassis.)

PHILIPS G26K520/01

The set is o.k. at first after switching on. Then smoke appears from the timebase area and the two resistors R4483 (15Ω) and R4484 (120Ω) associated with the pincushion distortion correction transductor are both found to be burning out. The transductor itself seems to be in order, checked with an Avo Model 8, also the associated components. If plug H on the line scan unit, connecting to the transductor, is left off there is a colour picture but with slightly impaired field scan. On replacing plug H the two resistors start to burn out again.

It seems almost certain that the transductor has shorting turns. It would be as well however to check the associated raster correction coil L4482 for continuity and the associated integrating capacitor C4481 (0·047μF). (Philips G8 chassis.)

DEFIANT 3A66

The problem with this set is sound but no raster. The boost voltage, checked at the tube base, is low at about 170V. The voltage at the screen grid of the PL500 line output valve is low at about 150V, though there is about –45V drive at the control grid and the oscillator can be heard operating through interference on the radio. The e.h.t. is very low – by holding a screwdriver at the PL500 top cap a spark of only about 1/16in. can be obtained. The line timebase valves, the boost capacitor, the high-value resistors in the width circuit and the 100μF electrolytic which decouples the anode of the efficiency diode have all been replaced. I don't think the boost line is being overloaded since if the top cap of the DY87 is removed the boost voltage tends to fall a bit.

The line output transformer used in these sets commonly develops short-circuit turns resulting in the symptoms you describe. Replacement is the only cure. The less likely possibility of faulty scan coils can be checked merely by disconnecting them: if this restores the e.h.t., replace the yoke. (Plessey dual-standard chassis.)

PYE CT203

The picture is OK when the set is first switched on but after about half an hour there is what looks like a foldover about two inches deep at the top of the screen.

The trouble is likely to be due to change of *Q* of coil L61 (NS phase control) in the pincushion distortion correction circuit. It is mounted in the middle of the convergence panel: try shunting it with a 1kΩ 1W resistor. (Pye 697 chassis.)

KB KV003

There is a loud buzzing sound on 405-line operation – it is not present when the set is switched to 625. The buzz, or roar, is tunable. As the picture is tuned in the buzz increases until at the point where it is loudest the picture starts rolling. After tuning through this point the buzz diminishes, the picture disappears in horizontal lines, the sound comes on loudest but the buzz then disappears. With acceptable buzz, the sound is on the low side and there is sound-on-vision. The buzz increases when the volume or contrast controls are advanced.

The fact that the hum is tunable and present on 405 lines only suggests that the effect is due to heater-cathode leakage in one of the two valves in the v.h.f. tuner. These should be checked by substitution. (ITT/STC VC11 chassis.)

KORTING TRANSMARE

When this 26in. colour set is switched on from cold there is severe sparking from the e.h.t. cap. This dies down as the set warms up. The c.r.t. was quite dirty so the area around the e.h.t. connector was cleaned with meths, but the sparking continued. The area was then sprayed with ignition sealer (Holt's Wet Start) and this seems to have cured the trouble. Is there a more serious cause of the sparking?

Some colour sets are prone to this trouble – it depends on the air humidity. The procedure recommended is to thoroughly clean around the e.h.t. cap with meths, then apply to the area a very thin layer of silicone grease. It is unlikely that the sparking is due to a fault in the set.

RGD 627

The fault with this set is a two inch gap at the top and bottom of the screen. The PCL85 field timebase valve has been replaced without improving the situation. The height control is at maximum.

There are two valves in the field timebase, the triode section of V8 (PCF80) forming one half of the field oscillator. The trouble is more likely to be due to a fault in the height circuit however. Check C75 (0·1μF) which decouples the slider of the height control – it has a habit of leaking to give the symptom you describe – and then the high-value ½W carbon resistors in the height control network. For correct height the voltage at pin 1 (triode anode) of the PCL85 should be about 100V – this must be checked with a meter having a 20kΩ/V or better internal resistance. (KB WV05 series.)

PHILIPS 322

When the contrast is at a reasonable level dark scenes are too black and light scenes too bright. I am thinking therefore of removing the black-level clamp. Can you suggest how this should be done?

Having advocated the use of black-level clamping for so many years we could not in all conscience advise the removal of a black-level clamp circuit. There isn't one anyway in this chassis! The video signal is d.c. coupled from the detector to the TBA550 integrated circuit, then via the contrast control to the BF337 video output transistor and the c.r.t. cathode. If the soot and whitewash effect cannot be removed at a lower setting of the contrast control, there could be a fault in the video output stage. Check the voltages here – they will usually be incorrect with this type of non-linear video response fault. Check that the preset brightness control R2252 is correctly set – for correct black level with the main brightness control at mid position. (Philips 320 chassis.)

GEC 2121

The problem is field buzz on sound when the volume control is set to a low level. The buzz varies as the field hold control is adjusted.

The effect could be due to C121 (150μF) which decouples the l.t. supply to pin 11 of the TBA120SQ intercarrier sound i.c. being of low capacitance. In some cases it helps to fit a 150-400μF capacitor in place of C187 (which decouples the same pin) on the sound module, reconnecting the original C187 (0·1μF) across the added capacitor but on the underside of the board. (GEC C2110 series.)

COLOUR RECEIVER STRIATIONS

I have been trying to find the cause of striations, i.e. vertical lines on the left-hand side of the screen gradually fading towards the centre, in colour receivers. Have you any general guidance?

Striations are caused by an inductive component in the line output stage ringing and causing velocity, i.e. intensity, modulation of the c.r.t. beams. The usual cause of the trouble is an open-circuit or high-resistance damping resistor across the line linearity coil. Other causes are a faulty output stage tuning capacitor or misadjusted tuning coil, or transformer ringing appearing on the luminance signal due to a fault in the flyback blanking circuit.

QUERIES COUPON

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TELEVISION SEPT. 1975

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 GEC Model C2041 operated normally so far as monochrome and sound were concerned but had a colour fault. The colour would sometimes resolve correctly after initial switch-on, but there was seemingly an even chance of the colouring being wrong due to severe blinds.

Tests were made on the decoder panel to establish that the ident signal was present at the bistable circuit, and all seemed to be well in this area at least. Further measurements and oscilloscope analysis then revealed that the bistable had a sluggish switching characteristic. Once it was switching, the stage would continue to switch line-by-line to yield the half line-frequency pulses for the PAL switch, but if for some reason the bistable ceased to switch it could not easily be started again.

While observing a colour picture it was noticed that a ragged, vertical line of white light would sometimes appear at the left of the display, and that when this happened there would be a momentary change of the colours in the picture.

It was next decided to remove the triggering pulses from the bistable circuit which of course then ceased to switch altogether. A 'scope measurement of the pulses from source was then made and it was discovered that the pulse amplitude was well below the manufacturer's stipulated 18V (it requires a Y-calibrated oscilloscope to obtain an accurate readout of pulse amplitude here).

What was the most likely cause of the symptom, and what were the clues available to the service technician to establish the likely cause? See next month's Television *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 152
(Page 491 last month)

Disappearance of the luminance (Y) information indicates that there is an open-circuit somewhere in the Y channel, while lateral displacement of the luminance information on the screen with respect to the colour information signifies a bandwidth or phase (timing) change either in the luminance or chrominance circuits. Since the two symptoms appeared to be related the most likely fault area was the delay line in the luminance channel.

This was where the chief engineer made his examination. Having satisfied himself that all connections to and from the Y delay line were in good order, he replaced the line. This completely cleared the symptom. The delay line was subsequently examined and it was found that there was an intermittent fault condition which gave either a short across the line (thereby removing the delay and causing the displacement symptom) or a break in continuity (thereby open-circuiting the Y channel).

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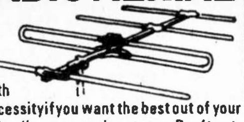

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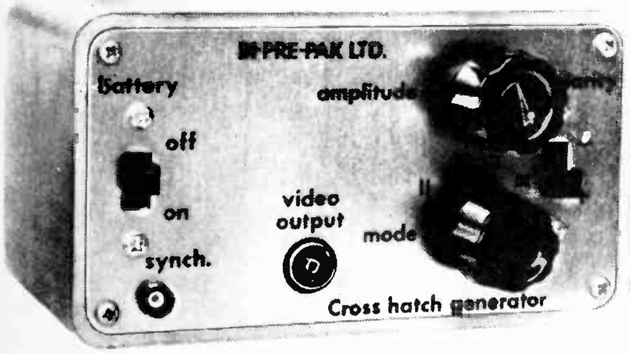

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