TELEVISION

20p

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

APRIL 1972

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EM81	42½p
EM84	37½p
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EY80	45p
EY81	40p
EY83	55p
EY86	40p
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EZ40	45p
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PCF84	47½p
PCF86	61p
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PCF806	61p
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PCH200	70p
PCL82	51p
PCL83	61p
PCL84	51p
PCL85	52½p
PCL86	51p
PD500	£1·52½
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PL36	64p
PL38	90p
PL81	51p
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PL82	36p
PL83	51p
PL84	41p
PL500	82½p
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PL505	£1·45
PL508	£1·00
PL509	£1·54
PL802	86p
PL805	86p
PY33	62½p
PY80	32½p
PY81	41p
PY800	41p
PY801	41p
PY82	35p

PY83	50p
PY88	41p
PY500	£1·00
PZ30	80p
QQUO2-6	£2·10
QQUO3-10	£1·25
QVO3-12	65p
R19	65p
R20	75p
SU2150A	75p
TT21	£2·40
TT22	£2·50
U18/20	67½p
U20	67½p
U25	75p
U26	75p
U31	45p
U37	£1·50
U50	30p
U52	30p
U76	25p
U78	25p
U191	75p
U201	35p
U281	40p
U282	40p
U301	57½p
U403	50p
U404	37½p
U801	£1·00
UABC80	52½p
UBF89	40p
UBC41	49p
UCC85	46p
UCH42	69p
UCH81	54p
UCL82	51p
UCL83	61p
UF41/2	55p
UF80/5	37½p
UF89	41p

UL41	57½p
UL84	55p
UM80/4	45p
UY41	40p
UY85	34p
U25	75p
U26	75p
U191	72½p
U193	41p
U301	85p
W729	55p
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OA2	32½p
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OC3	35p
OD3	32½p
3Q4	40p
3S4	35p
3V4	40p
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5U4G	30p
5U4GB	37½p
5V4G	40p
5Y3GT	30p
5Z3	45p
524GT	40p
6/30L2	75p
6AB4	32½p
6AF4A	47½p
6AG7	37½p
6AH6	50p
6AJ8	29p
6AK5	30p
6AK6	57½p
6AL3	42½p
6AL5	16p
6AM5	25p
6AM6	22½p
6AQ5	32½p
6AQ6	50p

6AR5	32½p
6AR6	32½p
6AS5	35p
6AS7G	80p
6AT6	45p
6AU6	29p
6AU6	30p
6BA6	47½p
6BE6	60p
6BH6	42½p
6BJ6	42½p
6BK7A	50p
6BL8	35p
6BN5	42½p
6BN6	40p
6BQ5	25p
6BR7	75p
6BR8	95p
6BW6	82½p
6BW7	69p
6BX6	25p
6BZ6	32½p
6C4	30p
6C5GT	35p
6CD6G	£1·40
6CA4	27½p
6CA7	52½p
6CBC	27½p
6CD6GA	£1·15
6CG7	45p
6CH6	55p
6CL6	50p
6CW4	62½p
6CY5	40p
6CY7	60p
6D3	40p
6DC6	67½p
6DK6	42½p
6DQ6B	60p
6DS4	75p
6EA8	55p
6EH7	32½p

6EJ7	35p
6EW6	60p
6F1	70p
6F8	40p
6F6G	25p
6F11	32½p
6F12	22½p
6F13	35p
6F14	60p
6F15	55p
6F18	40p
6F22	32½p
6F23	77½p
6F24	67½p
6F25	75p
6F26	35p
6F28	70p
6F29	32½p
6F30	35p
6J4	47½p
6J5GT	30p
6J7	42½p
6K6GT	50p
6K7	32½p
6K8G	30p
6K23	50p
6K25	75p
646GT	45p
6L7	32½p
6L18	30p
6LD20	32½p
6N7GT	35p
6P1	60p
6P25	£1·05
6P28	62½p
6Q7	37½p
6R7G	35p
6S2	40p
6S4A	55p
6SA7	37½p
6SG7	32½p
6SJ7	37½p

6SK7	32½p
6SL7GT	32½p
6SN7GT	30p
6SQ7	40p
6SR7	37½p
6T8	32½p
6U4GT	62½p
6U8	35p
6V6GT	32½p
6X4	25p
6X5GT	27½p
6X8	55p
6Y6G	60p
7Y4	60p
9BW6	42½p
10C2	50p
10D1	40p
10D2	40p
10F1	90p
10F9	50p
10F18	40p
10L1	40p
10LD11	55p
10P13	55p
10P14	£1·00
12AB5	50p
12AC6	37½p
12AD6	37½p
12A15	40p
12AQ5	40p
12AT6	25p
12AU6	75p
12AV6	30p
12AV7	45p
12AX7	30p
12AY7	67½p
12B4A	50p
12BA6	32½p
12BA7	32½p

12BE6	32½p
12BH7	32½p
12BY7	50p
12K5	50p
12K7GT	35p
12Q7G	25p
12SC7	25p
12SG7	35p
12SH7	25p
12SJ7	25p
12SK7	40p
12SL7GT	40p
12SN7GT	40p
12SQ7	40p
12SR7	32½p
14S7	80p
20D1	45p
20L1	£1·00
20P1	50p
20P3	60p
20P4	£1·00
20P5	£1·00
25C5	45p
25L6GT	37½p
25Z4G	30p
25Z6GT	50p
30A5	40p
30AE3	40p
30C15	75p
30C17	80p
30C18	75p
30F5	85p
30FL1	75p
30FL2	92½p
30FL13	50p
30FL14	77½p
30L1	45p
30L15	85p
30L17	85p
30P12	80p
30P18	35p
30P19	75p

30PL1	77½p
30PL13	90p
30PL14	85p
35A3	50p
35A5	55p
35B5	65p
35C5	35p
35D5	65p
35L6GT	47½p
35W4	25p
35Z3	55p
35Z4G	25p
35Z5GT	37½p
50A5	65p
50B5	35p
50C5	35p
50L6GT	40p
83A1	90p
85A2	37½p
90AU	£2·40
90C1	60p
90CU	£1·25
807	47½p
811A	£1·50
612A	£3·25
813	£3·75
866A	70p
5642	60p
6080	£1·37½
6146	£1·50
6146B	£2·37½
6267	32½p
6360	£1·25
6939	£2·10
7199	75p
7360	£1·80
7586	£1·25
9002	32½p
9003	50p

CATHODE RAY TUBES

New and Budget tubes made by the leading manufacturers. Guaranteed for 2 years. In the event of failure under guarantee, replacement is made without the usual time wasting forms.

Type		New £	Budget £
MW36–20			£4·50
MW36–21			£4·50
MW43–69Z	CRM171		
	CRM172	£6·60	£4·62½
MW43–80Z	CRM173	£6·60	£4·62½
AW43–80Z	CME1702	£6·60	£4·62½
	CME1703	£6·60	£4·62½
	CME1706	£6·60	£4·62½
	C17AA	£6·60	£4·62½
	C17AF	£6·60	£4·62½
AW43–88	CME1705	£6·60	£4·62½
AW47–90			
AW47–91	A47 14W	£5·95	£4·87
A47 14W	CME1901	£5·95	£4·87
	CME1902	£5·95	£4·87
	CME1903	£5·95	£4·87
	C19AH	£5·95	£4·87
147 13W	CME1906	£10·27½	£8·50
A47–11W	CME1905	£8·86½	£7·00
A47–26W	CME1905	£8·86½	£7·75
A47–26W/R	CME1913R	£9·33½	

Type		New £	Budget £
A50–120W/R	CME2013	£10·85	
AW53–80		£8·93½	£6·25
AW53–88	CME2101	£8·93½	£6·25
AW59–90			
AW59–91	CME2303	£9·58½	£7·20
A59–15W	CME2301		
	CME2302		
	CME2303	£9·58½	£7·20
A59–11W	CME2305		
A59–13W	CME2306	£13·65	£10·97½
A59–16W	CME2306	£13·65	£10·97½
A59–23W	CME2305	£12·60	£10·50
A59–23W/R		£12·60	£10·50
A61–120W/R	CME2413	£13·50	£11·50
A65–11W	CME2501	£16·50	£14·50
COLOUR TUBES			
A49–191X	19 inch	£52·50	
A56–120X	22 inch	£57·50	
A63–11X	25 inch	£62·50	
PORTABLE SET TUBES			
TSD217		£11·50	
TSD282		£11·50	
A28–14W		£9·16½	Not supplied
CME1601			£7·75
CME1602			£8·00

A discount of 10% is also given for the purchase of 3 or more tubes at any one time.
All types of tubes in stock. Carriage and insurance 75p anywhere in Britain.

TRANSISTORISED UHF TUNER UNITS NEW AND GUARANTEED FOR 3 MONTHS

Complete with Aerial Socket and wires for Radio and Allied TV sets but can be used for most makes.

Continuous Tuning, £4·50; Push Button, £5·00.

SERVICE AIDS

Switch Cleaner, 55p; Switch Cleaner with Lubricant, 55p; Freeza 62½p. P. & p. 7½p per item.

PLUGS

Jack Plugs and Sockets		Co-Axial Plugs	
Standard Plugs	19p	Belling Lee (or similar type)	6½p
Standard Sockets	12½p	Add 2p per doz. p. & p.	

LINE OUTPUT TRANSFORMERS

G.E.C.	BT454	£4·75	G.E.C.	2028	£4·75
G.E.C.	BT456	£4·75	G.E.C.	2041	£4·75
G.E.C.	2010	£4·75	G.E.C.	2000 Series	
G.E.C.	2013	£4·75	Philips	19TG	£4·75
G.E.C.	2014	£4·75	Pye	Mod. 36	£4·75
G.E.C.	2018	£4·75	Pye	Mod. 40	£4·75
G.E.C.	2043	£4·75	Thorn	800–850	£4·75
G.E.C.	2048	£4·75			

STYLII—BRITISH MANUFACTURED

All types in stock.

Single Tip "S"	13p	Double Tip "S"	33p
Single Tip "D"	37p	Double Tip "D"	47p

"S" = Sapphire "D" = Diamond

CARTRIDGES

	Inc. P.T. each
ACOS	
GP79	£0·63
GP91-1Sc -1	£1·05
GP91-2Sc	£1·05
GP91-3Sc	£1·05
Suitable to replace	
TC8	
GP92	£1·32
GP93-1	£1·24
GP94-1	£1·55
GP94-5	£1·80
GP95	£1·24
GP96	£1·57
ACOS	
104 1-10	£2·09

B.S.R.		Inc. P.T. each
X3M	S/S	£1·50 (X3M, X3H, X5M, X5H)
X3H	S/S	
X5M	S/S	
X5H	S/S	
SX5M	S/S	£2·00 (SX5M, SX5H)
SX5H	S/S	
SX5M	D/S	£2·10 (SX5M, SX5H)
SX5H	D/S	
X4N	D/S	£2·50
GOLDRING		
850		£6·95
G800		£9·35
G800E		£15·00
G800 Super E		£19·50

RONETTE		Inc. P.T. each
105	S/S	90p
106	S/S	99p
DC400	S/S	70p
DC400SC	S/S	70p
105	D/S	£1·11½
106	D/S	£1·11½
DC400	D/S	84p
DC400SC	D/S	84p
SONOTONE		
9TA	D/S	£1·35
9TA	D/S	£2·05
9TAHC	D/S	£2·05

EX-RENTAL TV SETS
19 inch B.B.C.2 Sets £16·50 23 inch B.B.C.2 sets £18·50. Add £5·00 per set for guaranteed working order. Brand new boxed 20 inch K.B. £55·00. Carriage £1·00.

SEMICONDUCTORS BRAND NEW MANUFACTURERS MARKINGS NO REMARKED DEVICES

2N388A	63p
SN697	20p
2N698	25p
SN706	13p
SN706A	13p
SN930	28p
SN1132	33p
SN1303	18p
SN1305	23p
SN1306	25p
SN1307	25p
SN2614	30p
SN3826	30p
SN4905	P/A
SN4914	P/A
SN1711	25p
SN2147	73p
SN2160	58p
SN2646	58p
SN2905	40p
SN2926	
Green	14p
Yellow	13p
Orange	13p
SN3053	28p
SN3055	75p
SN3392	20p
SN3702	18p

SN3704	23p
SN3705	20p
SN4061	23p
SN4062	23p
SN4286	18p
SN4291	18p
RCA	
40253	P/A
40398	P/A
40458	P/A
AC107	30p
AC117	60p
AC126	20p
AC127	25p
AC128	20p
AC176	25p
AC187	63p
AC188	38p
ACY17	28p
ACY20	25p
AD140	40p
AD142	58p
AD149	58p
AD161	38p
AD162	38p
AF102	58p
AF114	25p
AF115	25p

AF116	25p
AF117	25p
AF118	60p
AF124	13p
AF125	20p
AF126	20p
AF127	18p
AF139	38p
AF178	45p
AF179	45p
AF180	53p
AF181	43p
AF186	67p
AF239	43p
ASY28	28p
BA144	P/A
BA145	P/A
BA148	23p
BA155	P/A
BA156	P/A
BC107	15p
BC108	15p
BC109	15p
BC113	28p
BC114	38p
BC115	33p
BC116	63p
BC116A	38p

BC118	33p
BC134	58p
BC135	P/A
BC136	P/A
BC137	P/A
BC138	P/A
BC142	30p
BC143	P/A
BC147	18p
BC148	15p
BC149	18p
BC152	18p
BC158	18p
BC169B	14p
BC169C	15p
BC171	18p
BC175	28p
BC183	23p
BC184	23p
BC187	29p
BC213L	27p
BCY32	38p
BCY58	23p
BCY70	20p
BD121	65p
BD123	83p
BD124	63p
BD131	98p

BF115	25p
BF117	48p
BF163	35p
BF167	25p
BF173	33p
BF178	35p
BF179	73p
BF180	35p
BF181	33p
BF184	25p
BF191	23p
BF195	28p
BF196	43p
BF197	32p
BF200	37p
BF224	30p
BF225	30p
BF257	47p
BFX29	35p
BF161	P/A
BF162	P/A
BF163	25p
BFY19	23p
BFY50	23p
BFY51	23p
BFY52	23p
BSX21	38p
P346A	25p

T1843	40p
DIODES & RECTIFIERS	
1N914	8p
AA119	10p
BA102	23p
BA115	8p
BA114	13p
BY100	23p
BY126	20p
BY127	23p
BZY88 (Series)	33p
OA5	13p
OA47	8p
OA70	8p
OA79	9p
OA71	8p
OA90	8p
OA91	8p
OA202	10p

P/A = price on application

ADD 3p PER ITEM FOR POST & PACKING FOR ORDERS UNDER 24 PIECES

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TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

VOL 22 No 6
ISSUE 258

APRIL 1972

CONSTRUCTORS' COLOUR

THIS month we introduce a project which has long been promised to readers—a colour set for the constructor. The receiver is capable of the highest standards of performance, featuring automatic frequency, chrominance and gain control, RGB tube drive with effective black-level stabilisation, colour and contrast controls which track together and if the constructor wishes the latest varicap type tuner unit (other tuners can be used instead). In addition care and thought have been given to the design of a suitable cabinet so that you can at the end have a set the whole family can live with.

While the set uses high-performance circuitry we do not however make any claims to originality in this respect. That would not have been the object of the exercise. What is required is circuitry of proven performance and reliability, so the set is based on well-known circuits with an established reputation. This does not mean that we are adverse to novel ideas, and we hope to publish further circuits—in fact the venturesome will have seen many other approaches described by our regular contributors—at a later date. To start with however it is obviously best to keep to a well-trodden path: we can hardly ask you to spend not a little time and money on such a project without being certain of its basic soundness. Slight modifications to the original circuits have however been undertaken with a view to making them less critical and consequently better suited to one-off construction.

There is everything to be said for learning from experience and we hope and expect that this project will open up the subject to many newcomers to colour. With this in mind the constructional details will be accompanied by full circuit descriptions.

As readers of Part 1 will find out considerable thought has been given to devising ways to help those who get into difficulties. That said however we must nevertheless emphasise that this project is not one to be undertaken lightly. While the individual backroom genius may find he can put the set together with no trouble at all this is unlikely to be everyone's experience. Perhaps for those who are used to mulling matters over with their friends a joint approach would be best to start off with.

But however you decide to tackle it, we wish you every success and hours of happy viewing at the end. To provide a speedy check on whether any snags arise in practice a couple of further prototypes are being constructed using the specified components. With this "monitoring" we expect to be able to iron out any last minute problems.

W. N. STEVENS, *Editor*

THIS MONTH

THE NEXT ISSUE DATED MAY WILL BE PUBLISHED APRIL 17

Errors: Some gremlins seem to have got into our issue last month. In addition to one or two mis-spellings there was the unfortunate howler on page 215 where the heading should have read "Bush TV103/TV105 Series," not "Sobell ST282 Series—cont." This was due to the wrong heading being inserted at the platemaking stage, after passing for press. There is no connection between the RBM and Sobell-GEC groups. Our apologies to all.

TELETOPICS

START OF SATELLITE TV

The first experimental TV broadcasting service from a satellite direct to TV receivers is due to start in mid-1973 in the Rocky Mountain area of the USA, with transmissions at 2500MHz. The service will provide educational programmes to some 500 communal receivers in schools, public broadcast stations, cable networks and so on, though it has been stated that there is nothing to prevent individuals buying converters with parabolic aerials (at $150-200) to pick up the transmissions direct. The satellite is the one intended later for a stationary orbit over India to provide direct educational TV for communal sets there.

SERVICING CAREER AND WAGE STRUCTURE

With the aim of providing a career and wage structure the Scottish installation contracting industry's Joint Industry Board has introduced a system of grading and standardised rates of pay for service engineers in two sections of the industry, those carrying out audio/TV work and those repairing electrical appliances. The scheme is an extension of the already established graded rates for electrical installation operatives and the Scottish JIB has sent a circular to employers of audio, TV and domestic appliance servicemen all over Scotland inviting firms and their engineers to join the scheme.

In the audio/TV section there are three pay grades for qualified technicians, with apprentices getting an increasing percentage of the rate for trained men as they progress. The top rate of 80 pence an hour goes to technicians aged at least 27 years who have experience of supervision and are capable of completing 55 service calls a week. The qualification required for this grade is the complete C & G course 48, course 433 or equivalent. The rate for grade 2 technicians is 74 pence per hour. To qualify for this grade technicians must be at least 22, able to make 50 calls a week and have the C & G course 48 part 1, course 433 part 2 or equivalent. For grade 3 a technician must be aged 20 or over, capable of 45 weekly calls, have completed a recognised apprenticeship or equivalent course and have gained C & G course 433 part 1 or equivalent. Aerial installers are also included: the rate for qualified riggers is 54 pence per hour and for grade 2 riggers 49 pence an hour.

These ideas of the Scottish electrical contracting industry have been criticised by the RTRA, the Scottish branch of which claims to have been working for some time on a plan based on job description and minimum rather than fixed rates. The English RTRA has expressed strong reservations about the job-description gradings and even more about the fixed-rate idea. It seems however that the Scottish contractors have stirred things up and induced some sense of urgency. To us it seems high time that the undoubted skills of service engineers received due recognition and recompense.

TRANSMITTER NEWS

The BBC-1 u.h.f. service from the **Windermere** relay station has now started, on channel 51 with vertical polarisation (receiving aerial group B). Three more ITA relay stations have been brought into service: **Kilvey Hill** (Swansea) carrying HTV Wales programmes on channel 23 (receiving aerial group A, vertical polarisation); **Fenton** (Stoke-on-Trent) carrying ATV programmes on channel 24 (receiving aerial group A, vertical polarisation); and **Halifax** carrying Yorkshire Television programmes on channel 24 (receiving aerial group A, vertical polarisation).

The broadcasting authorities appear to be in a bit of a pother just now, having discovered that their u.h.f. transmitters are giving about 25% more service area than expected: good news for those of you able to get extra programmes as a result, but there could be co-channel interference problems as more stations are brought into operation.

RANGE OF HELICAL AERIALS

A range of helical u.h.f. aerials has been introduced by Precision Electro Mechanical Services Ltd., 12b Grove Road, London E3. The Enterprise range features a spiral active element and circular grid reflector. Advantages claimed are high power gain, high front-to-back ratio and less susceptibility to fading caused by multipath reception and wind movement. There are two group A versions, the A6 with a six-turn active element and the A9 with a nine-turn active element, and group B and C versions which both have nine-turn active elements.

TELEFUNKEN FIRST WITH 110° COLOUR

The first colour receiver with a 110° c.r.t. has now been introduced in the UK. This is a 26in. model from **Telefunken** and has a cabinet depth of only 18in. The chassis is a hybrid one employing 47 transistors, one i.c. and 5 valves. Valved timebases have been adopted rather than the solid-state techniques described in our pages last month. Features include five slider-type user controls and a varicap tuner. The price is £398.

Two new monochrome models have been introduced by **Alba**, the T1520 which is fitted with a 20in. tube and the 24in. Model T1924. It is interesting to note that these models use the BRC 1500 chassis: Alba have been using Philips chassis since they ceased producing their own in 1965.

A new 24in. monochrome receiver fitted with the Pye group 169 chassis has been introduced in the Pye and Ekco ranges. The **Ekco** version is Model T543 at £89, the **Pye** version model 161 at £88.

Reports of a high level of business come from the rental organisations who say that four out of every five colour sets at present going into people's homes do so on a rental basis.

THE VIDEOCASSETTE STANDSTILL

We have received further information on the reasons behind the standstill in videocassette development in the US. Apparently the Federal Communications Commission (FCC), which has power to control interference-causing r.f. radiation, has suggested a maximum output voltage of 2mV r.m.s. for devices such as videotape recorders, videocassette players, CCTV cameras and so on which provide an output consisting of an r.f. carrier modulated with a TV signal for feeding to the 300Ω (US standard practice) aerial input socket of a TV set, and has also proposed limits for spurious radiation from such equipment. Since many of the devices available or under development have outputs of 1V or more something of an impasse has been created.

SPECIAL SETS FOR CATV?

A report from Macclesfield Relay of difficulties encountered in using standard colour receivers for wired TV systems reminds us of a report in the US journal *Radio-Electronics* last September of just such problems there. The basic difficulty is inadequate i.f. selectivity and adjacent channel rejection. Macclesfield Radio comment that severe patterning on colour is caused by beating between certain ITA vision and BBC sound channels, and say that some chassis are affected far more than others. To overcome the problem Macclesfield Relay is to reduce the frequency of its BBC-1 channel by 1·75MHz. Since the Minister of Posts and Telecommunications is at present giving encouragement to the setting up of wired systems this is a problem that could be of increasing importance. In the US, the National Cable TV Association has asked the FCC to set standards for special receivers for cable TV systems and we understand that some US setmakers are developing special sets for use with wired TV distribution systems.

DEVELOPMENTS

The tubeless TV camera is of course the corollary of the flat TV set you hang on the wall. Both may eventually become practicable with advances in semiconductor technology though the well-tried thermionic devices seem in no danger for the foreseeable future. As a step towards the tubeless TV camera RCA Laboratories have released details of their work on a solid-state sensor consisting of a silicon integrated circuit with 1,408 photo-sensitive elements. When light is focused, using an ordinary camera lens, on this structure the elements take up a charge of strength proportional to the intensity of the light reaching them. These charges are read out in sequence using shift-registers. The present experimental device is said to be capable of providing a recognisable picture, especially of alphanumeric characters. To reach broadcast picture standards an array with some half a million elements would be needed. The next stage in RCA's programme is to develop an array of 10,000 elements.

Meanwhile Laser Video Inc. in the US are developing wide-screen laser-driven colour TV receivers. The model being worked on has a screen diameter of approximately 56in., is wall-mounted and approximately 9-10in. deep.

OFFICIAL STATEMENTS

The Minister of Posts and Telecommunications Christopher Chataway has stated in the House of Commons that he is "not persuaded that the time has yet come to allocate the fourth TV network". He has however "decided to end the restriction on hours of television broadcasting".

Christopher Chataway has also revealed that an extra 100,000 new television licences have been taken out since the TV licence Anti-Evasion Campaign was started last October. This represents additional revenue of about £1¼ million.

NEWS FROM MAZDA

Mazda have completed their annual review of valve and tube types to be included in their lists, and some more old friends go. Valve types 6F24 and 10LD3 are now obsolete, though the GZ34 has been added. Picture tube types CME1702, CME1705, CME1902, CME2101, CME2104, CME2301 and CME2302 are now classified as obsolescent, which means that they will continue to be available as long as stocks last but that there will be no further production. It makes us feel old: surely it *was* just the other day that the 19in. tube arrived on the scene?! And whatever happened to those CRM types? It does of course mean more scope for the dabbler in finding ways of keeping those old sets the local shops won't look at going!

Mazda also say their *Mazda Book of PAL Receiver Servicing* sold out in just six weeks but that a further reprint is expected shortly. This seems to confirm our own high opinion of the book.

AERIAL INSTALLATION ADVICE

Commenting on the work of the Antiference Mobile Research Unit Ralph Stallworthy has made a number of worthwhile points about current aerial installation problems. For instance, even with low-loss cable a great deal of signal can be lost through too heavy stapling, extra care being needed with semi-airspaced types. Cable kinking can also cause losses. The provision of a drip loop where the feeder enters the aerial junction unit is advised to prevent the connections being regularly wetted and eventually breaking down. For receiving extra ITV stations separate downleads with an aerial switch are recommended to prevent signal break-through in relatively inefficient combining units. Aerial amplifiers are apparently quite often badly installed, with bad connections (loose or completely unconnected braiding for example) and damaged components (especially misplaced coils).

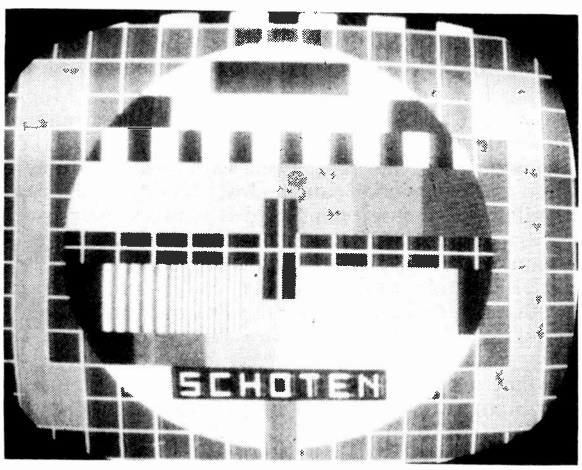
LONG-DISTANCE TELEVISION

ROGER BUNNEY

JANUARY has been a very quiet month. The improved Sporadic E openings noted during December continued into the first two weeks of January as several ever vigilant enthusiasts can confirm. It seems that medium distance skip was prevalent as the West German/Czechoslovakian directions were preferred, particularly on the 8th January over the late morning period. Since that date reception seems to have been confined to the more usual forms of Meteor Shower (MS). My own log for the period reflects the rather depressed conditions. It is possibly significant to note that on most days reception of sorts is possible, though mainly of short-duration bursts. For anyone despairing of the apparent lack of signals I suggest tuning to an empty Band I channel, accurately setting the line and field hold controls, increasing the receiver gain to maximum—with of course an aerial amplifier—and waiting patiently. Eventually some short bursts of signal will be seen, if not on the first day then on the second. The best period to operate in this mode is the early morning period between 0730-0900 when MS activity is at its best. The other advantage is that many of the European broadcasters are on earlier than the UK transmitters—as most of Western Europe keeps to CET rather than GMT, CET being +1 hour GMT.

Now on to my own log:

1/1/72 DFF (East Germany) E4; TVP (Poland) R1—(both MS).
2/1/72 RAI (Italy) IB (MS); NOS (Holland) E4 (trops).
4/1/72 NRK (Norway) E3; SR (Sweden) E2—(both MS).
5/1/72 SR E2 (MS); BRT (Belgium) E2 (trops).
7/1/72 NRK E3; SR E2, 3—(both MS).
8/1/72 DFF E4; SR E4; RAI IB—(all MS).
9/1/72 SR E4 (MS); BRT E2 (trops).
11/1/72 Switzerland E2; WG (West Germany) E2; SR E2—(all MS).
12/1/72 NRK E3 (MS).
13/1/72 DFF E4 (MS).
15/1/72 DFF E4 (MS); NOS E4; BRT E2—(both trops).
16/1/72 NOS E4; BRT E2—(both trops).
17/1/72 DFF E4 (MS).
20/1/72 NRK E3; SR E2—(both MS).
21/1/72 WG E4; NRK E3—(both MS); TVP R1 (Sp.E).
22/1/72 NOS E4 (trops).
23/1/72 NOS E4; BRT E2 (both trops).



PM5544 electronic test card, Schoten, Belgium. Courtesy P. D. van der Kramer.

24/1/72 SR E3; ORF (Austria) E2a (both MS).
25/1/72 Unidentified Sp.E pulse and bar pattern, long duration but weak, thought to be CT (Czechoslovakia) 0835-0844.
26/1/72 SR E3, 4 (MS).
29/1/72 DFF E4 (MS); NOS E4 (trops).
31/1/72 WG E2 (MS).

In the December column we reported some very long-haul u.h.f. DX signals in the United States. The WTFDA, Milwaukee has now sent us some detailed information of this rather epic reception. It appears that our old friend and veteran TV-DX enthusiast Bob Cooper of Oklahoma City, Oklahoma has been successful in the reception of two u.h.f. stations at distances over 1,200 miles. To quote the words of Bob himself as detailed in his report: "Tropical storm 'Beth', sitting off the New England shore, sucked up moisture from the Gulf Coast of Texas, and dead NE along a stalled NE/SW front, setting up a *super duct* that will long be remembered. Reports have it Oklahoma was too far West for the action, except between 0730-1030 August 17th. Then we had it, as you shall see. Net results: u.h.f. like never before, including snow-free WBJA-34 at 1,245 miles, weak but loggable (thanks to a clear channel) WSBK-38 at 1,491 miles and much more." The ch.A34 WBJA transmitter is located at Binghamton, NY, and ch.A38 WSBK at Boston, Mass. I am sure you will all agree that this reception is quite a fantastic distance for the frequencies involved. It shows what can be received by the ever vigilant DX enthusiast. Our congratulations to Bob Cooper.

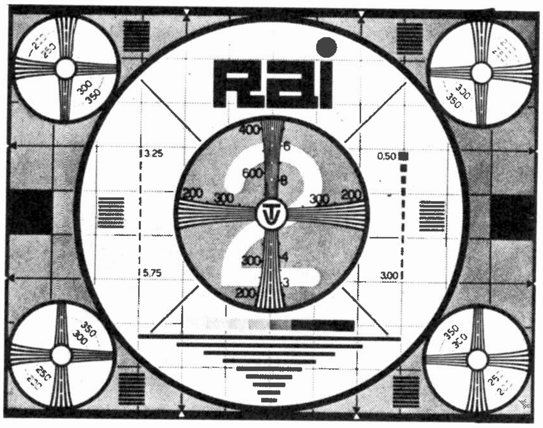
Sun Spots

Predictions for the next six months, courtesy Swiss Federal Observatory: January 52, February 50, March 48, April 47, May 45, June 44. Solar activity during December remained at quite a high level and on several days the individual count reached over the 100 mark. Indeed on the 17th December the count reached as high as 131.

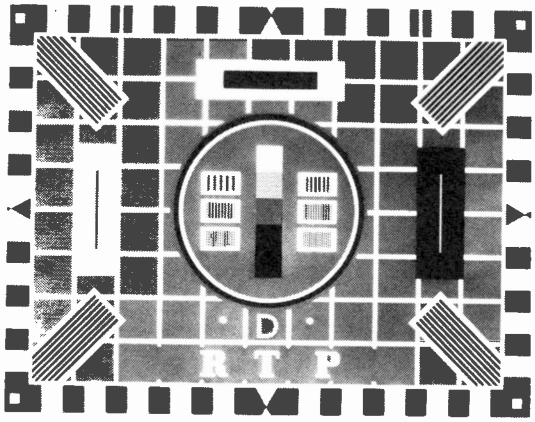
News

Yugoslavia: We recently indicated that JRT-Yugoslavia would be starting a u.h.f. service and now have news of the first transmitters. Situated in the Serbian part of the country, the second programme—in PAL colour—radiates from Avala ch.E22; Crveni Cot ch.E24; Jastrebac ch.E27. All the transmitters radiate with 1,000kW e.r.p., with believed to be horizontal polarisation.
Finland: Our good friend Seppo J. Pirhonen from Lahti advises of test transmissions. The TV1 network uses the electronic card (SWF type) and the TV2 network the familiar test card G. Test transmission times are: weekdays 0700-1400; Saturday 0700-1200. The TV1 network on Wednesdays has a shortened test transmission from 0700-1200. All times GMT.
Belgium: It appears that Belgium is now carrying the electronic test card type PM5544 on all v.h.f./u.h.f. transmitters. The card carries identification indicating either the BRT or RTB network but no other identification at present. We do not know if this is to be permanent, i.e. replacing the other cards that have been used up to the time of writing. Peter van der Kramer of the Europese testbeeldjagers has sent a photograph of the Schoten transmitter using this type of card just after the transmitter had opened. It is interesting to note that during the good tropospheric conditions that occurred at the

DATA PANEL 9—2nd series



Italy—RAI—Radiotelevisione Italiana



Portugal—RTP—Radiotelevisao Portuguesa

Italy: Two basically similar test cards are in use. The 1st National Programme transmitters on v.h.f. use a card similar to that shown above left except that the letter N is superimposed within the centre circle. The 2nd Programme transmitters use the test card as shown. The main transmitters of the National Programme carry an identification number within the centre of the top right-hand circle. The list of these transmitters was given in the May, 1971 DX-TV column, page 310. Additions are: Gambarie Ch. D (19) and Badde Urbara Ch. D (28).

Portugal: Either test card D or E is used, as shown (above right). The checkerboard pattern (see Data Panel 2 of this series) is also extensively used. Test card D courtesy Keith Hamer, Derby.

time of the transmitter opening the identification machine that electronically inserts the station name was faulty, the "Scho" of Schoten flashing on and off. This effect was reported over a wide area.

Spain: From time to time we receive reports of the TVE transmitter at Guadalcanal ch.E4 using the EBU test pattern with an identification "Guadcanal". Apparently this is used for Eurovision purposes when programmes are being relayed to certain North African countries.

Monte Carlo: In connection with the reports of activity with Tele Monte Carlo and a proposed coverage from a high-powered transmitter in the Alps over parts of Northern Italy we have now heard from our correspondent in Bergamo, Northern Italy about the situation there: he personally has seen no signals! A friend of his at Marseille advises that there is a high-powered transmitter "in a very favourable place on the Alps and this must cover North Italy as far as the Adriatic." An official letter from TMC headquarters to our Italian contact advises that only a low-powered transmitter is located on Mt. Agel (their existing v.h.f. transmitter site) and that it can only be received to the West of the Riviere Ligure. The channel used is E35. It seems that the area is part of the target coverage of a high-powered RAI (Italian) transmitter on ch.E34. As we seem to have covered this matter rather extensively in recent issues I propose to drop it until signals are being received: further speculation can only lead to greater confusion!

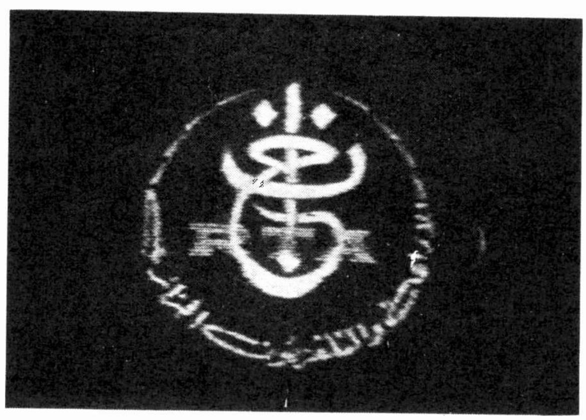
The EBU tell us that the subscription for the 17th edition of the "List of Television Broadcasting Stations" will be increased from 200 to 300 Belgian Francs. The new edition will commence from March 1st, 1972, with the usual main list, six bimonthly supplements and a map. This excellent list is available from The European Broadcasting Union, 32 Avenue Albert Lancaster, B-1180, Bruxelles, Belgium.

Data Panels

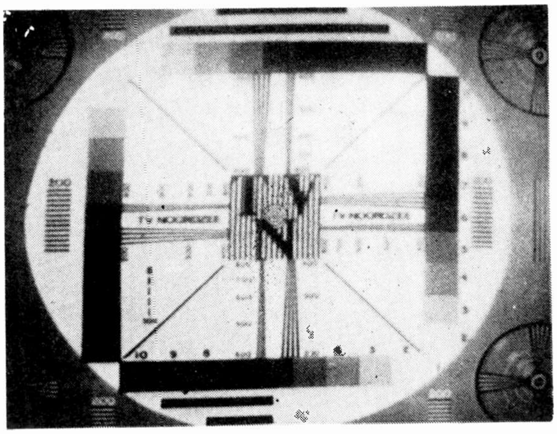
A letter has come from John Wood of Evesham who wishes to correct an error that crept into Data Panel No. 7 relating to the Radio Telefis Eireann test card. Test card E has now been dropped and a completely different type is now in use bearing the identification "RTE". We have written again to the broadcasting authorities there and hope that they come up with a current photograph of the card concerned. This will be included as soon as possible. In passing if readers spot any errors in the column please let us know so that we can keep accurate records. This is particularly important as items from the column are sometimes used by other organisations.

Letters

There have been a number of letters this month which is unusual for the rather quiet conditions prevailing at the moment. L. Berle of Roehampton, London SW15, has queried the identification of a number of ORTF (France) transmitters that he received during the improved tropospheric conditions of December. Using a Bush Model TV105 he noted excellent signals from Lille ch.F8a, Rouen ch.F10 and Le Havre ch.F7. The usual split image was

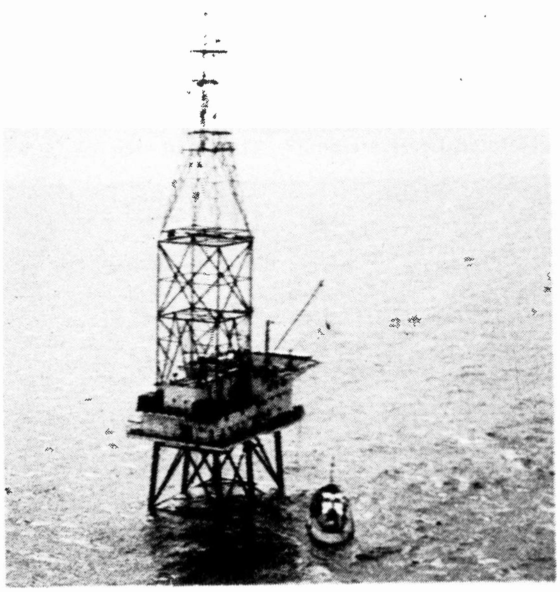


Reception of Algerian TV in Italy—see letters.



TV Noordzee test card.

TV Noordzee identification slide.



REM Island from the air.

noted—due to receiving the 819-line signal with a 405-line timebase—and signals at high levels lasted for some considerable time.

Michele Dolci at Bergamo, Northern Italy, in a recent letter reports his reception via Tropospheric propagation of Algeria on ch.E5. As with many enthusiasts elsewhere this occurred during the enhanced period over the 14-17th December. Interesting to note that his reception on 16th December between 2000-2345 GMT of the Algerian station was using his ch.E4 three-element array. Michele included a photograph of his reception showing the station identification crest. News too of the Greek television network—they are to build 17 stations of powers between 10-30kW. Unfortunately for us, though at some distance from Greece, they will be all in Band III.

We have heard from Wallace Roome of Pietersburg, South Africa, that despite the lack of television transmitters for many hundreds of miles he has had some limited successes. Although his letter is dated in December he comments that in the previous March-April period he received a Spanish station on ch.E2. Apparently the vision suffered from double images and tended to be snowy. We feel that the reception was from TVE Madrid ch.E2 via F2. Wallace goes on to say that the lack of signals is very frustrating: indeed if that was the only reception between April and December I personally would become somewhat desperate!

TV Noordzee

From time to time we are asked about transmitters that have ceased to operate for one reason or another and recently a query came in asking about TV Noordzee. As few people seem to have heard of this now defunct transmitter and in view of the interest it caused amongst TV-DX enthusiasts we decided to look into the happenings at TV Noordzee.

In 1964 activity was growing in the field of the so-called pirate radio, with floating radio transmitters of various powers and names anchored around the English and Dutch shores. Obviously if a TV transmitter could be put into use considerable advertising revenue would be obtained, especially in the Dutch area where television advertising is somewhat restricted. For such an undertaking however a ship could not be used successfully due to its movement. Eventually a complete floating island was constructed in the harbour at Cork, Eire and towed to a position off the Dutch coast near Nordvek Anglais. The island was known as the REM Island after the Dutch company Reclame Exploitatie Maatschapij. Initially there were radio transmissions on 1403kHz. These were followed on Saturday August 15th by the first programme of TV Noordzee at 1830 CET on ch.E11. The popularity of the programmes grew throughout the reception area and aerials, amplifiers and convertors quickly sold out. Coverage was confined to West Holland and parts of Belgium with programmes between 1830-2000 CET and 2200-2330 CET.

The Dutch authorities however were less than enthusiastic! Legislation was undertaken to curb the transmissions and an anti-REM law was passed on December 1st, 1964. It became operative on the 12th. On the same day REM announced that the radio and TV apparatus had been taken over by a foreign company; in fact a London company—High Seas Television Ltd.—had the use of the transmitters. Despite these last-minute moves the authorities landed on board the REM Island during the morning of December 17th and put the transmitting apparatus out of action.

During the few months of its activities TV-DX enthusiasts anxiously tried to receive the signals and a number were fortunate in this quest. The transmitter on ch.E11 was thought to be between 5-10kW e.r.p. We have included several photographs showing the REM Island, test card and identification slide. Our thanks to Heerema Engineering Service; Bob Quanger (Benelux DX club); Dich van Schenk Brill (Pirate Radio News); Peter van der Kramer.

A CLOSER LOOK AT PAL

PART 5

E.J.HOARE

ALIGNING PAL DECODERS

It is on the basis of circumstantial evidence and intuitive reasoning that we expect PAL decoders to be sympathetic towards new techniques for carrying out the basic circuit alignment processes. The cancellation effects produced by V axis switching, which we have already discussed and demonstrated in earlier articles of this series, must surely provide scope for the exercise of ingenuity by the experts. It ought for example to be possible to arrange matters so that the delay line matrix and demodulator phases can be adjusted for some sort of null condition, or for minimum blinds or a combination of both. And so it is. There are a variety of possible techniques and doubtless more will be invented.

What we aim to do now is to describe some procedures for aligning the decoder circuits and to delve a bit into the principles on which they are based. Circuits vary a great deal in detail so we cannot give explicit instructions for different receivers. Let us try instead to stimulate some thinking about the subject in general in order to encourage experiments with new ideas.

Television would be glad to hear from readers who have their own pet methods of aligning the matrix and demodulator circuits—whether they use special test gear or rule of thumb techniques. It might be useful to spread this information through the industry, and perhaps in a later article to explain more fully the principles involved. This suggestion is prompted by an almost abortive hunt through some of the setmakers' service manuals. There seems to be a strange lack of guidance on the subject of decoder alignment. One or two manuals contained nothing at all; others merely suggested rather vaguely that the demodulators should be trimmed for maximum output. What about the delay line?

Let us first run through a few ideas which to be honest are intended as curtain raisers to the more sophisticated and accurate methods we will describe later. These simple approaches have their merits in particular circumstances and in any case may prove interesting to experiment with in slack moments.

Delay Line Matrix

A properly adjusted delay line and matrix circuit accepts the combined chrominance subcarrier and provides completely separated pure U and V outputs by the well known sum and difference process. An incorrectly adjusted delay line circuit on the other hand does not separate the U and V signals properly. As a result blinds occur on the picture and these are aggravated by inaccurate reference carrier phasing in the demodulators.

An obvious method of alignment is to adjust the amplitude and phase controls for minimum blinds, or rather no blinds, repeating the process several times in order to set the controls to the middle of the null region. This is not a particularly good method but with practice it can produce acceptable results. It can after all be argued that if no blinds can be seen then the alignment is sufficiently accurate not to cause visible distortion of the PAL signal. The contrary point of view is to the effect that the PAL immunity to errors is being used up in a poor adjustment procedure instead of being passed on to the viewer.

Another method, which seems a little unexpected at first sight, is to a.c. couple an R—Y reference carrier to the input to the delay line circuit. The injection point must be common to both the direct and delayed paths and in many decoders the base of the delay line driver stage is a suitable point. The output of the local oscillator is usually in R—Y phase and if the a.p.c. loop has been correctly adjusted this is a suitable source provided a low-impedance stage such as an emitter-follower is chosen.

The essence of the method is that an R—Y input to the delay line circuits should produce full output to the R—Y channel and none to the B—Y channel. If an oscilloscope is connected to these output points in turn the delay line can be adjusted for maximum R—Y and minimum B—Y. The receiver must of course be operated on a colour signal in order to lock the local oscillator in its correct phase, and care must be taken to ensure that no appreciable loading of the oscillator or chrominance circuits occurs as phase changes may be introduced which will degrade the accuracy of adjustment.

Demodulation Phasing

We have three methods to suggest here—one interesting and two useful.

Assuming that the delay line circuit is properly aligned then we have two outputs of pure U and V respectively. Nothing we do to the demodulators will alter this simple fact. Now suppose we display a normal colour pattern and then interchange the feeds to the two demodulators so that the V demodulator gets a U signal and vice versa. What is the result? Yes, you are right—no colour.

If colour is in fact present it is due to misalignment of the demodulators or to crosstalk in the decoder circuitry between the U and V channels. All that is required is to adjust the phase of the reference carrier to each demodulator in turn to produce minimum colour output. Ideally you need a pattern with R—Y and B—Y bars but any colour signal will serve although there will be some degree of interaction between the adjustments. These should be repeated several times in very small steps.

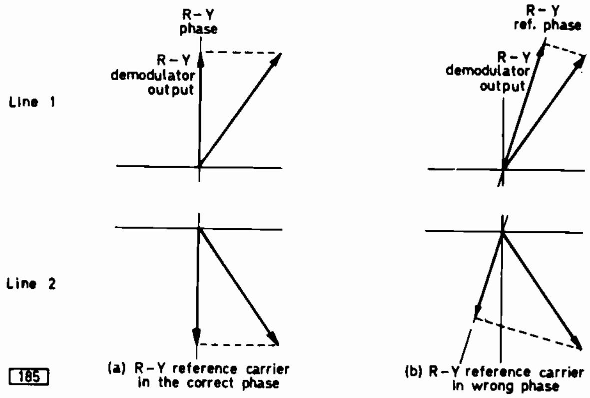


Fig. 1: With Simple PAL decoding a demodulator phase error causes different outputs on alternate lines and hence blinds on the display.

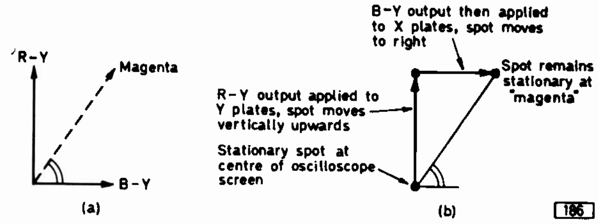
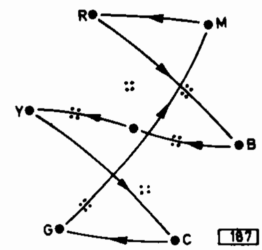


Fig. 2: (a) The R−Y and B−Y components of a magenta hue. (b) If the R−Y component is fed to the Y plates and the B−Y component to the X plates of an oscilloscope with its internal timebase stopped, the display shown here will be obtained.

Fig. 3 (right): An X−Y oscilloscope display for a normal colour-bar test pattern with the receiver operating correctly.



This is an interesting method and in theory is critically accurate. In practice its delightful simplicity is sometimes spoilt by crosstalk which makes it impossible to obtain no colour at all.

Our next suggestion is to connect an oscilloscope to each demodulator output in turn and to adjust its reference signal phase very carefully for maximum output. You cannot get more than the correct output: only less. This is not a very accurate method but it is adequate for most purposes and involves no interference with the circuitry.

Now we come to the Simple PAL technique. If the outputs of the delay line matrix are shorted together we get no signal separation and the original combined chrominance subcarrier will be applied to both demodulators. Fig. 1 shows what happens when this signal is applied (a) to the correctly adjusted and (b) to the incorrectly adjusted R−Y demodulator. You can see immediately that incorrect adjustment, even if quite minor, causes a difference in output on alternate lines, i.e. blinds on the picture. Any hue not on the B−Y axis will produce this effect. So all that needs to be done is to adjust both demodulators for minimum blinds.

Incidentally this method illustrates rather well why Simple PAL decoders are rarely used. It is almost impossible to tune out blinds altogether. Even the smallest phase error will cause a noticeable increase.

Vectorscope Displays

If one could display the decoder outputs corresponding to a known colour test pattern signal input on a vectorscope it would be a simple matter to check whether the decoder alignment was correct. Unfortunately vectorscopes are expensive pieces of equipment and are normally used only for monitoring purposes in broadcast studios and by the makers of test equipment.

It may not be generally realised that a comparatively ordinary oscilloscope can serve very well indeed for aligning decoders by means of a similar type of display. Furthermore the method is very accurate and shows clearly what type of alignment errors are present. The type of 'scope needed is one with access to the X plates in addition to the normal Y input terminals. The bandwidth required is only a few hundred kHz and the sensitivity such that near full deflection is obtained with an input corresponding to the R−Y and B−Y outputs from the two colour demodulators. It is possible to buy oscilloscopes that meet these requirements near the bottom end of the price range so this poses no particular problem.

The essence of the technique is delightfully simple. Take say a magenta hue as shown in Fig 2(a). This has R−Y and B−Y components on the V and U axis. In other words R−Y and B−Y demodulator outputs at these amplitudes will when displayed on a colour c.r.t. (with the derived G−Y component applied as well of course) produce a light output of magenta hue.

If the R−Y demodulator output is applied to the Y plates of the 'scope with the timebase stopped the stationary spot will move vertically upwards, i.e. it will move up the R−Y (or V) axis of the conventional phasor diagram as shown in Fig. 2(b). If we now connect the B−Y demodulator output to the X plates the spot will move to the right, parallel to the B−Y (or U) axis, as shown. The spot will then be stationary at a point that subtends the subcarrier phase angle corresponding to magenta.

Thus a stationary spot will appear on the oscilloscope for each individual area of colour in the picture. If the standard colour-bar test pattern signal is applied to the receiver for example six dots will be displayed on the oscilloscope, corresponding to the three primary colours and the three complementaries. This is illustrated in Fig. 3 together with the faint lines between the dots caused by the path traced out by the electron beam as it switches from hue to hue.

Alignment by Vector Display

The vector display that we have just described can be used to best advantage when the receiver reference oscillator is out of lock. The a.p.c. loop should be disabled so that the oscillator is running free and the frequency should then be adjusted by means of the usual trimmer so that it is slipping at a rate of a few cycles a second. It is convenient to disable the colour killer also. The slip frequency can then be judged by observing the colour drifting in and out of synchronism on the screen of the picture tube. The

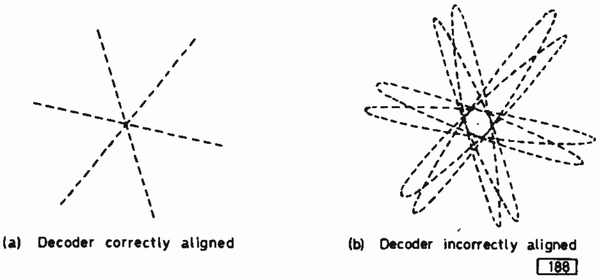


Fig. 4: X−Y oscilloscope display under the same conditions as in Fig. 3 but with the decoder reference oscillator not in lock.

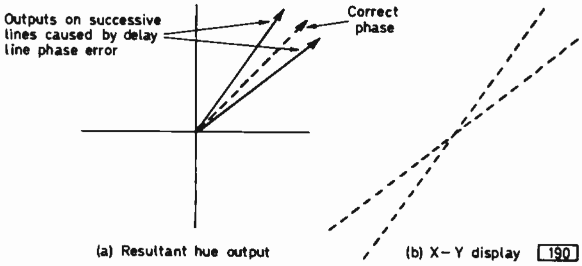


Fig. 6: A delay line phase (time) error produces different hues on successive lines and this is shown clearly on the X−Y display (b).

display that will be obtained is shown in Fig. 4 for correctly and incorrectly aligned decoders. Before proceeding further it may be helpful to describe what is appearing on the screen of the oscilloscope.

If you consider the red and cyan bars of the standard colour-bar test pattern for example the conventional phasor diagram will be as shown in Fig. 5(a). If we choose an instant in time when the free running oscillator happens to be in its correct phase—and if the decoder is correctly aligned—the reference carriers to the R−Y and B−Y demodulators will also be correctly in their respective V and U axis phases. Thus we get an output corresponding to say the red hue. This will be displayed as a dot. When the hue changes an instant later to cyan we get another dot. If we take another instant in time several lines later the reference oscillator will have drifted away from its correct phase with the result that the R−Y and B−Y reference carriers are now on new axis as shown in Fig. 5(b). This means that both demodulator outputs are reduced in the same proportion. So the two dots move closer to zero: i.e. closer together along the line R−C.

If, repeating the process, we move on to the instant shown in Fig. 5(c) there will be no output at all from either demodulator because the reference carriers to each demodulator are 90° out of phase. The dots are now coincident at the zero point. The result of all this is that we get a dotted line R−C as shown earlier in Fig. 4(a).

The point of interest to consider now is what happens to this line when decoder alignment errors are present. Take the case of a phase error in the delay line circuitry. We saw in a previous article of this series that the resultant of the R−Y and B−Y outputs varied from line to line as shown in Fig. 6(a). We would therefore expect to see this same pattern on the oscilloscope. Happily for the author and his previous analysis we do in fact get a pair of dotted lines separated by an angle dependent upon the phase error introduced by the delay line, as shown in Fig. 6(b).

Referring again to the earlier article (with a little more confidence this time!) we concluded that an amplitude error in the delay line matrixing process would cause crosstalk in both U and V outputs as illustrated in Fig. 7(a). What happens to our vectorscope display?

We can see this fairly easily without going into too much detail. The reference carriers supplied to the R−Y and B−Y (or V and U) demodulators are in quadrature (90° apart) and are slowly rotating about the U and V axis. See Fig. 7(b). When the R−Y reference carrier is at 90° to the R−Y subcarrier signal the B−Y reference carrier is *not* at 90° to the B−Y signal carrier. Thus when there is no R−Y output there will still be some B−Y output. So the straight line that we get with correct alignment becomes an ellipse. See Fig. 7(c) and (d).

The same argument applies if the two demodulator reference carriers are not in quadrature. We still get an ellipse.

Overall Phase

The only other adjustment with which we are concerned here is the overall phase of the two reference

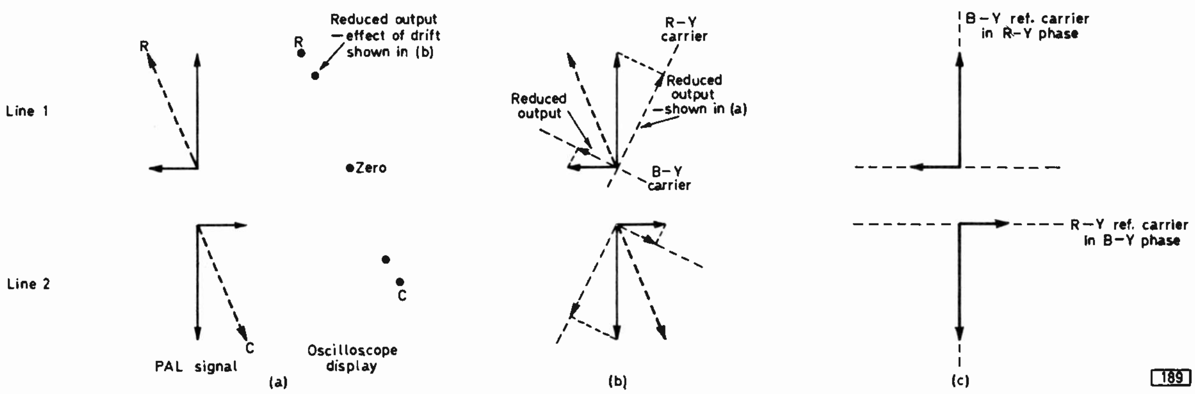


Fig. 5: The dotted lines shown in Fig. 4 (a) are produced as the reference oscillator drifts through one complete cycle. (a) Oscillator reference carriers in correct phase. (b) Both carriers here have drifted away from their correct phases, giving reduced output. (c) When both reference carriers have drifted 90° out of phase there is zero output from both demodulators: the spot is then at the centre of the screen.

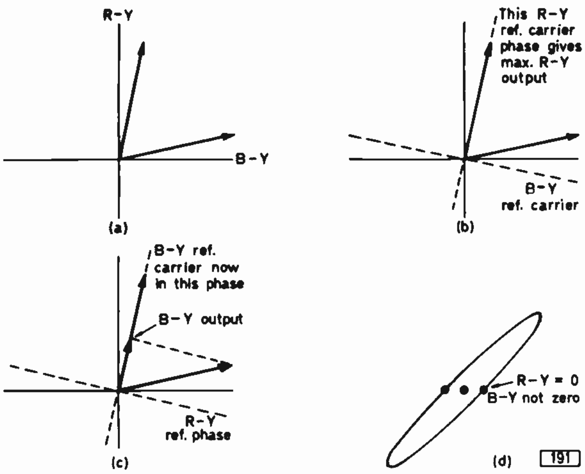


Fig. 7: Crosstalk between the R−Y and B−Y channels causes an ellipse on the X−Y display. (a) These signal components are the result of incorrect delay line amplitude adjustment. (b) This phasing corresponds to a point almost at the tip of the ellipse. (c) No R−Y output, but there is still some B−Y output so the result is an ellipse. (d) An ellipse is formed if the R−Y and B−Y outputs are not zero simultaneously.

carriers. In most cases this is the static phase of the reference oscillator itself, controlled by the a.p.c. loop. If you look more closely at the oscilloscope display when the reference oscillator is properly locked you will see clusters of faint dots as shown in Fig. 3. These are usually called "half-amplitude dots" and are caused by the outputs of the two demodulators at the instant when the hue is changing from one colour bar to the next. On one line the information is say yellow and on the next magenta. When the information from these two lines is added and subtracted in the delay line matrix the electronic averaging process obviously breaks down and we get dots corresponding to this spurious signal. In the case of yellow and blue the information before and after respectively contains no chrominance because it represents a white or a black bar. Thus the matrix outputs into the V and U channels are correct for hue but of half their proper amplitudes. Hence the half-amplitude dots. The spacing of these dots is a minimum when the overall or static phase is correct.

Vector Display Alignment Procedure

We can now list the full procedure for decoder alignment using a vector display.

(1) With a colour-bar signal or any pattern with large areas of colour first obtain a normal picture display.
(2) Connect the X and Y plates of the oscilloscope to the B−Y and R−Y demodulator outputs.
(3) Disable the a.p.c. loop and the colour killer. Bias back the a.c.c. circuit if the saturation is too high.
(4) Check and if necessary adjust the reference oscillator for slow slip.
(5) Adjust the gain of the oscilloscope to give a display which fills about two-thirds of the screen. You should now have the display of Fig. 4 or its equivalent depending upon the colour test pattern.
(6) Adjust the reference carriers' quadrature condition and the delay line matrix amplitude control to turn all ellipses into straight lines.
(7) Adjust the delay line matrix phase control to swing pairs of lines together to form single lines.
(8) Repeat (6) and (7) as necessary.
(9) Enable the a.p.c. loop and adjust the overall phase for best coincidence of the half-amplitude dots on the yellow/blue axis.

No decoder is perfect and if the ellipses cannot be closed completely it usually means that there is some U/V crosstalk built into the circuit. Good results will be obtained on the picture even if the ellipses are appreciably open, because this is a very accurate method of alignment. Furthermore it shows very clearly the type and extent of any errors present.

If more gain is needed the oscilloscope can be connected farther down the channels: for example at the outputs of the colour-difference amplifiers. The disadvantage of doing this is that any crosstalk or other spurious signals will tend to distort the display.

Split-screen Pattern Generator

A very convenient method of aligning decoders involves the use of a pattern generator made by sssh (you know who!) which gives a clear visual indication of any decoding errors. It is the so-called split-screen display and is of special interest because apart from being a good method it also once again makes use of the unique properties of the PAL technique. It is worthwhile describing in detail because it illustrates PAL principles rather well and in any case few engineers would wish to use a piece of test gear without understanding how it works.

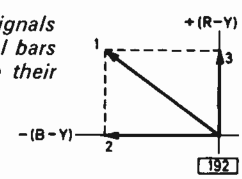
For the adjustment of delay line phase and amplitude a pattern is used which has four vertical bars. The fourth bar is pure luminance, with no chrominance at all. The other three bars have hues corresponding to phase angles of 146°, 180° and 90° on the conventional R−Y and B−Y phasor diagram. This chrominance information is NTSC encoded: that is to say no switching is carried out on alternate lines, except for the burst which alternates in the normal PAL sequence. The three chrominance vectors are shown in Fig. 8 and these will be the same on all lines because of the unswitched encoding.

You will see immediately that these three bars have been carefully chosen. Bar 2 is pure − (B−Y), bar 3 is pure + (R−Y) and bar 1 is a straight mixture of bars 2 and 3. Thus bars 1 and 3 have equal amounts of + (R−Y) and bars 1 and 2 have equal amounts of − (B−Y).

The key to understanding how this pattern can be used to display delay line amplitude and phase errors lies in the effect of PAL delay line matrixing upon an NTSC encoded signal. Fig. 9 shows the three bars individually on two successive lines of a field. Note that the PAL sum and difference processes in the delay line matrix are carried out completely normally but on an abnormal signal.

The result of this unexpected combination of techniques is a little surprising. If the matrixing is correct there is no output from the matrix into the R−Y

Fig. 8: The three chrominance signals used for three of the four vertical bars of the special test pattern. Note their relationship.



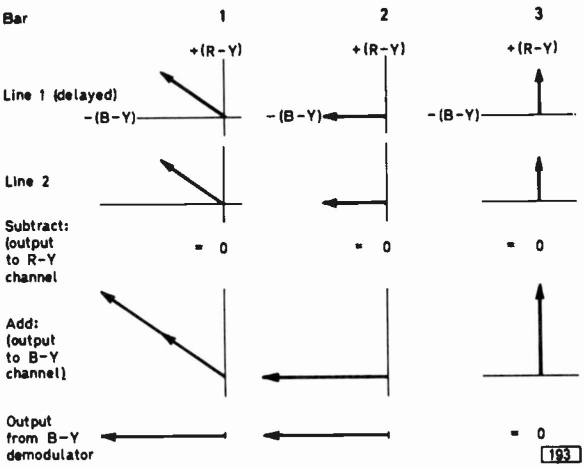


Fig. 9: When decoded an NTSC signal produces no R−Y output, only B−Y. Bar four has luminance only.

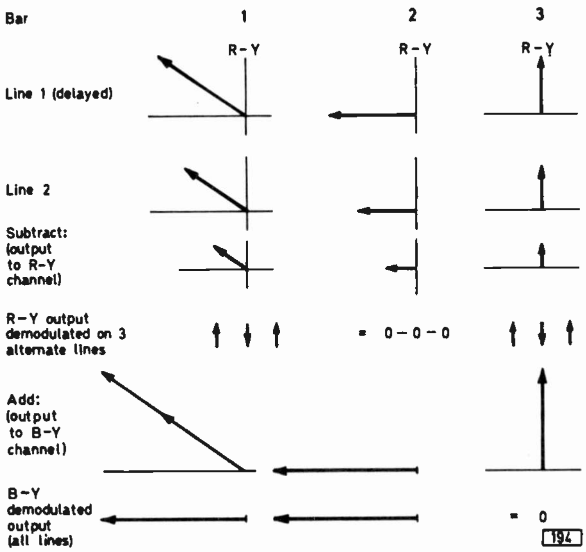


Fig. 10: Decoding the NTSC signal (with switched burst) when the direct and delayed path signals are unequal. Note the alternating outputs in bars one and three, causing blinds on the display.

channel! Whatever the chrominance signal input may be (NTSC encoded) there is no R−Y output from the decoder: this is because we are subtracting delayed and undelayed signals which are identical, so there can be no resultant.

If we look at the sum output from the matrix, feeding the B−Y demodulator, things are more normal. We get twice the amplitude of the chrominance signal (delayed+undelayed) in the B−Y channel. But note the catch for the unwary. Bar 2 has pure − (B−Y) and so we get a − (B−Y) output. Bar 1 has + (R−Y) and − (B−Y) components but only the − (B−Y) component produces an output: the + (R−Y) component is in quadrature and so produces no output from the B−Y demodulator. Bar 3 is pure + (R−Y) and likewise produces no output.

The result of all this on the screen is as follows:

Bar 1. − (B − Y).

Bar 2. − (B − Y): same amplitude as bar 1.

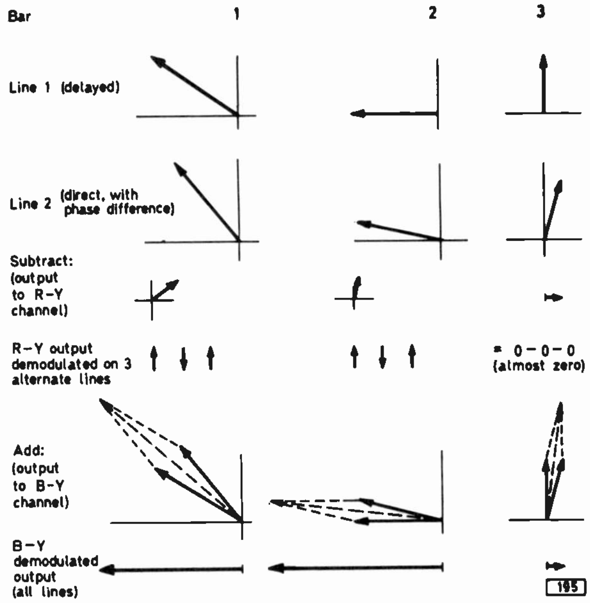


Fig. 11: The same decoding process as in Fig. 10 but this time with a phase difference between the direct and delayed path signals. Switched R−Y outputs are present on bars one and two, causing blinds.

Bar 3. No colour output, only luminance.

Bar 4. Luminance as bar 3.

The hue produced by − (B−Y) is greenish. So the first two bars will be of this colour and the other two bars will be light grey.

Delay Line Adjustments

An amplitude error in the delay line circuitry, causing the delayed and undelayed signals to be unequal, will produce the effects shown in Fig. 10. Subtracting these unequal signals will produce an output to the R−Y channel for each of the first three bars. The output for bar 2 will be pure − (B−Y) and so the R−Y demodulator will not "see" it. Thus bar 2 is unchanged apart from a small difference of saturation. Bar 1 will have an R−Y component and so will bar 3. As however the bursts are switched in the normal PAL manner the reference carrier to the R−Y demodulator will also be switched and so these spurious R−Y signals will reverse in phase from line to line: thus blinds will be seen in bars 1 and 3.

Turning now to a delay line phase error we get the results shown in Fig. 11. Following a similar analysis to that just used for amplitude errors we see that there will be only a very small spurious switched R−Y output in bar 3. Bars 1 and 2 however have quite a serious error causing blinds. It is interesting to note that bar 2 has this spurious R−Y signal in spite of the fact that no R−Y information is present in the generated signal. This is a function of delay line PAL decoding.

Summarising our results so far we get:

Amplitude error: Blinds in bars 1 and 3.

Phase error: Blinds in bars 1 and 2.

In making any adjustments of phase or amplitude it is necessary to ignore any changes in hue and to align the decoder purely for minimum blinds—repeating the adjustments several times as required. If substantial errors are present the switched R−Y component will be sufficiently large for the hue differences between sequential lines to be recognized. One line will have + (R−Y), a bluish red. The next line will have − (R−Y), a greenish blue. These hues will of course show up more clearly in the light grey of bar 3 than the greenish bar 2.

Demodulator Adjustment

The colour pattern for adjusting the R−Y and B−Y demodulators has the same chrominance and luminance information as before but is encoded differently and thus displays different hues on the screen of a colour TV receiver. The upper half of the pattern is PAL encoded. So instead of producing decoder outputs of − (B − Y), i.e. greenish, in the first two bars and grey in the other two we get hues corresponding to the subcarrier phase angles. Thus bar 1 is 146° =orange/yellow; bar 2 is − (B−Y) =greenish; bar 3 is + (R−Y) =rose; bar 4 is grey.

The lower half of the pattern is also PAL encoded but chrominance information is transmitted only on alternate lines, the others being luminance only. This means that the delay line matrixing process is put out of action and we get the results shown in Fig. 12(a). You will see that the same signal is applied to each demodulator.

Now if the reference carriers to the two demodulators are both correct we shall get the outputs shown in Fig. 12(b) which will give the same hues as on the upper half of the screen. The Simple PAL decoding of the lower half will give the same result as the delay line PAL decoding of the upper half.

Figure 12(c) shows the effect of reference carrier phase errors in the R−Y and B−Y demodulators. You will see that an R−Y phase error will produce a spurious output in bar 2 which has no R−Y signal. The hue will therefore be distorted. Similarly a B−Y phase error produces a spurious output in bar 3 which has no B−Y signal. Again the hue is distorted. No blinds occur in either case because there is no switched component when alternate lines contain no chrominance information.

The process of demodulator phase adjustment is very simple. Each demodulator is adjusted in turn to give identical hues on both halves of the pattern: bar 2 for the B − Y demodulator, bar 3 for R − Y. In many decoders there is some degree of interaction and so the usual procedure is to repeat the adjustment as necessary.

The split-screen technique provides a very critical indication of correct demodulator phase adjustment and in practice it will be found that different pattern generators give slightly different answers. This is perfectly acceptable because of the tolerance of the PAL system to small errors.

Oscilloscope Measurements

The same colour pattern described above can also be used for adjusting decoders by means of the c.r.t. drive waveforms displayed on an oscilloscope. This procedure is described and illustrated in the manual provided with the pattern generator and there is no particular point in repeating it here. Suffice it to say that the method is based on producing an oscilloscope display such that successive lines of a field are superimposed on each other. Any spurious switched component present in the output, caused by misadjustment of the delay line or demodulators, will have opposite polarity on alternate lines and so will result in the two superimposed waveforms being separated. The appropriate preset controls are adjusted until only a single trace is obtained on the oscilloscope.

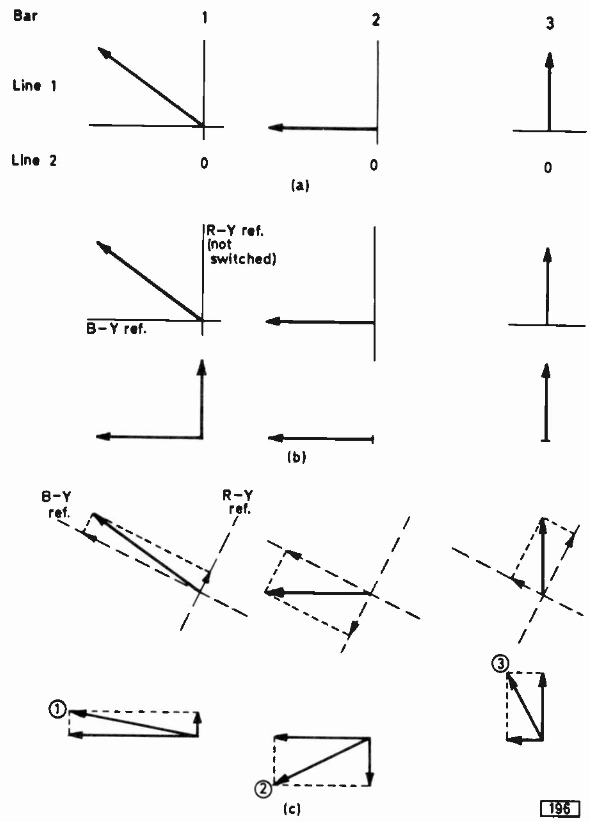


Fig. 12: The split-screen test pattern provides a very sensitive visual indication of demodulator errors by hue changes in bar two for R−Y and bar three for B−Y. (a) Delay line processing of a signal with chrominance on alternate lines only: either adding or subtracting gives outputs identical to line one above, thus the same signal is applied to each demodulator—this is equivalent to Simple PAL decoding. (b) If the reference carriers to the R−Y and B−Y demodulators are in the correct phases the original R−Y and B−Y signal components are obtained. (c) Note how the resultant chrominance phases have been changed in amplitude and phase angle by incorrect demodulation.

On the whole this method is probably not quite as accurate as using the TV screen display, if only because most engineers have to work with oscilloscopes that give rather a coarse trace. It may however prove useful if the decoder is very seriously out of alignment and difficulty is experienced in interpreting the colour display.

Concluding The Series

We began this series by making the point, to which few people will object, that in PAL we have chosen the right system. Engineers with experience in the field will agree that although not all our customers receive perfect pictures the quality on the whole is very good. Certainly it is better than reports from countries using the well-established NTSC system had

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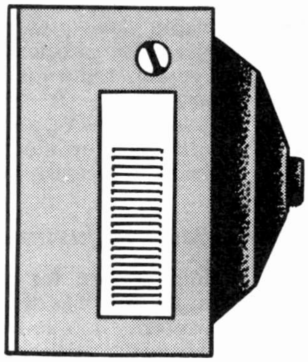
Renovating the RENTALS

CALEB BRADLEY B. Sc.



2 THORN 800 & 850 CHASSIS

THESE dual-standard capable chassis are found in a wide range of Thorn group (Ferguson, HMV, Ultra, Marconiphone) sets, a few Decca models (DR61 and DR71) and also in sets made specially for rental. The latter may carry the name DER or the name of the rental company. Thousands of the sets are still being rented and thousands more are available on the ex-rental market (see end of article). In general their attractive styling, up-to-date screen sizes (19 and 23in.) and suitability for dual-standard use make them a good buy for reconditioning for either own use or resale.

Common Features

The "800" began way back in 1961 with the Ferguson 705T. This was basically a 405-line set with provision for conversion to dual-standard operation although in those days no one was certain just what the second standard would be. A 405-625 knob at the side of the cabinet operated switches in the line timebase and at the video and sound amplifier grids, but there were no circuits connected to the 625 side of the switches! An interesting proposal at the time was that new programmes on u.h.f. could be accommodated simply by fitting higher frequency coils in the v.h.f. tuner. This worked up to a point but could not give the sensitivity of a purpose-built u.h.f. tuner as used today.

Stripped of some of its gimmicks, such as motor-driven channel selection and remote control, the basic 705T chassis continued as the 800 and was made in large numbers—see photograph and Fig. 1. It established the Thorn pattern of a lightweight steel frame carrying the timebase components on a board at the bottom with the i.f. strip on a slanting board at the top. Accessibility and ventilation are both fairly good with this arrangement and the boards are covered with printed annotations making them almost as easy to understand as circuits. Conductors are helpfully printed in colour on the boards according to the following code: **white** heaters and a.c.; **blue** earth; **blue and white** cathode connections; **green** grid connections and a.g.c.; **red and green** screen grid connections; **red and white** anode connections; **red** h.t.; **broken red** decoupled h.t. Later red and blue were used for boost h.t. conductors.

The 850 Chassis

The foregoing features were retained in the 850 chassis which was introduced in 1963-64. There are two distinct versions of this: a convertible version

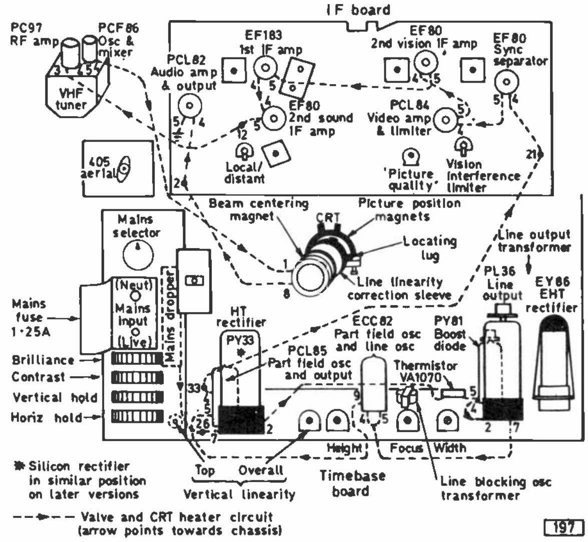


Fig. 1: Layout of the Thorn 800 chassis. The i.f. board has been tilted up and the line output stage shield removed for clarity.

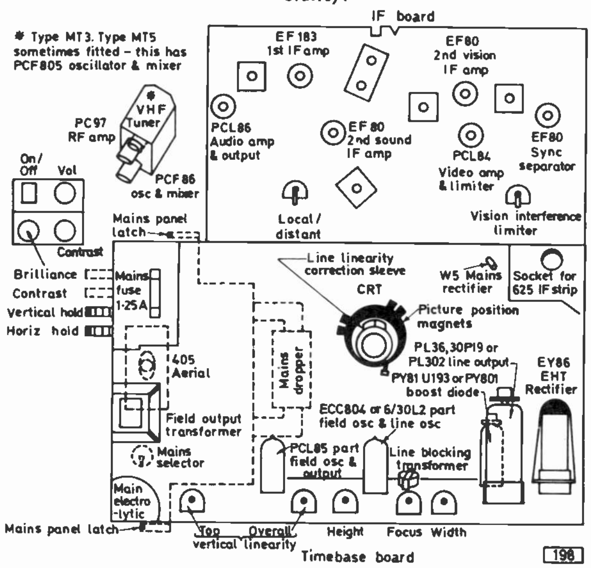
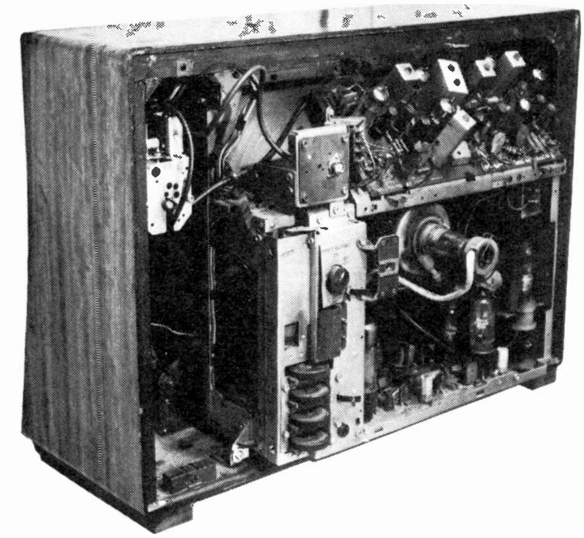
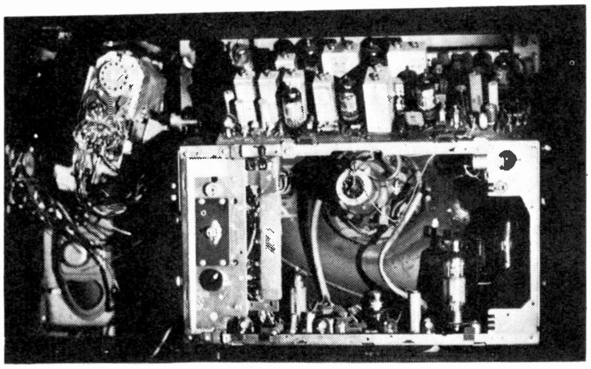


Fig. 2: Layout of the convertible Thorn 850 chassis. The heater circuit is similar to the 800. On some sets the controls, mains dropper and fuse are repositioned.



A Thorn 800 chassis: hinges at the right enable the chassis to be swung out almost 90° after removing two screws at the left, giving access to both sides.



A dual-standard Thorn 850 chassis, fitted in the wide cabinet of an Ultra Bermuda model.

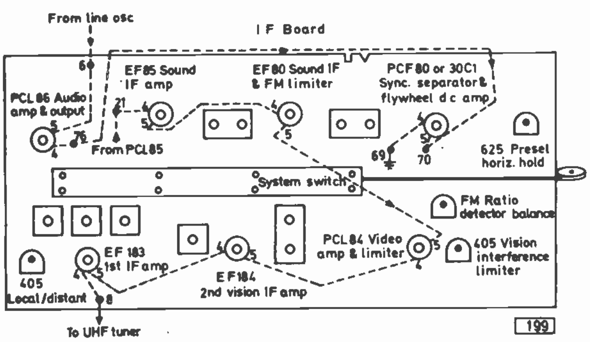


Fig. 3: Layout of the i.f. board used in the dual-standard 850 chassis. This chassis is otherwise similar to Fig. 2 except that the 625 i.f. strip socket is not required.

(Fig. 2) and a dual-standard version (Fig. 3 and photograph). The latter version needs only the addition of a u.h.f. tuner for 625-line use while the convertible version needs both a u.h.f. tuner and an additional 625 convertor i.f. strip (same as the 800). The suppliers listed at the end of the article state that they have limited stocks of the manufacturers' original convertor strips and tuners and adding these can be quite straightforward as will be described.

Tuner Faults

Component failures in the v.h.f. and u.h.f. tuners are rare except for occasional loss of gain (low contrast) due to ageing of the valves, particularly the r.f. amplifier. "Scratchy" v.h.f. channel switching can usually be cured by springing off the tuner cover and wiping the coil studs with switch cleaner.

Two types of v.h.f. tuner have been used. One has a dual-concentric spindle the outer of which is used for fine tuning. Sometimes the plastic collar which holds the outer sleeve breaks and some careful rebuilding with Araldite is called for. The panel carrying the tuner, edgewise volume control and press-type on-off switch is easily removed by loosening the main knob grub screw, removing the knobs and then removing a large nut at the rear. This nut clamps the tuner to the side of the cabinet by means of a small right-angled bracket. After long use the panel may move too far back for easy use of the controls because this bracket has become distorted. Also the on-off switch frequently breaks; usually the button has simply shattered. When reassembling it is worth smearing some soap between the tuner knobs to reduce friction as the fine tuner knob is rather hard to grasp.

The second type of v.h.f. tuner has separate knobs for channel switching and fine tuning. The fine tuner is pressed to engage a small plastic sprocket-screw for the channel in use; this in turn presses on a fine tuner bar. The cast disc which carries the sprockets is clamped to the tuner shaft by a grub screw (⅛in. hexagonal core): if this loosens the fine tuning becomes erratic.

A point to note about both v.h.f. tuners is that the fine tuning range is not very great so that adjustment of the local oscillator cores may be necessary. This entails removing the tuner from the cabinet since the core for the channel in use is accessible through a hole in the front of the tuner. Use a non-metallic screwdriver to set the core for an optimum picture with the fine tuner set midway.

The Heater Chain

We dealt with the general unreliability of mains dropper resistors last month and this chassis is no exception. Where failure of the valves to glow is due to an open-circuit heater, the heater routing shown on the chassis layouts will help in tracking it down. The heater arrangement used in these (and other) BRC chassis is unusual in that the c.r.t. heater is not connected directly to chassis as is the general practice.

Note that all common E prefix and P prefix valves should show heater continuity between pins 4 and 5 (B9A range) or pins 3 and 4 (B7G range) when checked out of the set on an ohmmeter. ECC81/2/3 valves also have a heater centre tap at pin 9.

Valve Shorts

Local screen, anode and/or cathode resistor burn-ups can result from shorts inside any of the i.f. strip valves but the PCL84 video amplifier is particularly prone to this. Even after replacing the valve and all the obviously cooked resistors vision may not return.

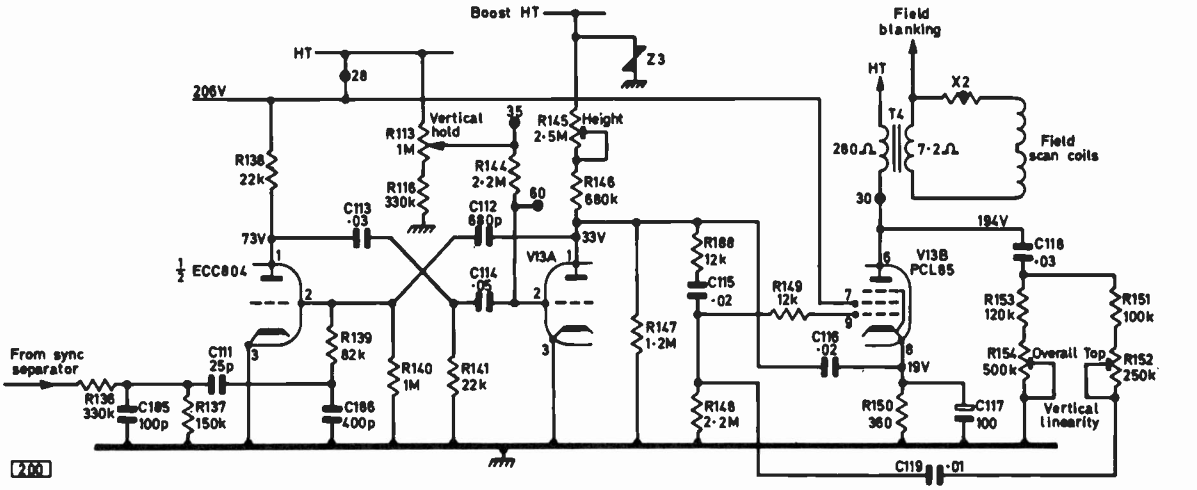


Fig. 4: The field timebase circuit. This is as used in the 850 dual-standard chassis but the earlier 800s and 850s are very similar. Early 800s had v.d.r.s (voltage dependent resistors) in series with R147 (on this circuit) and across T4 (field output transformer) primary winding.

This is because the vision detector diode has also blown. It is an OA70 located inside the rectangular can to the left of the PCL84.

Field Timebase Faults

Two valves are involved in the field timebase, a PCL85 and an ECC82 or ECC804. Either may fail and the voltages shown in Fig. 4 should be obtained on replacement if no components have changed value. Several components in this section can give trouble. When field lock is lost suspect R138 behind the ECC804; this runs warm and may have changed value so use a 1W replacement. Also suspect R144 or either C113 or C114 of being leaky. When vertical linearity is spoilt by top or bottom cramping check the PCL85 pentode cathode voltage. An incorrect reading may be due to R150 changing value or C117 going leaky. Bottom compression can also be caused by C119 or C118 leaking.

HT Smoothing

The large three-way electrolytic used for h.t. smoothing often loses capacitance and the resulting ripple on the h.t. line causes intermittent field sync, S-shaped verticals and brightness variation down the picture. It is located at the bottom left of the frame and there is enough room to fit substitute components if the proper replacement cannot be obtained or if it is only wished to replace one section. When replacing do not attempt to remake the special wire-wrap connections used in this and other parts of the set but use ordinary soldered joints.

White Flashing on Screen

White flashing on the screen can be caused by poor contact between the tube flare coating and the earthing spring with sparking visible in darkness. Cleaning will cure this. Other causes are breakdown of the scan coils, necessitating replacement, or arcing between the scan coils and the linearity sleeve. A possible cure in this case is to withdraw the sleeve and turn it round so that the puncture is at the rear, keeping the sleeve at the same angle to avoid affecting linearity.

Line Stage Chokes

There are rather fragile square cross-section air-cored chokes glued to the top cap connectors of the line output and boost diode valves and either of these going open-circuit causes loss of picture. In fact if these are simply shorted across performance is still fairly good although the picture may suffer from vertical striations.

The 625 Convertor Strip

The 625-line convertor i.f. strip is secured to the rear top rail of the chassis with connections as detailed in Fig. 5. The circuit of the strip is shown in Fig. 6 and its layout in Fig. 7. The main features are a flywheel sync circuit with amplified control voltage output—effective on both standards—an f.m. detector without balancing preset and video drive to the tube by a cathode-follower.

Before adding the strip cut out the following (see Fig. 5):

Links X on slide switch S12.

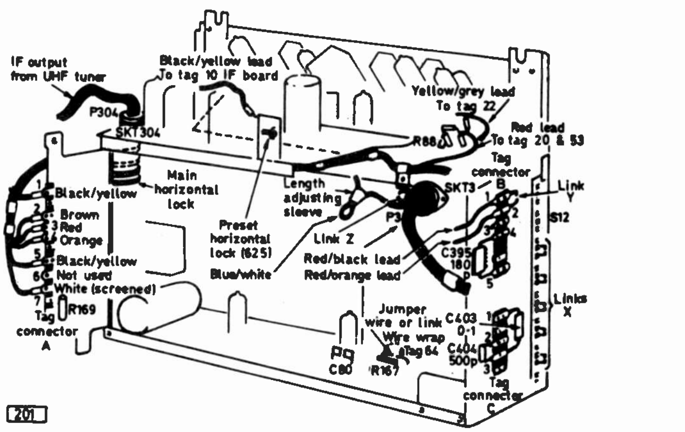


Fig. 5: Connection details for the 625 convertor i.f. strip.

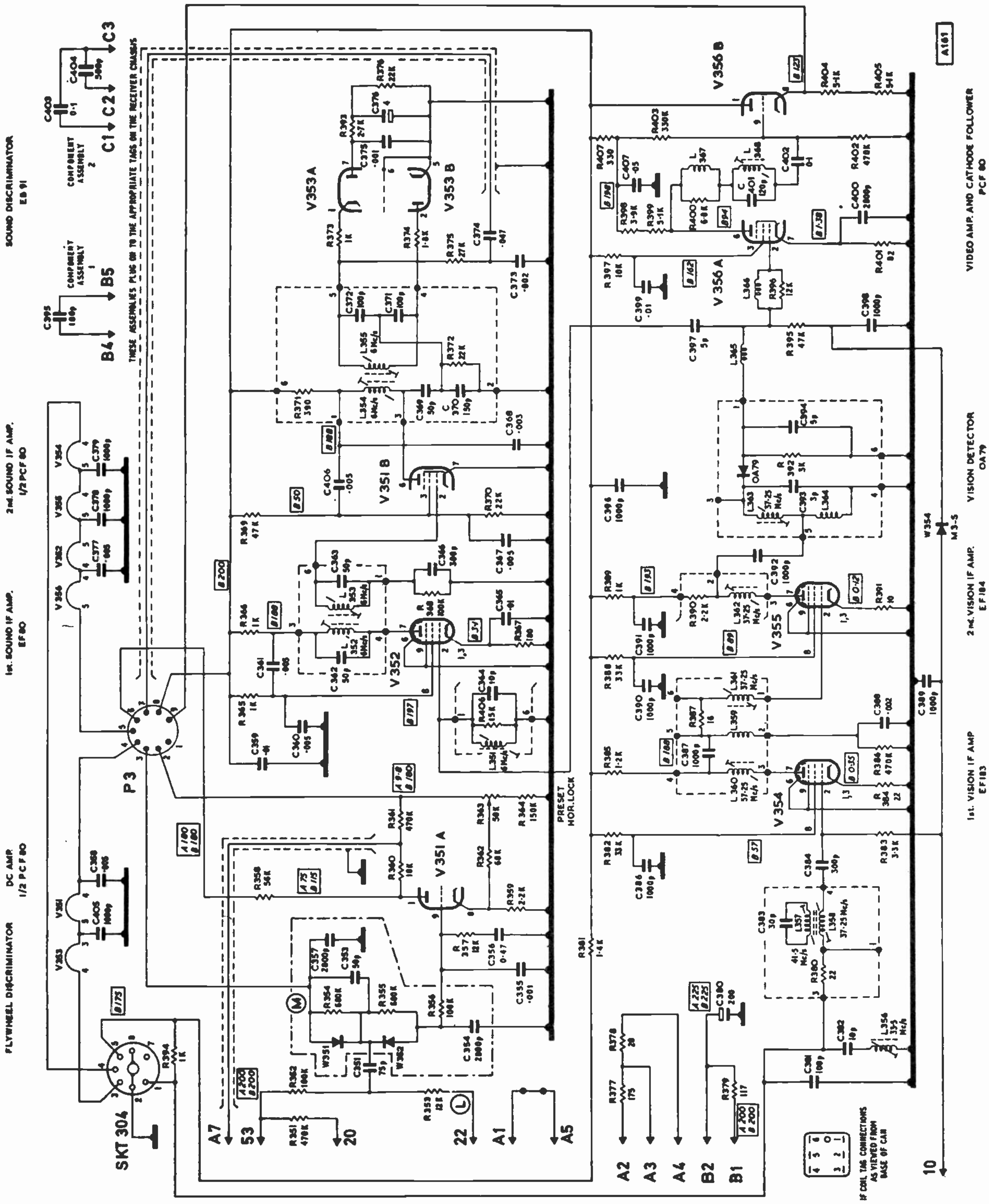


Fig. 6: Circuit of the 625 convertor i.f. strip for the 800 and 850 (convertible version) chassis.

Link Y on tag connector B.
Link Z on SKT3.
The jumper wire parallel to R167 (4·7kΩ) on the timebase board.
R88 (120kΩ) in lower right-hand corner of the i.f. board.
R169 (390kΩ) on tag connector A on the mains input panel.
C80 (25pF) adjacent to the ECC82/ECC804 on the timebase panel.
The three separate capacitors C395, C403 and C404 are connected as shown in Figs. 5 and 6. The i.f. strip has a plug lead to fit the socket on the right-hand of the chassis—colour-coded leads to be connected as

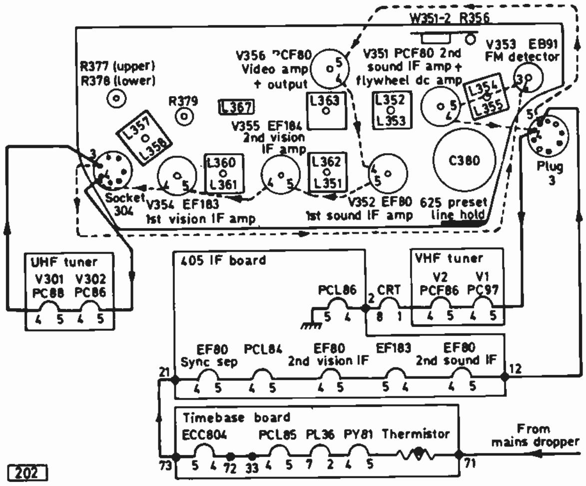


Fig. 7: Layout of the 625 convertor i.f. strip, with the complete heater chain after conversion (arrows point towards chassis).

shown in Fig. 5—and a socket for the u.h.f. tuner.

The new board has a preset 625-line hold control which is set up as follows: Short the top end of R356 (100kΩ—see Fig. 7) to chassis thereby disabling the flywheel sync discriminator. Set the main horizontal hold control for correct or near correct lock on 405 then switch to 625. Set the preset similarly for lock and then remove the short.

UHF Tuners

We gather that the sliderule-scale type of u.h.f. tuner intended for the Ferguson Model 3605 and others is not readily available but that the 3604-type with an indicator knob can be satisfactorily fitted in its place. A high-performance transistor tuner which plugs directly into the convertor strip is also available. Contact the supplier listed at the end of the article for details of what is available for particular sets. The Murphy conversion plinth which was described in our November 1970 issue has also been successfully used with the 800 and 850 chassis although a suitable adaptor lead has to be made up.

Back Panel

The original back panel will no longer fit the set after the convertor strip has been added. If the manufacturer's intended replacement panel cannot be obtained the stout cardboard box in which the strip was supplied can be used to extend the panel. Adequate ventilation holes must be made and of course no internal metal parts must be accessible.

This Month's General Fault: Blank Screen, Sound OK

This is a common symptom and unless the c.r.t. or its electrode voltages are at fault usually means that the e.h.t. is absent. The working sound channel tells us that h.t. is present. Listen hard for a line whistle since this indicates that the oscillator is working. The line output, boost diode, e.h.t. rectifier and line oscillator valves can quickly be checked by substitution

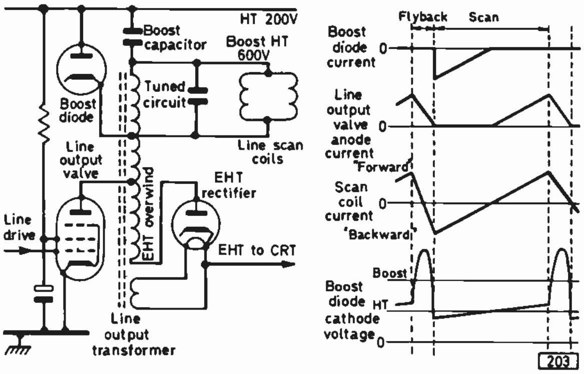


Fig. 8: Basic elements of the line output stage, with the associated waveforms.

(switch set *off* first!). If these bring no improvement check the screen voltage of the line output valve since the screen resistor often cooks, and the drive at its grid. There should be about 10V a.c. here with a negative d.c. level. If there is drive the remaining easy suspects are the boost h.t. capacitor and the transformer tuning capacitors. After eliminating these there is little left but the line output transformer itself which is comparatively expensive to replace. On some models it is possible to save money by buying a new winding insert only but the replacement involves more work.

When there is no grid drive the line output valve usually glows red hot inside. The fault may lie anywhere in the line oscillator circuit but first check the flywheel sync diodes if fitted, the coupling capacitor to the output valve and for a short- or open-circuit in the line oscillator transformer (if fitted).

The concept of generating the e.h.t. and boost h.t. from the flyback energy in the line output transformer is often forgotten as the breakthrough which made domestic television economic and the action of the circuit is not as well known as it should be. The essentials are shown in Fig. 8. Consider the state just before the end of the line scan. The line output valve is passing a large current which is flowing "forwards" in the tuned circuit comprising the scan coils. The valve then cuts off abruptly. Since the transformer is an inductive load a great positive peak forms at the valve anode. The peak rises and decays according to the resonant frequency of the tuned circuit. As it decays, current flows "backwards" in the scan coils, charging up the boost capacitor *more positively* than the h.t. rail. When the new scan starts the boost diode passes "forward" current into the tuned circuit immediately; the line output valve does not conduct until the *net* current in the scan coils is "forward", i.e. some way through the scan. At this point the source of current becomes the boost h.t. instead of the h.t. rail, giving the circuit higher efficiency. The boost diode prevents the boost capacitor discharging into the h.t. rail. Small currents can be taken from the boost supply thus generated to feed other parts of the set, typically the c.r.t. first anode and focus electrodes and the field oscillator for which a high voltage source gives better linearity. A servicing point is that the value of the boost capacitor is far from critical; both paper and electrolytic types are used in different designs, but it must have a high pulse working voltage.

A many-turned overwind, usually on a separate limb of the transformer and encapsulated in pitch, and a small diode valve provide the e.h.t. supply to the c.r.t. inner coating. Although the supply is in pulses the capacitor formed with the outer earthed coating of the c.r.t. and the high source impedance provide adequate smoothing. In the chassis described this month the e.h.t. cable is in addition looped several times to act as an r.f. choke.

The problem of heater-cathode insulation in the e.h.t. rectifier, which at 15kV or so would be almost insurmountable, is avoided by powering the heater from a few turns of heavily insulated wire wound on the line output transformer.

A final warning about e.h.t.: cathode-ray tubes form excellent e.h.t. capacitors and there is usually nothing in the television circuit to discharge them when the set is switched off. A nasty surprise can be had when handling a c.r.t. even several days after use. Do not rely on momentarily discharging the e.h.t. connector since many tubes will build up a potential again after an hour or so. To be certain leave a shorting link in place for at least five minutes and preferably all the time that servicing operations are being carried out.

Suppliers

For Ferguson Model 506T receivers and spares for this chassis (covered in *Renovating the Rentals* last month) contact: Padgetts Radio Store. Old Town Hall, Liversedge, Yorks. Tel. Heckmondwike 4285.

Sets fitted with the Thorn/BRC 800 and 850 chassis are widely available but in particular try: Thornbury Trade Disposals, Thornbury Roundabout, Leeds Road, Bradford, Yorks. Tel. 0274-665670.

For 625 conversion kits for the 800 and 850 chassis and u.h.f. tuners contact: Manor Supplies, 172 West End Lane, London NW6. Tel. 01-794 8751. (Mail order: 64 Golders Manor Drive, London NW11.)

FOR THE SERVICE ENGINEER

A new pocket-sized multimeter has been introduced by Avo. The Avometer Model 72 has an impedance of 20,000Ω/V and a frequency response to 30kHz. Ranges are 150mV-1kV d.c.; 10V-1kV a.c.; 50μA-1A d.c.; 1Ω-20MΩ.

A new range of screwdrivers which hold screws firmly at all angles has been introduced by IXP Ltd. The Self-grip is available for both slot and cross-cut screws. Sizes range from 2·5mm to 6mm blade diameter with length from 75-175mm, and cross-slot sizes 0, 1 and 2 with a length from 125-175mm.

Adcola have introduced a thermal cable stripper incorporating a length stop device. The thermally-controlled blade temperature is specifically designed for stripping p.v.c. and polythene and cables up to $\frac{1}{8}$in. thick can be handled. There are two models, the R400 and a bench mounted version the R310.

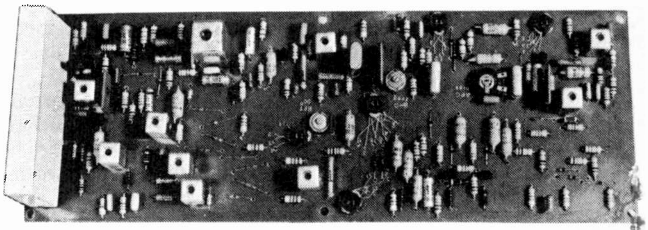
An extra-pressurised aerosol cleaner, the Preclene, is now available to the trade from Electrolube. The price of a single 12oz. aerosol is 63p.

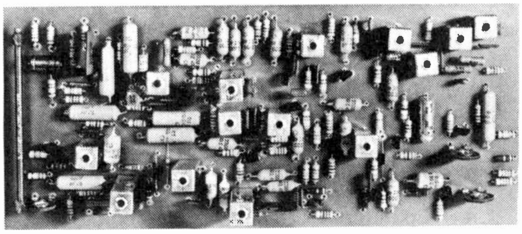
ITT-KB SERVICE DEPARTMENT MOVES

The Service Department of the ITT-KB group is now located at Eldonwall Industrial Estate, Paddock Wood, Tonbridge, Kent.

PART 1

The 'TELEVISION' COLOUR RECEIVER





THIS is the most ambitious project we have ever covered in TELEVISION. In response to the requests of many readers we have arranged the construction of a colour receiver in a way that we hope many people will be able to tackle.

But we feel we must also warn the reader: this is not the kind of project that you can afford to start without some thought. As we will see later there is a fair amount of money involved and of course the project can consume a considerable amount of the reader's time. The purpose of this introductory article is to outline some of the techniques and facilities that the receiver itself and the magazine are offering towards the construction.

A certain amount of skill is needed in the construction. This is inevitable with a project of the relative complexity of a colour receiver, and although we believe we have reduced the chances of building errors to extremely small proportions we would be way out in assuming that there are not going to be some errors made. This has to be and has been taken into account.

Method of Construction

The receiver construction is arranged in modules the size of each having been chosen so as to be a complete section of the receiver without being too large or cumbersome. Each of the main modules is on a printed circuit panel and these are mounted in the receiver so that they can be swung out for easy servicing—all the panels that is except the power supply.

The individual modules will be described in turn in the magazine and complete constructional and assembly details given; the modules will then be assembled in the cabinet—which will also be described—and the whole receiver harness wired up and the unit made to operate correctly. We will proceed at not too fast a pace, allowing the reader to follow the articles on a monthly basis whilst he is constructing the panels. In that way readers can have a completed receiver within one month of the final article appearing.

At this stage it is sufficient to indicate the general facilities and methods used in the receiver: individual circuits will be described in full along with the constructional procedures. We would also point out at this stage that no claims are made to circuit originality: to design a completely new receiver system is unnecessary because we believe that what readers basically require is a product whose performance and reliability have been well tested. There are however a number of little "twists" of our own that have been introduced to improve the facilities and performance without impinging on the overall cost and we feel that these will be welcomed.

Block Diagram

The block diagram shown in Fig. 1 is very basic and serves only to show the general arrangement of the receiver and in particular the number of circuit modules involved.

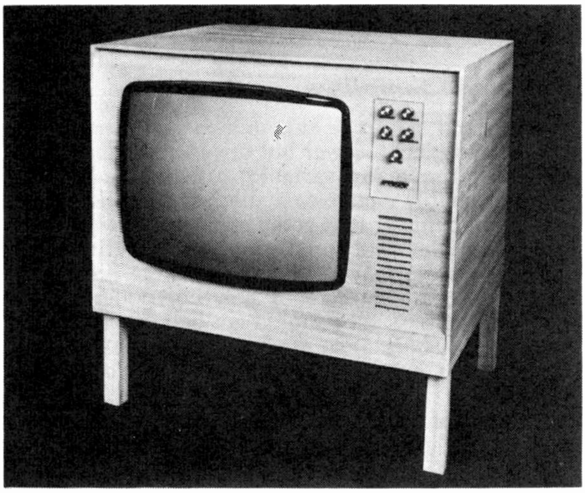
The u.h.f. tuner (which may be a push-button, conventional or varactor type) has automatic frequency control (a.f.c.) fed to it from a discriminator at the output of the i.f. strip. A.f.c. is not just a desirable feature on a colour receiver, it is almost essential to enjoyable viewing to ensure that the saturation of the colour picture does not drift with small changes in tuned frequency. If a conventional tuner is being used and is not already fitted with a.f.c. facilities it can be suitably and simply modified.

The tuner output goes to a three-stage i.f. amplifier in which the majority of the out-of-band and v.s.b. shaping is undertaken by a filter arrangement at the input. The amplifier itself is basically broadband and is designed with forward a.g.c. facilities.

Two detectors are used for the main signals—one for luminance and one for chrominance and intercarrier sound—and separate feeds are taken off for the a.f.c. discriminator and the a.g.c. detector.

The intercarrier amplifier in the receiver uses a silicon integrated circuit on the grounds of cost and efficient circuit action. A second silicon integrated circuit is used to provide the audio output. The prototype receiver uses a 3W output stage driving a 16Ω 8×5in. loudspeaker in the cabinet. For those who want higher quality audio reproduction a low-level output is also provided to drive an external hi-fi amplifier system.

The decoder used for the chrominance information is of the PAL-D type and is a straightforward design



of conventional form providing R−Y and B−Y outputs. The decoder forms a separate module by itself.

The luminance path consists of a preamplifier driving the luminance delay line and a phase splitter to give an output feed for the luminance matrixing and a feed for the sync separator.

The drive to the shadowmask tube is in RGB form and the matrixes and output amplifiers are designed to be extremely stable, well matched and under-rated. Feedback clamping is used to both stabilise the black level and provide brightness control on the reproduced picture.

The timebases form another complete module with only the line output transformer and e.h.t. tripler not being mounted on the printed circuit panel. The line timebase uses flywheel sync of course and the line oscillator and line output stages use the only three valves in the receiver. A great deal of consideration went into the decision to use valves for these stages and much as it would have been pleasant to have had a fully solid-state receiver the importance of ensuring reliability—particularly in a home-built receiver—outweighed the wish to be technically "with it". A low-voltage overwinding with an e.h.t. tripler is used and fifth harmonic tuning of the transformer employed. The generator is of the sinewave oscillator type for greatest stability.

The field timebase is solid-state with a silicon controlled switch (s.c.s.) oscillator and a transistor transformerless output stage. Feeds from both the line and field timebases provide the convergence waveforms and are fed to a separate module.

The separate power supply unit uses isolated chassis, transformer inputs and provides three sets of voltages, h.t., stabilised l.t. and heater volts. The additional safety afforded with an a.c. isolated chassis is not expensive to provide and must be considered very worthwhile.

An optional extra which can be fitted to the receiver is a crosshatch generator giving a built-in alignment source. This uses transmitted syncs and breaks into

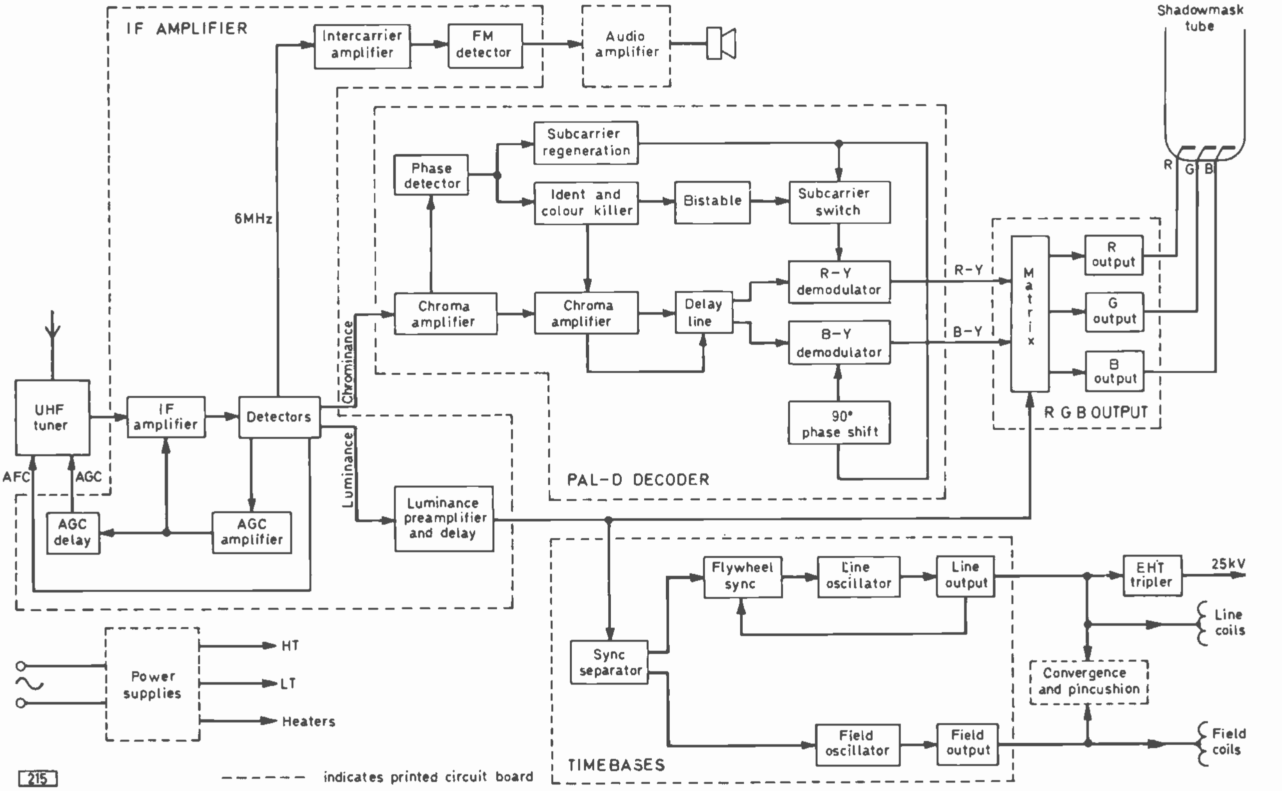


Fig. 1: Basic block diagram of the colour receiver project. Most of the components are mounted on the seven printed circuit boards indicated above. A conventional, push-button or varactor (varicap) tuner unit may be used but the latter type, which is now readily available, is recommended.

the luminance feed in the receiver whilst disabling the colour-difference feeds from the decoder.

The Cabinet

It would be a very great pity to spend a fair amount of money on the construction of a colour receiver only to have it sitting on the floor of your lounge in an open, Meccano-like condition. Apart from the dangers associated with the high-voltage circuits it is far more likely that the woman of the house will be persuaded to allow the rather inevitable mess during receiver construction provided she is guaranteed a reasonable piece of furniture at the end. Full constructional details will therefore also be given of a cabinet to go with the receiver. Indeed the cabinet played an important part in a number of the decisions associated with the design.

Cabinet size is dictated to a very large extent by the dimensions of the shadowmask tube and the other forward-facing components—basically the tuner and loudspeaker: a reasonably compact cabinet has been built around these size-determining elements. The problem in designing a cabinet for the home constructor is to keep the joinery simple while still giving strong construction and a presentable appearance. The extent to which we have achieved this can be judged from the photographs in this issue. Individual deviations by the constructor can of course be made and more (or less) frill attached. For the prototype receiver we had to decide which size tube is the most acceptable to the majority of viewers and from the sales figures of commercial colour receivers this seems to be the 56cm. (22in.) size. This is indeed a nice compromise between the small and the large and the price is a nice average as well. Details will however be given of the modifications required for the smaller and the larger tubes should these be wanted by some readers.

The strength of the cabinet has been put into the legs. They in fact continue to the top of the receiver beneath the external finish and form the basis of a main frame. Commercial designs rely heavily on proprietary processed boards so that they can be produced cheaply in bulk and also because these can have a surface finish already provided. For the amateur cabinet maker however these materials are expensive when thick enough to be reasonably strong and are difficult to work using hand tools. The design evolved therefore uses a timber frame to provide the strength with a thinner form of board to give the outer appearance. Even so one can sit on the prototype and there is no give in the surface.

The prototype receiver had to match in a roomful of high-quality mahogany furniture: the surface was therefore veneered in mahogany and when the series has been completed it will be polished to match the other furniture. The constructor may not need or want such a finish and alternative details will be given for finishing the cabinet without using veneer.

Space has been left in the cabinet for an 8×5in. loudspeaker and either a push-button assembly for varactor tuner control or a conventional push-button tuner can be incorporated.

But one of the nicest little extras we have provided in the receiver is at the bottom of the cabinet. The bar of wood across the front is in fact the front of a drawer in which all the convergence and basic set-up controls are fitted. This enables all facilities except of course static convergence to be easily adjusted from the front of the receiver.

Costs and Suppliers

We would like to be able to give a precise price list for the complete receiver but this is unfortunately not practical; too many variables are involved and we cannot possibly dictate to a supplier that the price he charges for this or that component must remain fixed from this point until completion of publication. What we can however say is that the absolute limit of the cost for a complete set of new components and a new shadowmask tube should not be more than about £135. If you care to shop around—particularly in the case of the tube—this total may be considerably reduced.

A supplier has been arranged for *every* electrical component in the receiver. This includes not only the standard resistors, capacitors, transistors etc. but also items of major importance in the project: coils (either wound and ready for use or in a kit for home winding), printed circuit boards, convergence components and so on. For each component or batch of components in any module the supplier, the price, postage charges and other relevant data will be given. You will not be left out in the cold unable to obtain the components necessary to complete the project. Should any supplier let us down—and this is unlikely because we have screened them carefully—we will make alternative arrangements with all haste to fill the gap that is left.

Some readers are obviously going to deviate from the published design. In general we cannot guarantee to be able to assist such readers because the nature of the modifications tried out may be basically in error or may differ strikingly from the receiver requirements. For example a reader may opt to use a 625-line i.f. strip that he already possesses so as to save the cost of building a new one; in some cases this may be quite all right but in many others the modifications necessary to make the strip suitable for use with the rest of the receiver may be considerable.

One final word relating to the named suppliers seems in order. We have had to estimate how many readers will construct the project: we could be grossly in error with our guesswork and the demand for components could therefore be much larger than we expect. If this should happen we hope you will have a little patience with all concerned.

Alignment and Testing

Some parts of a colour receiver are very difficult to set up. Whilst alignment can be done without the use of specialised test gear the results can rarely be perfect and there are unfortunate occasions when the initial adjustments are so far out that there is no output with which to observe the results! This can be especially true of i.f. strips. We have reduced to an absolute minimum the number of variables that might be encountered and the printed circuit boards have undergone a number of design stages to reduce possible problems.

We will therefore give two distinct sets of procedures: instructions will be given on the setting-up using virtually no test equipment and a different set of instructions will be given for professional setting-up. We realise that with this system there are some readers who although capable of the constructional side of the receiver will be deterred through having no test gear and an inbred—and very natural—fear of alignment. Mainly for these readers we are arranging an alignment service to which the completed circuit boards can be sent for alignment. This service must of course be charged for but the costs will amount to little more than the alignment time required and will certainly not be made at a "deterrent" level.

This same service will also be available for faulty units where the reader has made an error he cannot trace or where through no fault of his own components may be faulty. These things do happen and whilst we cannot possibly hope to prevent them we can at least offer this service to help readers out of any difficulties. Fault-finding of this nature (particularly in a module such as an i.f. strip) can be very long winded and without the proper test equipment may even be impossible if the unit is also misaligned. Even with professional equipment and techniques however some of these faults can still be difficult to trace and we must therefore charge the reader an economic rate for any work carried out on these lines.

We should also point out to the intending constructor that although these services will be available it would be foolish to construct the receiver without one particular piece of test equipment—a multimeter of preferably 20kΩ/V. Without making very basic checks with a multimeter on the final construction considerable damage may be done.

For those who feel able to perform their own alignment, using either their own or borrowed test equipment, the essentials (in addition to the multimeter) are: (1) An oscilloscope (6MHz bandwidth, line and field triggering). (2) A signal generator (with accurate frequency calibration and at least i.f. and intercarrier outputs and preferably a u.h.f. output). (3) A colour pattern generator. It is also advisable to have some sweep equipment available (again preferrably u.h.f. but i.f. will do).

For the reader who plans to use our alignment service or the alignment-without-instrument instructions the optional crosshatch generator should be built into the receiver so that convergence can be set up in the absence of a commercial generator. The only other process that cannot be fulfilled without external equipment is external degaussing and details will be given for the construction of a degaussing coil.

Normal problems of misunderstanding or misinterpretation will be covered in the usual way by our Query Service under the normal conditions.

Towards the end of the series we will publish full circuit voltage details and signal waveforms in a correctly operating receiver to assist the constructor in any future servicing that may be needed.

Making a Start

There is quite a lot of information about the receiver construction contained in this short introductory article: you should spend some time familiarising yourself with the points we have raised.

Additionally check that you have the basic tools necessary for the construction of the first few modules of the receiver: (1) long-nose pliers; (2) small side-cutters; (3) soldering iron suitable for transistor work; (4) small hand drill with standard set of twist drills *plus* a $\frac{1}{32}$in. twist drill.

"That's not the lines, it's the price!"

If you intend making your own printed circuit boards as well (details will be given) you could obtain the necessary etching material. We would recommend that you obtain a 1kg bottle of Ferric Chloride (hydrated, technical) manufactured by for example BDH Chemicals of Poole (product 26093). Most retail chemists will order this for you.

A Final Warning

Let us be blunt: have you understood this introductory article on the colour receiver project? If you have then you are probably in fairly good readiness to understand the whole series. If you have not followed this article then we must advise you to be extremely cautious about whether you proceed any further. We will go as far as it is possible for us to go in helping any reader who gets into trouble but we must be cautious about the degree of assistance that we can afford to give—we cannot after all be expected to build, rebuild or complete a receiver that a reader has abandoned. In addition do make sure that you can afford the project.

We are certainly not trying to dissuade you from the project: we would not have gone to the very considerable troubles that have arisen in presenting this work just to end up by putting people off but we do nevertheless feel a considerable obligation to ensure that readers do not start on a path they cannot finish. Each person knows his individual capacity and patience better than we can guess it. To those of you who decide to follow us through the project we wish a happy and successful constructional period—the results of which will be a high-quality colour receiver in an attractive cabinet and a furthering of your colour television receiver knowledge.

Next month we build the first module of the receiver—the PAL decoder panel.

SERVICING television receivers

L. LAWRY-JOHNS

BUSH TV103/TV105 SERIES—cont.

The line output transformer can give trouble and this is usually indicated by the resistor R98 (2·7MΩ) wired on the rear end overheating. If this is found to be the case disconnecting R98 will cause arcing from the transformer core to chassis thus denoting a breakdown of insulation. A new transformer must then be fitted.

Field Timebase

The field output valve V11 is a PL84 with an ECC82 V10 acting as the oscillator. Either can become defective to cause either poor scanning, loss of height and hold or complete failure with a white line across the screen.

In these receivers a white line normally indicates valve failure, the ECC82 being responsible in the majority of cases. The PL84 is more likely to cause fold-up at the bottom or a similar condition.

Where one is more likely to be fooled for a while is when there is very poor linearity and the output valve is in order as is its bias resistor R84 and bias electrolytic C89, the controls and so on. With monotonous regularity we have found C82 to be at fault. This is conveniently mounted from one linearity control to the other in an obvious position thus making replacement extremely easy.

When searching for a cause of poor linearity, particularly at the bottom, do not forget to check the h.t. electrolytics especially C85 which decouples the screen of the PL84.

Hold troubles usually centre around the ECC82, either the valve itself or an associated resistor. Where the hold is weak however the ECC83 sync separator V9 can be responsible and it should be appreciated that an ECC82 will not function properly as a replacement.

Sound Faults

Whilst the valves, mainly the PCL82 V8, can be responsible for loss of sound complete absence is often due to lack of h.t. supply. R107 2·2kΩ is the supply resistor usually responsible with the habit of becoming open-circuit. There are times when it can be burnt out, either by a faulty valve or by a shorted electrolytic C125.

Distorted sound is another thing altogether. This can be due to a number of factors. If the distortion is worse on a strong signal check R48 and R49. These can go high-resistance, virtually shutting off the interference limiter MR4. If the distortion is present all the time or develops after the set has been on for a period the PCL82, its bias resistors R55 and R56 and, occasionally responsible, the coupler C67 should all be checked.

The Vision Strip

We have already mentioned the habit of R31 changing value to cause chaos and confusion. There is another unhappy fault which happens now and then. This is when the PCF80 video amplifier V5 develops an internal short: the screen feed resistor R32 then burns up and the cathode bias resistor R35 is not long in following suit. Should R32 be found burnt up therefore replace the PCF80 and check R35. Due to the presence of C124 the detector diode escapes damage and will rarely be found defective.

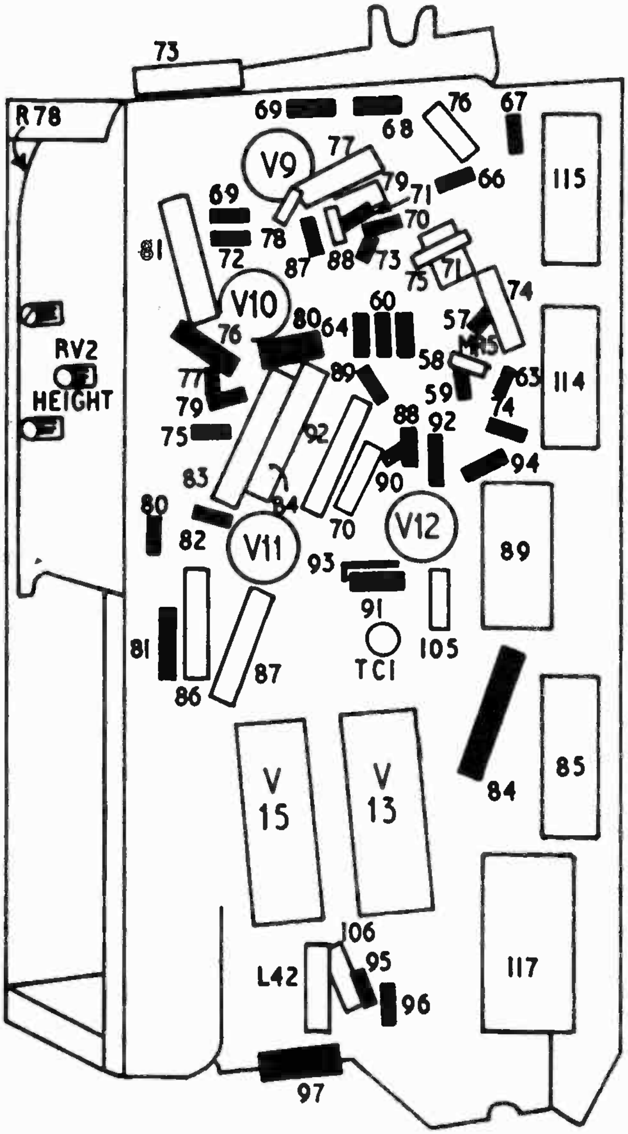
While the vision i.f. amplifier V4 seems to carry on working for ever and is rarely suspected we have found on some occasions that when it does lose emission the resulting symptoms can be confusing. The symptoms may well be persistent vision-on-sound and some degree of sound-on-vision. One would normally check the tuning and the a.g.c. circuit to find the cause of this sort of trouble but a good deal of time can be saved by checking the cathode voltage of V4. If this is less than 1·5V the valve should be changed and the trouble should be clear without further ado. This sort of trouble is usually however caused by a faulty EF85 in the V3 position or possibly a defective PCC89 on the tuner, either valve developing leakage to cancel the a.g.c., or by a shorted a.g.c. line capacitor which will give the same effect. These are more common causes and the repairer should normally check them first.

Tuner Unit

Apart from the necessity to clean the slider contacts at regular intervals the tuner as a rule does not give a lot of trouble. The PCC89 has a habit of losing emission to give a weak and grainy picture and either valve can cause the symptoms of no signals at all.

There are however times when the tuner is known to be at fault but the valves are also known to be in order. In this event it will be necessary to check the voltage supplies to each valve base. This may not be easy but it is often necessary. The screen feed resistor R9 (12kΩ) of the mixer V2 (pin 9) can go high-resistance leading first to a weak reception condition and then to a condition of no signal at all except perhaps in areas of high signal strength.

There are very few faults which will not be revealed by a careful check of the switch contacts, valve base contacts, voltages and resistors for correct value.



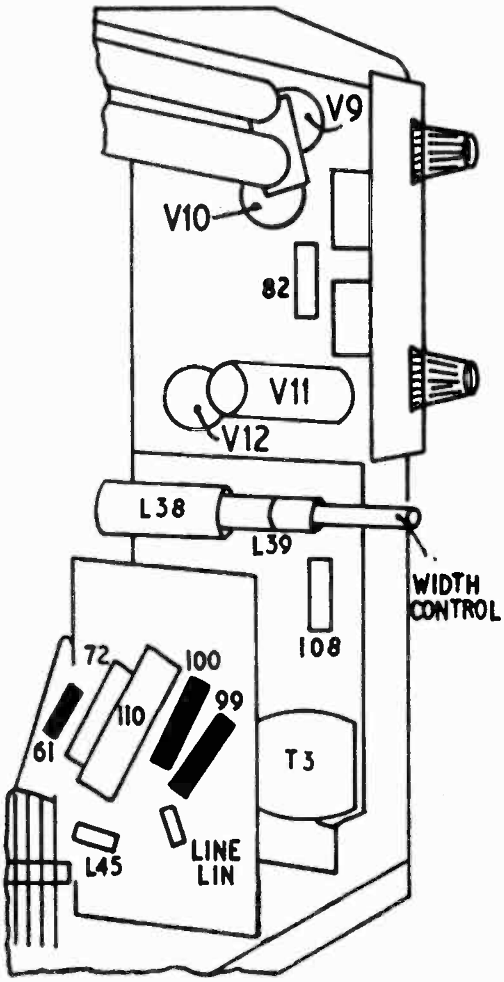
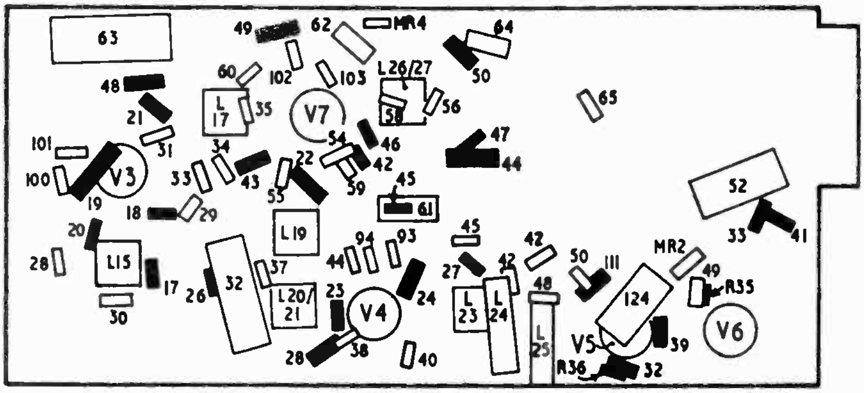


Fig. 4 (above left): The right-hand chassis viewed from outside.

Fig. 5 (above right): The right-hand chassis viewed from the inside.

Fig. 6 (right): Layout of the i.f. decked, viewed from the outside. This is mounted on the left-hand side.

Note: In all these layouts, resistors are shown in solid black, capacitors in outline.



Variations

Some early versions are fitted with an EF80 in the V4 position in place of the EF184. There are several circuit differences between the 21in. models and the 19in.-23in. models, mainly in the line timebase and the heater circuit. The line output valve is a PL81 in some models. Some versions are fitted with a 56kΩ resistor and 50μF electrolytic in place of VDR1 in the brightness circuit while in others an extra EB91 valve is used in the flyback suppression/brightness circuit.

TV TEST REPORT

E. M. BRISTOL

ANTIFERENCE AK10 AERIAL KIT

THIS month we are departing from our usual test equipment report to take a look at a u.h.f. aerial kit that has been produced for the do-it-yourself TV owner. The continued expansion in u.h.f. monochrome viewing plus the boom in colour TV is resulting in the welcome disappearance of unsightly v.h.f. aerials from the roof-tops and the substitution of the less conspicuous u.h.f. array. The result has been a lot of extra work for the aerial riggers. Now while most of these make a good job of erecting an aerial this is not always the case. Some use inferior aerials to cut the cost of the installation, do not try for optimum results—being content to aim the aerial in the general direction of the transmitter—and are not too fussy about damaging or misplacing tiles.

As a u.h.f. array is less of an armful than a v.h.f. one many owners are tempted to have a go at installing one themselves and have the bonus of saving a pound or two in the process. Aerials of all sorts and sizes are readily available at local dealers and so are most of the bits and pieces needed to go with them. If you are like me however you will probably find that you have forgotten some necessary item when you are halfway through the job and then have to drop everything and go out to get it—only to find that the shops have closed!

The Antiference AK10 is a complete kit containing all that is necessary to install the aerial except the coaxial downlead. Obviously the length of the coaxial lead needed will vary considerably from one installation to the next so it would be impractical to include this in a kit. All one needs to do is measure up the length of coaxial cable needed, add two or three yards to be on the safe side and then buy the resultant length along with the kit.

Kit Contents

First let us see what is contained in the kit. The aerial itself is the Antiference TC10, a ten-element Yagi with folded dipole, and is part of the normal Antiference range of aerials. Next there is a mounting arm which consists of a tube with a right-angled bend, and a clamp for securing the aerial to the arm with a bracket for fixing the arm to its mounting place. Three plastic pull-through-and-lock cable securing straps are also supplied for holding the downlead firmly to the aerial.

Coming now to the bottom end of the installation we have a white outlet box, a two-yard jumper lead fitted with coaxial plugs at both ends and a supply of cable-clips with nails for running the downlead along the skirting board to the outlet box. Also supplied are screws for the outlet box and aerial bracket and a couple of wall plugs. Last but certainly not least there are printed on the box step-by-step installation instructions and eight very clear diagrams. Although installation is a simple operation there are pitfalls for anyone who has not fitted an aerial before: these instructions however make everything perfectly clear. When dressing the cable for example the amount of conductor, insulation and braiding to be exposed is usually estimated by guesswork; often it is found that one has bared too much or not enough. Here the exact amounts for top and bottom ends of the coax are given.

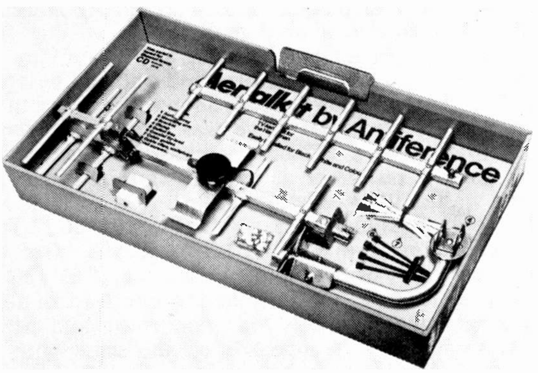
So much for the contents of the kit: we will now take a closer look at the individual items. Most important of course is the aerial itself. U.h.f. aerials are commonly available with from 6 to 18 elements, usual combinations being 6, 10, 13 and 18. The greater the number of elements (other features of the design being carefully adjusted) the greater the gain and the more directional the aerial. High-gain aerials are needed for monochrome reception in the fringe areas and also for colour reception in the medium ranges but low-gain arrays are satisfactory for medium-range monochrome and short-range colour reception. Local topography may of course modify these general rules.

Now it may at first thought appear that a kit should include a high-gain aerial and thus be suitable for all areas. There are snags however. High gain in good service areas can mean input stage overloading and cross-modulation. This could of course be cured by using an attenuator but then the question would arise of whether to supply one with the kit and whether the extra expense would be justified. A further factor is that high-gain aerials can be very sharp in their directivity so that a few degrees outside the normal acceptance angle will actually give a lower signal than a lower-gain aerial similarly off direction. As the aerial is intended for inexperienced fitting it may well end up several degrees away from the optimum. High-gain aerials should in fact be fitted by experienced riggers and are not suitable for a do-it-yourself kit. A 6-element aerial on the other hand would only be suitable for use in very good reception areas so that a kit with such an array would be of limited appeal. By using a 10-element array a compromise has been reached giving reasonable signal strength over most of the service area with a fair latitude in positioning.

Report

The aerial tested was a group C/D one and was tried out on channels 58, 61 and 64. The acceptance angle for this is $\pm 23°$—for an 18-element array by the same firm the acceptance angle is $\pm 18°$.

The gain of the aerial on channel 58 is 11·5dB, on channel 61 11·8dB and on channel 64 11·6dB. Thus to all practical intent the gain is constant over the three channels. In fact over the whole range of the aerial (embracing 19 channels for group C/D) the maximum deviation was only 0·9dB. The front-to-back ratio is about 30dB average for the three channels.



The Antiference AK10 aerial kit.

While there must be a compromise between low and high gain for a kit I think that of the two medium-gain arrays, 10- and 13-element, on balance a 13-element one would have been better. Colour sets need a good signal to avoid noise on saturated chrominance areas and undoubtedly many of these kits will be used with colour sets. In addition as the kits are intended for facia-board or window-sill mounting rather than chimney mounting we may expect a somewhat lower signal due to shielding by nearby walls and other buildings. Hence a few extra microvolts would have been an asset: the decrease in acceptance angle would not be too great and the extra directional properties could be useful in dealing with ghosting.

Having said this on behalf of prospective users in poorer signal areas I must add that I found the noise on a colour receiver operating in a medium-range area to be quite acceptable with the aerial mounted in the attic and ordinary coaxial downlead used—not low-loss as recommended.

As to construction the aerial and the arm are made of aluminium to avoid rusting, and to prevent the usual black deposits on the hands when handling and also to prevent corrosion due to acid in the atmosphere the aluminium has been chromate-dipped. We found that it can indeed be handled without any trace of soiling. The brackets and clamps are of steel treated

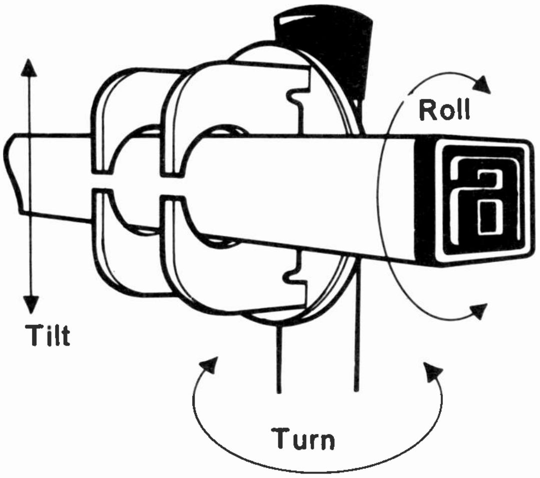


Fig. 1: The ingenious aerial clamp.

to avoid electrolysis action between dissimilar metals. The life-expectancy of the aerial is of course an unknown quantity but it can be mentioned that Antiference have a good reputation in the trade for long-lasting aerials and there are still many old Antiference v.h.f. aerials up and going strong while the aerials of many other makes of the same vintage have long since fallen apart.

Assembling the aerial is straightforward. The reflector which consists of four elements mounted on two brackets is packed flat but clicks into position without removing or fitting a screw and is locked by tightening a wing nut. A boom-arm supporting the first 6 directors is separate but slots into the main arm and is secured by tightening another wing nut. Just a minor point here, the boom can be fitted upside down by someone who doesn't bother to read the directions: I know they should do but some folk like to try first and read about it afterwards. Actually the instructions could be missed (as in fact I did!) because they are printed on the bottom of the box: on or inside the lid would have been a better position.

The clamp for holding the aerial to the arm is one of those delightfully simple devices which are really highly ingenious. It is shown in Fig. 1. By means of it the aerial can be tilted up or down, rolled from dead vertical or horizontal, or turned. All these movements are solidly locked by tightening just a single wing nut. Thus the mounting bracket can be fixed to the house in almost any position and on any convenient support and the aerial can then be swung to the right direction. Top marks for this!

As already mentioned the mounting bracket is designed for fixing to a wooden facia, window-sill or brickwork—hence the wall plugs supplied. There is no chimney lashing. Here again thought has been given to the prospective installer: few householders relish the prospect of clambering over the roof to the chimney stack (though this is the standard fixing position for the professional rigger) but a ladder up to the guttering is within the capabilities of most. Before fixing though, heed the instructions by trying different positions both vertically and horizontally. At u.h.f. quite amazing differences in signal strength can be found only a foot or so apart.

The outlet box and jumper lead are standard items. One advantage of the latter is that the plugs are fitted *and soldered*. It has been found that amateurs often make rather a mess of fitting a coaxial plug. Either they don't solder them (and this goes for many aerial riggers too), relying on a press fit between the cable centre conductor and the centre pin of the plug and thereby sowing the seeds of future trouble, or they melt the plastic inner insulator by holding the iron on too long. Often too they manage to get a short from the centre pin to the braid. All these problems are eliminated by having the lead ready made.

Finally the cost has to be considered. The retail price of the kit is £4. If we add the cost of the equivalent aerial from the Antiference list and all the bits and pieces we come to a figure very little less. But with the kit we have the advantage of all the things we need for the installation in one package plus the valuable set of instructions and diagrams.

Kits are available for group A (channels 21-34), group B (channels 39-51) and group C/D (channels 49-68). I would then recommend this kit for use in all except fringe areas and difficult locations where the services of aerial specialists should be obtained.

SERVICE NOTEBOOK

by G. R. Wilding

No Picture

THERE was absence of line whistle on a GEC Model 2017 and the overheating PL500 and PY800 clearly indicated lack of line drive. A new PCF802 line generator/reactance valve failed to produce results and on making voltage tests it was found that there was zero potential at the screen of the pentode section. This was due to R124, which is connected from one end of the oscillator coil to the pentode screen grid, being open-circuit. On replacing this resistor line whistle and a normal picture developed, although it was found necessary to readjust the core of the oscillator coil for optimum locking. The line output pentode appeared to be none the worse for its temporary overload but as tapping the envelope of the PY800 produced an occasional splutter this was replaced.

During the subsequent soak test it was noticed that sound quality gradually deteriorated. A new PCL84 failed to improve matters but although the 120Ω pentode cathode resistor was of unchanged value the cathode voltage was over 4V instead of 3·1-3·0V on v.h.f. and u.h.f. respectively. This naturally indicated excessive anode and/or screen current but as the screen is directly returned to the HT3 rail the most likely cause of the excessive cathode bias voltage was a slight leak in the coupling capacitor from the triode section anode. On changing this capacitor the cathode voltage of the pentode remained constant at 3V and the sound was undistorted.

No Colour

THERE was normal monochrome but no colour on a dual-standard Bush Model CTV25—even after disabling the colour-killer by applying forward bias to the delay line driver transistor 5VT2 by means of an 18kΩ resistor from its base to the positive l.t. rail. This strongly suggested absence of reference oscillator output and this was confirmed by 'scope application to Test Point E4 (Fig. 1).

Voltage tests then showed that the collector potential of the reference oscillator transistor 6VT3 was 15V—equal to l.t. rail supply—while the base and emitter potentials were virtually nil whereas they should have been 2·7V and 2·5V respectively. Our first suspicion was that the base bias supply resistor 6R55 was open-circuit or that there was an internal base-emitter short in the transistor as either of these would remove the forward bias and cut off the collector current. Ohmmeter tests showed however that 6R55 was OK but that there was almost a perfect short-circuit from 6VT3 base to chassis. This clearly ruled out the transistor as its emitter is returned to chassis via the 100Ω resistor 6R64.

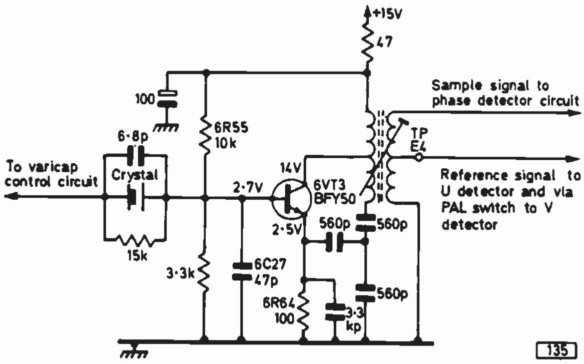


Fig. 1: The decoder reference oscillator circuit used in the Bush-Murphy dual-standard chassis.

The only possible cause was a short in 6C27 the 47pF capacitor from 6VT3 base to chassis (used to reduce the effect of the input capacitance of 6VT3 on the crystal tuning). On unsoldering one lead of this component the diagnosis was confirmed and after replacing it colour reappeared on the screen but it was naturally found necessary to run through the reference oscillator phase discriminator setting up procedure to establish optimum colour lock.

Unusual Short-Circuit

On switching on a Bush Model TV115L a section of the mains dropper began to grossly overheat and glow. A short-circuit of such severity is usually caused by a heater-cathode short in the line output pentode or the boost rectifier, both being placed at the top of the heater chain, or by a short in the h.t. rectifier resulting in the a.c. supply to its anode being passed via the electrolytics to chassis.

We switched off before the valves had time to warm up but were unable to see the line output valve and boost rectifier as they are enclosed in the usual protective can. As the original finned h.t. rectifier had been replaced by a BY100 conveniently mounted at the bottom of the chassis however we decided to check this first and found a dead short with the ohmmeter connected in either direction. On unsoldering one lead we found that this component was perfect and on then unsoldering one lead of the shunting protective capacitor we found this to be perfect also. Furthermore when any valve was removed from the circuit the resistance reading across the mains lead became almost infinity so that if there was a heater-cathode short-circuit in the line valves it wasn't present when they were cold. Most heater-cathode failures of course develop only when the valves concerned get hot so we next changed both the line output valve and the boost rectifier since it appeared that one or the other must be at fault.

On switching on again however the results were as before, a section of the dropper resistor overheating but no valves warming up. There was obviously something unusual about this fault or the circuit, and on noticing a large 0·5μF capacitor mounted close to the PL36 we applied an ohmmeter to it and found it to be completely short-circuit. On snipping it out of circuit the valves warmed up normally, there was no sign of overheating at the dropper resistor and on resoldering the h.t. rectifier back in circuit the h.t. reappeared and the set worked normally. On inspecting the circuit diagram we found that this capacitor is connected between the a.c. mains supply and the h.t. rail thus shunting the h.t. rectifier: its purpose is to apply a small a.c. to the d.c. supply to improve the hum level by cancelling the residual ripple. All of which goes to show that even in the simplest receiver subcircuits—the h.t. and heater current supplies—there can be surprising circuit variations which if not known can cause much needless testing.

Tweaking the older set

VIVIAN CAPEL

MOST workshops get their share of ancient TV sets which for one reason or another must be kept going for a little while longer. Many of them need expensive repairs which are not economically worthwhile so that quick, short-cut methods have to be employed to get the set working to a reasonable standard. Often the fault complained about by the owner is put right whereupon a smeary picture with poor definition appears on the screen. This may not have been mentioned in the original complaint—in fact it may not have been recognized as a fault condition by the owner who may have accepted the condition for a considerable period.

I.F. alignment seems to be required but the engineer knows that a complete realignment by the book will be a lengthy and hence uneconomical procedure considering the age of the set. The only thing to do is to attempt to obtain some improvement by adjusting the cores on a test card.

Check the Video Circuits First

Before doing this however the conditions at the video stage should be checked as a fault here can considerably modify the video response. The d.c. operating conditions can be checked with a meter, and in particular the small-value capacitors that are generally to be found shunted across all or part of the cathode bias resistor should receive attention. The function of these capacitors is to bypass the bias resistor and therefore to reduce the current negative feedback taking place across it. Because of the small value of these capacitors they are effective only at high frequencies at which they thus produce increased gain. This helps overcome the h.f. losses that may be occurring elsewhere in the video circuit and it can be seen that should they go open-circuit the result will be poor h.f. response.

Another possible cause of poor h.f. response in the video stage is the peaking coil(s) often found in series with the anode load. These present a high impedance at high frequencies and thus increase the anode load and the gain at these frequencies. They are usually shunted by a resistor and in fact are often wound over the body of the resistor. Thus if the coil goes open-circuit the h.t. feed to the video amplifier anode is maintained and this may lead one to look elsewhere for the cause of the trouble. The most common place for such coil(s) to go open-circuit is at the end where the winding is soldered to the resistor lead-out wire. A spot of corrosion here or even a dry-joint from the time of manufacture may take many years to show up. A check with the ohmmeter, which should give a fairly low reading if the coil is OK, and a visual inspection should reveal the fault if present. Similar coils are often included in the grid feed as well.

Forming the IF Response

Having eliminated the video stage by these few tests attention must be turned to the alignment. Although recommended alignment methods vary tremendously from one set to another—as a glance at a few service manuals will confirm—the basic principle is the same. The standard 405-line vision i.f. is 34·65MHz. As only one sideband is necessary to carry the signal information single-sideband operation is used and the response below 34·65MHz is therefore eliminated. Above 34·65MHz the response is extended as evenly as possible to 37·65MHz, 3MHz higher, where it falls off rapidly to a dip at 38·15MHz: this is the 405-line sound i.f. where it is essential to have the response at a minimum to avoid sound-on-vision effects. The typical response curve is shown in Fig. 1.

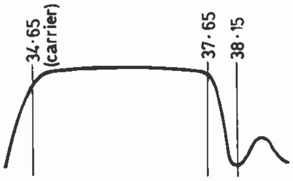


Fig. 1 (left): Typical 405-line vision i.f. response curve.

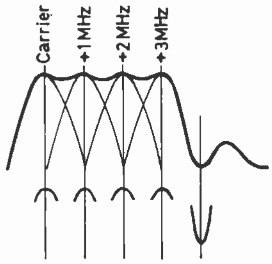
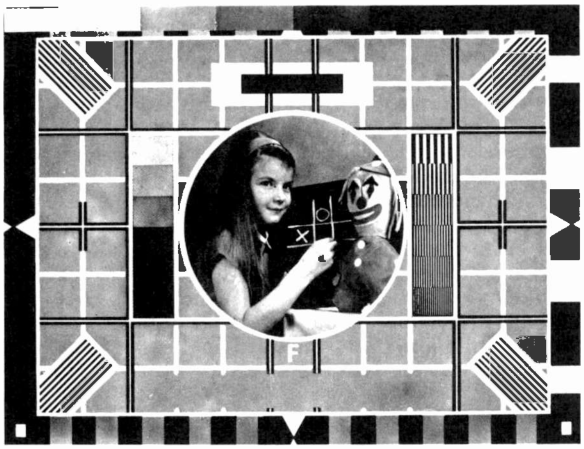


Fig. 2 (right): How the various individual stagger-tuned responses add to give the overall response. The sharp dip is due to the sound rejector.

In order to achieve a flat response extending over 3MHz the individual i.f. coils are stagger-tuned, that is each is tuned to a different frequency within the passband. The effect of this is shown in Fig. 2 where there are four different tuning frequencies: each peak is arranged to fill in the gap in the passband left by the others. Individual sets vary as to the number of different peaks used to obtain the overall curve, depending on the number of tuned circuits in the i.f. strip and the width of each one. In order to minimise the bumps and dips across the top of the complete curve caused by the individual peaks, the individual responses are broadened or flattened either by damping the coils with shunt resistors or by employing loose coupling in the i.f. transformers. The final transformer is well damped by the detector diode.

The rapid drop at the upper end of the curve is caused by the sound rejector circuit(s). The response given by these is not broad like the passband response



Test card F as radiated on the 405-line v.h.f. channels. The frequency gratings are to the right of the centre circle. As the card is originated on the 625-line standard and converted down to 405 lines the gratings represent (from the top) 1 MHZ, 1·6MHz, 2·25MHz, 2·6MHz, 2·9MHz and 3·4MHz. The latter two are likely to be indistinct on most 405-line receivers due to the removal from the transmitted signal of colour information (which is at the h.f. end of the channel bandwidth) to avoid degradation of the converted 405-line picture. Test card F is the joint copyright of the BBC, BREMA, EEA and ITA.

peaks but is made as sharp as possible in order to give the maximum rejection at the sound i.f. This is indicated at the right of Fig. 2.

Mistuned IF Stages

Having digested the basic theory—or refreshed our minds on it as the case might be—let's see what happens when things go wrong. In theory once a coil has been tuned and the core set it should never again need adjustment. In practice however this is not so: cores become loose and shift and stray capacitances which help to tune the circuits alter as a result of valve and component replacements. Thus realignment becomes necessary.

Unless the set has been in the hands of someone who has recklessly twiddled all the cores in sight—and this is unfortunately not an uncommon experience—one can assume that not all the cores need adjustment. In fact only one or two might require resetting and even these should not be too far out. The question is, which ones?

One method of finding out without going through the process of complete realignment is to systematically turn each core in the vision i.f. strip a couple of turns each way. Note carefully the starting position and return the core to it if no improvement is obtained. This should be done with the test card being displayed. Watch the h.f. response as indicated by the frequency gratings and the l.f. response as shown by a clear presentation of the black bar at the top of the card without smearing on the right. Also look for signs of ringing—the appearance of an outline to the right of the frequency gratings.

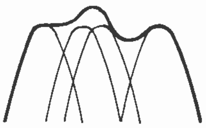
It will sometimes be found possible to improve one of these three factors at the expense of one of the others. This indicates that we are on the wrong track and the core should be returned to its previous position and another one tried. Each core that is tried should be returned to its original position *before* the next one is adjusted. If on adjusting a core improvement is noted in any respect without detriment to the others the core can be left in the best new position found and the others tried for further improvement.

It may not however be necessary to try each core in this manner. It may in fact not be possible because over a period of time some cores have a habit of jamming tight so that no amount of persuasion will shift them.

Assessment by Test Card

Let us assume then that one of the i.f. coils has shifted its tuning point by a moderate amount: what will the likely effect be? This depends of course on which one it is. If it is a coil which contributes one of the inner peaks a sideways movement will produce on the overall response curve a dip where it should have tuned and a higher peak where it is now tuning because it has become partially superimposed on one of the other peaks: a typical example is shown at Fig. 3. The result is an excessive response at some modulation frequencies and a reduction at others. On test cards this will appear as a flaring or ringing after one set of frequency gratings accompanied by a loss of resolution at the adjacent one.

Fig. 3: If one of the circuits is off tune the result is a dip where its peak should have been and a peak where it is superimposed on another.



In the curve shown in Fig. 3 the displaced peak has moved towards the low-frequency end of the pass-band so we would expect flaring after the 1·5MHz gratings and loss of definition at the 2MHz gratings. The higher frequencies would in this case be unimpaired. Had the peak moved the other way however there would have been a dip at around 2MHz as before but flaring at 2·5MHz. If one of the other peaks had moved there would be a corresponding indication in the frequency gratings.

It can be seen therefore that if it is known which core affects which part of the response (this can be ascertained from the service manual by looking up in the alignment procedure the frequency differences from the centre 34·65MHz vision i.f. given for the various coils) then by looking at the test-card frequency gratings the core to adjust can be selected right away.

In our illustration (Fig. 3) the peak that is responsible for the response at around 2MHz has moved to a lower frequency (discovered from the effect on the test card). If we have the manual we can check therefore to see which core must be adjusted to affect the response at 34·65+2·0=36·65MHz or thereabouts: this is the one to attack! We can even tell which way to turn it because if it is tuning too low we must decrease the inductance so as to tune higher, which means bringing the core out of the coil, while if it is tuning too high we must increase the inductance by screwing the core in.

Even though one of the tuned circuits has gone off tune to give the response shown in Fig. 3 and the effect can be seen on the test-card frequency gratings it is unlikely that the fault will be too noticeable on a picture provided the deviation is not too great. This is especially the case in old sets where there are likely to be other faults as well—such as a not-too-bright tube.

Mistuned Sound Rejector

Look now at the response curve shown in Fig. 4. Here the higher frequencies are completely killed off by a sharp dip that has appeared and the result on the screen is a very poor-definition picture. That sharp dip and its position at the h.f. side of the curve should give you a clue as to its origin if you didn't already know: yes, it's the sound rejector that is off tune.

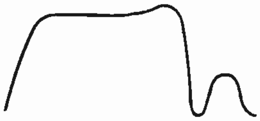


Fig. 4: The result of the sound rejector being off tune is sharp h.f. loss.

It follows from this that a mistuned rejector has a far worse effect on the picture than an off-tune i.f. coil; furthermore because it is sharply tuned the setting is much more critical. One turn of the core of an i.f. coil may have little observable effect on the picture but just try it with the rejector! Not only is there a marked loss of h.f. but there will probably be signs of sound-on-vision on heavy sound passages as well. It is quite likely however that if the core is not too far off tune the rejection at the sound i.f. will be sufficient to reduce the sound interference to an almost unobservable level with average sound modulation. This will be especially so if there is another rejector that is on tune in the circuit.

Where there is poor definition therefore, whether sound-on-vision is present as well or not, it always pays to try the rejector(s) first. The rejector(s) can be identified from the manual as the core(s) which must be adjusted for *minimum* output at 38·15MHz. Adjustment must be for minimum sound-on-vision and the easiest method is to use the fixed note that is occasionally transmitted with the test card. After tuning the fine tuner for maximum sound the rejector is adjusted to give minimum ripple. If the note is not present (they rarely seem to transmit what you want when you want it!) it is possible to use the accompanying music if it is not too soft. Owing to the varying nature of the music a null point is not always easy to find: the best way is to tune slightly to one side until sound-on-vision just appears on sound peaks, then to tune to the other side for a similar effect and finally to set the core to the halfway point between the two positions.

The method recommended in manuals is, of course, to use a signal generator to inject a 38·15MHz signal. The sound i.f. coils must however be tuned to the same frequency and as they may be a little off tune using the signal generator method means lining up the sound i.f. stages first. By using the transmitted signal and tuning the oscillator (fine tuner) to maximum sound however, one is sure to tune the rejector(s) to the same frequency. Once the correct setting has been made the video definition should be restored.

Adjacent Channel Rejectors

More often than not in such cases it is found that adjustment of the rejector(s) is all that is required and that further attention to the i.f. cores brings very little improvement. Some sets, particularly fringe models, have rejectors tuned to the adjacent sound and vision carrier frequencies. Thus there is an adjustment for minimum response at 33·15MHz (adjacent channel sound) and less often at 39·65MHz (adjacent channel vision). These are well outside the vision passband and should not cause any trouble—except to allow adjacent carrier sound or vision through—even if they have drifted a bit.

Jammed Cores

Jammed cores are always a problem. One can go to a great deal of trouble to remove a core, probably breaking it in the process, only to find on fitting a replacement that little or no improvement can be made by adjusting it so that the old one must have been in the correct position all the time. By diagnosing which core is most likely to effect an improvement in the manner outlined here any others that are jammed can be left alone.

Most cores even in older sets are of the hollow type with a hexagonal hole for insertion of a suitable trimming tool. Trying to turn these with anything other than the proper tool will almost certainly break them if they are a little stiff. Even the correct tool becomes rounded at the corners with frequent use and then fails to turn the core. A supply of these tools should be kept by the engineer (they are quite cheap) and they should be discarded as soon as they exhibit signs of wear.

Fortunately such cores if they jam or break can be removed without too much trouble by being broken up inside the coil former. A small-bladed screwdriver is used to break off pieces of the core which will fall through to the bottom end of the former. If this is done a piece at a time it is not long before the complete core is broken up and the coil former is clear. Make sure to clean the thread of any remaining pieces before fitting a new core or this too might jam. A smear of thick grease will help to prevent it jamming yet will lock it against working loose from vibration.

Sound/Vision Beat Patterns

Another effect often seen on older sets is the appearance of a fine pattern of dots over the screen. This is caused by a 3·5MHz beat pattern and a trap to eliminate it is often found somewhere around the video amplifier, usually in the cathode circuit. Often this is a single unscreened coil. The core should be set to give minimum patterning but it is often found to be off tune. Although the pattern is not always instantly noticeable it is surprising how much cleaner the picture looks when the pattern is removed.

Conclusion

The methods we have outlined here for lining up the i.f. tuned circuits on the test card should not be used on modern sets, especially dual-standard models. Wobbulator alignment is the only sure way of getting the desired response with these models: even the spot-frequency method painstakingly and laboriously carried out often yields disappointing results. For a quick job to bring about passable video response on an otherwise uneconomic repair there is, however, nothing to beat knowledgeable core adjustment on test card. ■

COLOUR RECEIVER CIRCUITS

GORDON J. KING

THE BURST CHANNEL

LAST month we looked at some active reference generator circuits—the type using a crystal oscillator and a.p.c. loop. This month the plan is to go on to investigate the passive type of reference generator. Since, however, with this type of generator the signal is derived directly from the bursts let us first look at the circuits in which the bursts are extracted from the chroma signal. We shall consider the burst channel first as used with conventional active reference generators and then pass on to the passive generator system.

We saw last month how with an active generator circuit the phase detector produces a variable control potential to vary the bias applied to a capacitance-diode in the crystal oscillator circuit. To do this the phase detector must receive both the bursts and a sample signal from the reference generator.

Block Diagram

The bursts form a part of the chroma signal, which is usually extracted from the composite transmitted vision signal by a high-pass filter. For correct operation the bursts, which occur during the back porch of the sync pulse, have to be extracted from the chroma signal and furthermore the chroma channel has subsequently to be blanked so that the bursts are not present at the output of the chroma channel. Fig. 1 shows in block diagram form the processes involved.

Burst Gating

As the bursts are present on the rear porches of the line sync pulses it is a relatively simple matter to extract them from the chroma signal by "gating" at line frequency. The separated bursts are then amplified and passed to the phase detector. The gating transistor may operate as the amplifier as well and the stage is designed to be non-conductive (i.e. biased to cut off) during the lines of picture information. Pulses at line frequency rate are applied to the stage to make it conduct and pass the signal during the period of the bursts only. Exact pulse timing is thus important.

Typical Circuit

The circuit used in dual-standard Decca receivers is shown in Fig. 2. Here Tr1 is the first chroma amplifier stage which feeds signal to the second chroma amplifier and also the burst gate/amplifier Tr2. The signal for the burst amplifier is filtered out by the 4·43MHz tuned circuit L1/C1—with damping provided by R1—and is coupled to Tr2 base through C2. There is no fixed bias at Tr2 base while a reverse bias is applied to its emitter via R3. It is thus normally non-conducting. To gate it on during the bursts correctly-timed positive-going pulses are fed to the base via R2. The transistor thus switches on during these periods and amplified bursts appear across L2 which is the input to the phase detector.

The Burst Signal

The bursts can be regarded as a 4·43MHz carrier wave with 100% squarewave modulation of mark-space ratio approximating 1:28—see Fig. 3. In other words the burst signal consists of the 4·43MHz carrier wave with upper and lower sidebands corresponding to the line frequency and its harmonics *plus* sideband components of $\pm\frac{1}{2}$, $\pm1\frac{1}{2}$, etc. of the line frequency due to the swinging bursts (the $\pm45°$ alternate line phase shifts used for ident purposes). The half line-frequency components arise because the swinging bursts return to the same phase every *second* line. The bursts in other words are also effectively modulated by a frequency of half 15,625Hz, generally

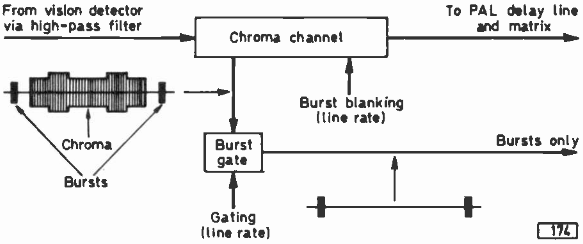


Fig. 1: Block diagram showing the burst gating action.

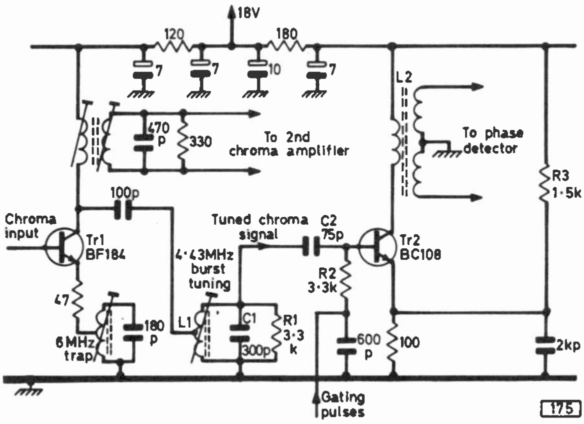


Fig. 2: Representative circuit (Decca dual-standard): Tr2 is the burst gate/amplifier which drives the phase detector transformer L2. It is fed with chroma signal from the chroma amplifier Tr1 via the tuned circuit L1, C1 and is gated on during the bursts by pulses fed via R2 from the pulse generator stage shown in Fig. 5.

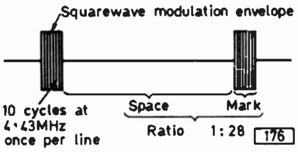


Fig. 3 (left): As the bursts occur once each line (during the back porch period) they can be considered as a 4·43MHz sinewave 100% modulated by a squarewave at line frequency.

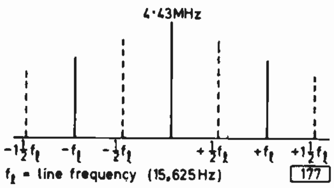


Fig. 4 (right): As a result the burst signal consists of the 4·43MHz subcarrier plus sidebands at line frequency as shown here. There are also sidebands at half line frequency because in the PAL system the bursts are alternated in phase line by line. These sidebands are shown in broken line. The bandwidth of the burst signal extends ±1MHz each side of 4·43MHz.

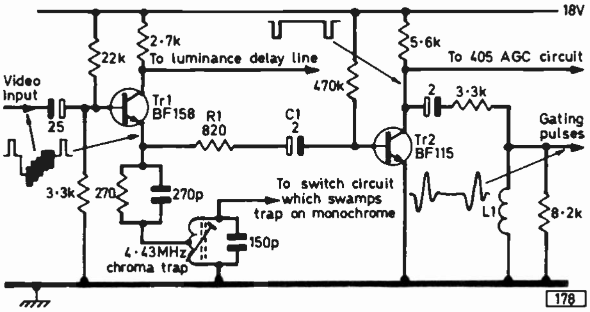


Fig. 5: The pulse generator used in Decca dual-standard models to produce the pulse to switch on the burst gate. An output with positive-going sync pulses is taken from the luminance preamplifier Tr1 and fed to the base of Tr2. As a result Tr2 produces negative-going pulses which are fed to L1. This coil rings, producing a positive-going overshoot which is coincident in time with the bursts and is used as the burst gating pulse (fed to Tr2 in Fig. 2).

referred to as 7·8kHz. The spectrogram in Fig. 4 shows the immediate sidebands of the bursts and to avoid distortion of the bursts the bandwidth of the burst channel must accommodate all the sidebands up to about the twentieth, corresponding to about 650kHz.

Gating Pulses

The gating pulses are sometimes derived from a separate gate pulse generator stage which is activated by either the line flyback pulses or the line sync pulses. It is important that the burst gate opens only during the periods of the bursts and closes completely during the lines of picture information: if these conditions are not satisfied colour distortion appears on the picture.

The pulse generator and associated circuits of the Decca set are shown in Fig. 5. Tr1 is an amplifier transistor in the luminance channel and Tr2 the pulse generator transistor. The video input at Tr1 base has negative-going picture signal and positive-going sync pulses and signal of the same polarity also appears at the emitter. This is fed via R1 and C1 to Tr2 base. Consequently Tr2 is cut off during the negative-going picture signal but passes current pulses when triggered on by the positive-going line sync pulses. These current pulses appear as negative-going pulses at Tr2 collector. Positive-going pulses are required however for the gating action. These are obtained by using the negative-going pulses to make L1 "ring", the positive-going overshoot of each ringing pulse being employed to switch on Tr2 in Fig. 2. This technique ensures that the gate opens only during the bursts—which are on the sync pulse back porch—and not during the line sync pulses themselves. The pulses at Tr2 collector are also used for 405-line a.g.c. gating.

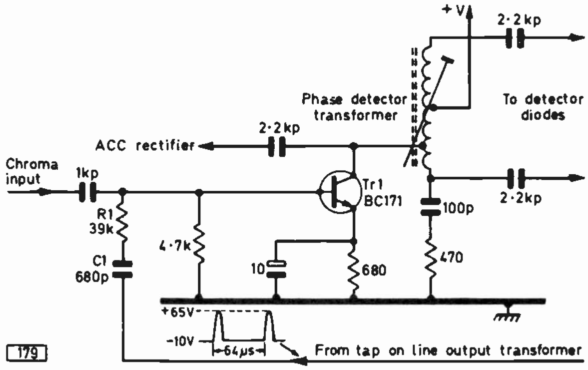


Fig. 6: The burst gate/amplifier used in the ITT-KB CVC5 single-standard colour chassis. This is gated by flyback pulses from the line output stage. The collector circuit is rather unusual in comprising a series tuned circuit, the coil driving the discriminator diodes in the normal manner.

ITT-KB Circuit

The gated burst amplifier circuit used in the single-standard ITT-KB CVC5 series chassis is shown in Fig. 6. The chroma signal input is taken from the chroma amplifier channel (see Fig. 1, page 221, previous issue) and fed to the base of the burst gate/amplifier transistor Tr1. Being an npn type this transistor requires positive-going pulses to switch it on during the periods of the bursts. These pulses are obtained from the line output transformer (flyback pulses as shown in the inset waveform) and a suitable degree of delay is provided by the *RC* coupling circuit R1/C1 so that the transistor switches on at the times corresponding to the bursts proper. R1 also ensures that the switch-on current is limited to a safe value for the transistor.

Two-stage Circuit

A circuit employing two stages is shown in Fig. 7 (Baird 700 series). Burst gating is accomplished at the input stage Tr1, the action being as follows. During lines of picture signal, there are no gating pulses and Tr1 is cut-off, its base being negative with respect to its emitter as its base is at chassis potential (through P1 and R1) while its emitter is taken to a small positive potential at the junction of the potential-divider formed by R2 and R3. The positive potential from the supply line cannot reach Tr1 base via D1 because the cathode of this is connected to supply positive—it is thus reverse biased. During line flyback however a 60V pulse is applied to the anode of D1 through R5 and simultaneously to Tr1

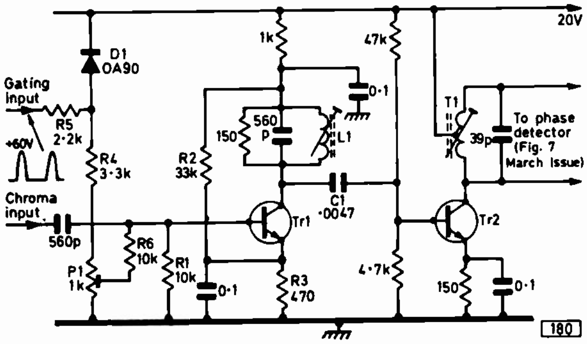


Fig. 7: Two-stage burst channel used in dual-standard Baird colour sets. Line flyback pulses clamped to the 20V l.t. rail by D1 gate the base of Tr1.

base through R4, P1 and R6. This pushes Tr1 hard into conduction while at the same time switching on D1 which effectively clamps Tr1 base to +20V from the supply line. The bursts then develop across L1 in Tr1 collector circuit and are coupled via C1 to Tr2 base. This transistor acts as an amplifier and a loading device to the phase detector input transformer T1. P1 regulates the bias applied to Tr1 base during the periods of the bursts for best gating effect.

Passive Subcarrier Regenerator

Before going on to PAL switching and V-chroma line identification circuits we must conclude the reference generator department by examining the passive type of subcarrier regenerator. This type of circuit differs from the active circuits described last month in that the reference signal is not generated by an active oscillator stage. Instead the reference signal required by the chroma detectors is obtained direct from the bursts.

As we showed in Fig. 4 the bursts consist of a 4·43MHz carrier wave and sidebands or side frequencies spaced either side of the carrier wave at half line frequency and multiples thereof. From this it follows that by feeding the bursts through a very narrow passband filter all the side frequencies will be removed and the original carrier wave only will be obtained. This is in fact just how the passive reference generator system works.

The narrow passband filter consists of a quartz

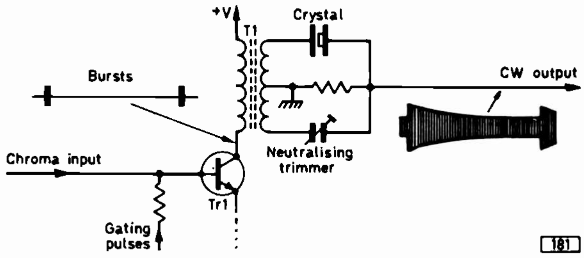


Fig. 8: The basic passive subcarrier regenerator circuit. The crystal acts as a high Q filter which removes the sidebands from the burst subcarrier to provide a 4·43MHz c.w. output.

crystal and the basic scheme of operation is shown in Fig. 8. The bursts at the collector of the gating/amplifier transistor Tr1 are developed across the primary of the filter input transformer T1 the secondary of which is loaded into the crystal proper. The circuit here is akin to a bridge, with the crystal in one arm and a trimming capacitor in the other. It is the purpose of the capacitor to balance out or neutralize the capacitance of the crystal and when this is achieved the circuit acts as a very narrowband filter. The filter circuit neatly removes the side frequencies of the bursts, leaving the 4·43MHz carrier wave (or subcarrier) as shown by the output waveform. The filter in other words effectively "unmodulates" (as distinct from the action of demodulation) the squarewave modulation!

In spite of the effective *Q* of the circuit being in excess of 10,000 however the selectivity is still not sharp enough to attenuate adequately the half line-frequency components adjacent to the carrier frequency. For this reason PAL receivers employing the passive reference generator scheme incorporate an extra artifice which deletes the burst phase swings so that the crystal filter is presented with "phase constant" bursts having spectral lines corresponding

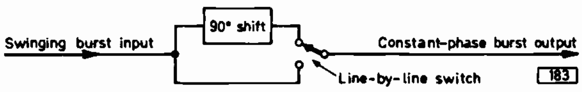


Fig. 10: Diodes D1 and D2 in Fig. 9 in conjunction with the transformer T1 form a 90° phase shift switch to remove the alternate line phase swings from the bursts.

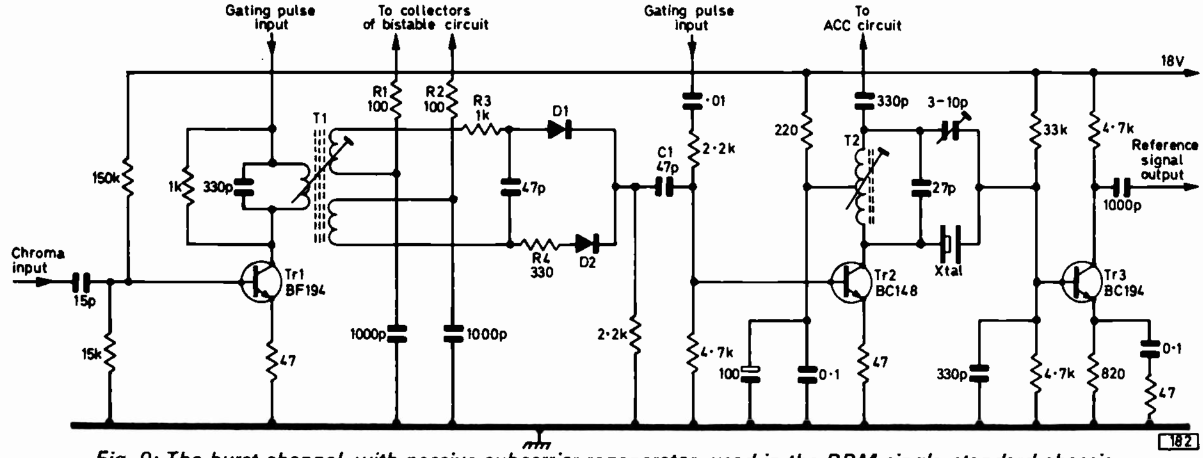
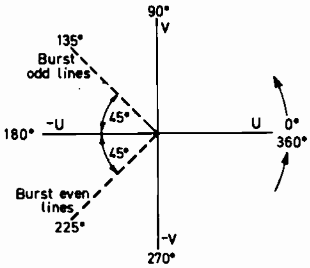


Fig. 9: The burst channel, with passive subcarrier regenerator, used in the RBM single-standard chassis.



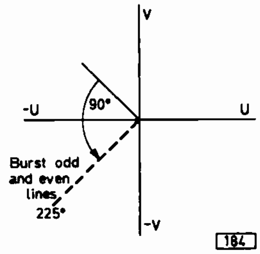


Fig. 11 (left): How the transmitted bursts swing ±45° with respect to the —U axis on alternate lines.

Fig. 12 (right): When the 90° switch is correctly synchronised the bursts settle at 225° on all lines. If the switching is out of synchronism the bursts on alternate lines cancel so that there is no reference signal. This feature is used in the RBM chassis for ident purposes as we shall see in a later instalment.

only to the line frequency and its harmonics. The latest crystals well and truly reject these side frequencies—just as they do when used for the same purpose in American NTSC receivers.

Rank-Bush-Murphy Circuit

The single-standard Rank-Bush-Murphy chassis features a passive reference signal generator of this kind as shown in Fig. 9 (later chassis use the integrated version covered in the November 1971 TELEVISION).

The composite chroma signal is fed to the base of Tr1 which is the first gating/amplifier stage. The collector of this stage is fed with clipped positive-going line flyback pulses and as these pulses occur only during the burst periods the transistor is switched on only when the bursts are present.

The burst input swings ±45° in phase relative to the —U chroma axis line-by-line in the conventional PAL manner and it is the job of diodes D1, D2 and the associated components to delete these phase swings and thus convert the bursts to a constant phase. What happens is that the diodes in conjunction with transformer T1 shift the phase of the bursts on every other line by 90° as shown in Fig. 10. The switching action occurs as the result of line-by-line alternate conduction of the two diodes, the switching waveform being obtained from the collectors of a pair of transistors in a bistable multivibrator circuit.

On one line for example the potential at R1 is positive and as this is reflected through the top winding of T1 secondary and R3 to D1 anode this diode switches on and the burst at the end of that line is conveyed via C1 to Tr2 base at the phase dictated by the top secondary winding. The other diode is switched off under this condition. On the next line the voltages at the collectors of the multivibrator transistors reverse so that D2 switches on while D1 is switched off. The burst then passes from the bottom secondary winding of T1 via C1 to Tr2 base. The phasing of the transformer windings is such that the burst on one line is shifted 90° in phase relative to the burst on the next line (just as in Fig. 10 in fact). Bearing in mind that the burst phase is also alternating between 135° (odd lines) and 225° (even lines) as shown in Fig. 11 it will be appreciated that the 90° switching just described will counteract the PAL swings and make the input to Tr2 base phase constant. The operation is shown in Fig. 12 where it will be seen that the 90° phase shift occurs on the odd lines so that the burst phase at Tr2 base settles at a constant 225°.

Tr2 is the second gate/amplifier and the pulses for gating it are obtained from an overshoot ("ring") derived from a tuned and suitably damped circuit which is stimulated by line flyback pulses. This ensures that the gate pulse timing is correct. The arrangement is similar to that employed in the Decca chassis (Fig. 5).

Tr2 collector is loaded by the crystal filter input transformer T2 and the action here is just as explained in relation to Fig. 8. The constant-phase subcarrier is amplified and limited by Tr3 before being processed for application to the chroma detectors.

This chassis also incorporates an interesting method of PAL V-chroma switching identification. We shall be looking at this later. Next month we shall start on PAL V switching and "ident".

COLOUR SERVICING FILM

Zaar Films Ltd. of 339 Clifton Drive South, St. Annes-on-Sea, Lancashire, have released three teaching films on colour television servicing and installation. They are available in 8 or 16mm. form and are in full colour with a magnetic or optical sound track and have been produced with the co-operation of several well-known firms in the TV industry. The three films are Part 1 "The Colour Signal", Part 2 "The Receiver Decoder" and Part 3 "Receiver Installation", and have running times of 30, 20 and 25 minutes respectively.

A CLOSER LOOK AT PAL

—continued from page 257

led us to fear and expect. Theory predicts that hue errors will not arise in the PAL system and practice confirms it. Any errors that do occur are caused primarily by inaccurate adjustment of the display system, particularly by the grey-scale tracking and purity.

In this series we have tried to show why it is that PAL serves us well. We have discussed the reasons why signal phase distortions are largely cancelled; why distorted sideband working fails to produce the ill effects so common with NTSC; and we have demonstrated the high degree of immunity to decoder alignment errors.

Of comparable importance in our search for higher average colour quality in customers' homes is the fact that PAL decoders lend themselves to a variety of simple alignment procedures. These are based on critical visual display techniques and not in any sense upon measurements. PAL decoders also have a built-in faciliy for instant checking of alignment accuracy —blinds.

With the coming of high-performance integrated circuits and all solid-state receivers we are poised for a major breakthrough in terms of performance, complexity of component assemblies, receiver size, reliability and cost. Who would have thought four years ago that colour TV would travel so far and so fast?

YOUR PROBLEMS SOLVED

★ Requests for advice in dealing with servicing problems must be accompanied by a 10p postal order (made out to IPC Magazines Ltd.), the query coupon from page 282 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone.

PHILIPS G6 CHASSIS

The trouble is the blue convergence. On a crosshatch pattern the blue horizontal lines are bowed upwards. Reasonable convergence can be obtained at the centre of the screen but it is very poor at both sides. The blue convergence controls L1614, R1237 and L1605 have no effect on the blue pattern at all.—I. Carter (Rugby).

First check carefully the plugs and sockets from the coils to the convergence panel then check that the system switch is over correctly and making proper contact. If the red and green patterns are not correctly converged, re-converging them may enable the blue pattern to be brought into registration. If the line convergence controls you mention have no effect check the coils and controls for continuity and also C1205, R1240 and C1210 in the horizontal convergence circuit. Also check and adjust the blue field convergence controls R1259 and R1265 as the effect of these in conjunction with the others and the static controls may help. We feel however that the trouble is most likely to be a loose plug or connection.

BUSH TV161

There is loud hum on this set though the picture is not in any way affected. Disconnecting the aerial makes no difference. Also after the set has been on for about two hours the sound becomes very distorted and weak. The PCL82 audio valve has been replaced without improving matters.—H. Aarenson (Erith).

Check the PCL82 valveholder as there may be leakage between pins 3 and 4 (pentode grid and heater). This could also cause the distortion. Apart from this check the PCL82 voltages.

FERGUSON 3624

The trouble is lack of field hold. There are two complete pictures and moving the hold control only makes the picture revolve. The field timebase and video/sync valves have been replaced without any improvement.—J. Pinney (Birkenhead).

Check the value of the 470kΩ resistor R98 in series with the field hold control. Then check C80 (0·01μF) and C79 (0·003μF high-voltage) which couple back to the triode grid of the field timebase valve.

PYE 62

There is reduced width on this three-year-old model. The line output and efficiency diode valves have been changed. The width preset controls are both at the extreme end of their travel.—R. Davies (Swansea).

There are two 3·9MΩ resistors R155 and R156 in the width control circuit. The most likely cause of the trouble is that one or both of these has changed value.

PHILIPS 19TG173

The trouble is that the 625 sound is very poor and distorted although the picture is good. On 405 the picture is very shaky at times and flickers quite a bit. I have tried to clear this fault by adjusting the fine tuner but this makes no difference.—H. Dean (Manchester).

The poor 625 sound could be due to inaccurate tuning of the 625-line sound i.f. coil cores, faulty OA79 detector diodes (in L211 can), a faulty ratio detector balance control R228 or the 4μF electrolytic C219 in this circuit. The shaky picture could be due to excessive contrast, a faulty a.g.c. line clamp diode X206 (BA115) or flywheel line sync valve V401 ECC82.

DEFIANT 9A50

The field hold is rather erratic, the picture sometimes remaining stable for an hour or two but sometimes for no more than five minutes. Sometimes the slip is slow but it usually speeds up and can nearly always be reset with the hold control. Sometimes the picture rolls for a minute or so and then suddenly stops. The trouble occurs on both 405 and 625 lines. Also on 405 lines there is heavy sound-on-vision.—G. Harris (Glencoe).

Check the PCL85 field timebase valve and the resistors associated with the field hold control as one or more may have changed value. Also check the resistors in the video stage where the 18kΩ bias stabilising resistor—made up of 10kΩ and 8·2kΩ in series—may be changing value. To clear the sound-on-vision check the setting of the preset contrast control near the PCL84 and if necessary reset the sound rejector.

PYE CT72

This set gives very good colour pictures but after running for some time it goes black-and-white. This always seems to occur on a camera change. On return to the first camera the picture is perfect again. The fault occurs more with cartoons and such like. Sometimes the colour does not go altogether but is very pale with horizontal bands of colour, green and pink, about ⅜in. wide. Always on switching back to another camera the colour is perfect again.—S. Hickson (Cheltenham).

There are two large coils on the decoder panel to the left of the delay line, i.e. to its right as you look in the back. The largest of these is L27, the 7·8kHz ident coil. Unscrew this on a test card until the colours reverse then screw it back one turn. Then adjust the other coil for maximum voltage at TP17 by D22.

FERGUSON 3703

The trouble is loss of line hold and picture break up after the set has been switched on from cold and has been in operation for about 15-30 minutes (field hold is not affected). The picture returns to normal after a period varying between 2 and 20 minutes and generally the trouble does not then recur. Occasionally however the break up and recovery repeat themselves before the picture reaches a stable state for the rest of the time the set is switched on. Varying the tuning has no effect on the broken-up picture.—R. Sanders (Driffield).

The fault you describe is usually due to a dry-joint or other improper connection in the flywheel line sync discriminator, d.c. amplifier or line oscillator stage. Disturbing the components in turn should reveal where the trouble is and the joint that has to be remade.

PHILIPS 19TG172

There is an intermittent fault on this receiver, the picture and sound fading a short time after switching on. A quick flick of the channel change or a thump on the side of the set restores the picture.—J. Heath (Braintree).

The most likely source of the trouble is the plug and socket connection on the lower part of the left-side panel. This terminates a screened lead from the tuner unit. Remove the plug, clean and tighten up. There are two pins plus a locating plug.

HMV 2620

On 405 lines the picture is not very bright and the sound poor though if the tuner is rotated the sound and vision are momentarily good. On 625 lines the picture is good and the sound loud, but after about five minutes both sound and vision begin to fade and then disappear completely leaving nothing but mush on the screen. The switches have been cleaned and the video valve replaced.—D. Read (Northampton).

It seems that R22, the 3·9MΩ resistor from the slider of the 405-line contrast control to the a.g.c. line, has gone high-resistance. It is situated in a convenient position at the rear centre of the chassis. To cure the u.h.f. trouble we suggest you change both u.h.f. tuner valves—the PC86 and PC88.

BUSH TV125

There is no e.h.t. present and the efficiency diode and heater dropper 3R58 are overheating. The line output transformer was replaced after which the set appeared to work normally for about three weeks except that 3R58 was still overheating slightly. The raster has now completely gone. The efficiency diode and e.h.t. rectifier were replaced at the same time as the line output transformer.—H. Boyle (Andover).

The PY88 efficiency diode usually overheats if the boost capacitors 3C23 or 3C24 short so these should be checked. Then check if necessary for corrosion at the e.h.t. rectifier base.

PYE 11

Choke L23 in the h.t. line is burnt out: could you let me know the value? Also I have fitted a u.h.f. tuner and it is working well but I would like to know how to tune out noise on the u.h.f. sound.—L. Graig (Sidmouth).

L23 is an ordinary i.f. choke of value about 30μH. We don't think it is very critical so you may find that if the core is intact you can rewind it—using 40 s.w.g. enamelled wire. To tune up the u.h.f. sound adjust L28, the 6MHz oscillator coil beside the EH90.

MURPHY V530

Adjusting the line hold control results at best in two pictures side by side. There is insufficient width and pincushion distortion some of the time. The sound quality is also only fair.—G. Burnhill (Peterborough).

A common cause of your troubles is low h.t. due to a worn mains rectifier. Change this. Then check the 30P4 line output valve as this may be low emission. Also check the value of the 150pF coupling capacitor from pin 6 to pin 2 of the 6/30L2 line oscillator valve.

McMICHAEL MT762

After adding a u.h.f. tuner this set gave perfect performance on both systems. However although the sound has remained OK the picture gradually deteriorated until it is now rather faint with poor definition. The vision strip valves and voltages are all OK. The fault is common to both systems.—P. Larkin (Maidstone).

We are inclined to suspect the tube first anode supply (pin 3 of the tube base). This supply is derived from the boost line via a 390kΩ resistor which is decoupled to the h.t. line by an 0·1μF capacitor. If the voltage at pin 3 is little higher than the 200V h.t. rail change this capacitor.

PHILIPS 19TG170A

The width is inadequate and the sound distorted although the height is sufficient. When the brilliance is reduced the width increases.—G. Cox (Leamington).

The width trouble is normally due to the two 8·2MΩ resistors above the preset width controls (lower right) on this model changing value. Apart from this the PL500 (PL504) line output valve may be loosing emission. The distorted sound is probably due to the PCL82 audio valve being faulty, but you should also check its 470Ω cathode bias resistor and the 2·7MΩ resistor (R234) connected to pin 9 (triode anode).

HMV 1893

There is lack of field hold and reduced height. The picture becomes steady after the set has been on for a few minutes but the line hold is then very critical. The field timebase and video/sync valves have been replaced.—J. Burns (Deal).

The reduced height and field roll are due to the 22kΩ load resistor R113 of the ECC82 section of the field multivibrator stage changing value. The poor sync is most likely to be due to a fault in the video stage and we suggest you check the value of the bias stabilising resistor R55 (47kΩ) and the bias electrolytic C54 (50μF).

BUSH TV125

On 405 the picture displays considerable overshoot with definite deterioration of the bandwidth. On advancing the contrast control the trouble is aggravated while parts of the picture tend to pull to the right. The picture on 625 is OK in every respect. No amount of careful tuning helps. The video amplifier and its anode load resistor and the tuner unit valves have been replaced.—G. Duneven (Porchester).

This chassis uses separate vision detector diodes for the two systems. On 405 the detector is 2MR1, with 2MR4 as noise limiter. You will have to check all the components associated with these diodes—the diodes themselves, the small capacitors and resistors and the coil connections.

DECCA DR123

The sound and picture are OK except that there is pulling from side to side on the picture, vertical lines being wavy and bent. The video and vision i.f. valves have been changed.—R. Thomson (Tring).

Line synchronisation on this as in most Decca sets is controlled by an ECL80 phase comparator valve, V15 on this model. Change it.

INVICTA 7193

The picture suddenly faded away as though the set had been switched off although the sound remained perfect. The line output stage valves have been replaced but there is still no e.h.t.—C. Speer (Crewe).

Check the right-side PCL84, the triode section of which is the line oscillator, and the 0·01μF coupler C87 from this to the line output valve. Check the boost capacitor C97 (0·1μF). The line output transformer could unfortunately be suspect.

QUERIES COUPON

This coupon is available until April 17, 1972, and must accompany all Queries sent in accordance with the notice on page 280. Don't forget the 10p postal order!

TELEVISION APRIL 1972

TEST CASE 112

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 portable receiver fitted with the Thorn 950 chassis was brought in by the field technician with the complaint that after about thirty minutes operation the bottom of the picture would start to creep up, ultimately leaving a gap of about a couple of inches at the bottom of the screen. The technician had tried a replacement field output pentode at the customer's home, but to no avail. He had also removed the field circuit subchassis and visually investigated the components, being aware that a scorched resistor with changed colours often signified an open-circuit or changed value, but in this case there was nothing to indicate the whereabouts of the fault.*

In the workshop the valve and its cathode resistor were checked first of all but both were clear of trouble. It was noticed though that as the bottom contraction increased a degree of correction was possible by operating the height control, the control eventually being at maximum setting.

At this point the technician switched off, removed a field timebase component and found that the height was excessive when next switching on. Readjustment corrected this and protracted running indicated that the fault condition no longer existed. The technician then fitted a new component in place of that previously removed, once more readjusted the height and finally made sure that the set worked normally for several hours before conveying it to the delivery bay. What was the most likely cause of the trouble and the component responsible? See next month's TELEVISION *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 111

Page 235 (last month)

The resistor was a 1·2MΩ one in series with the height control and had increased in value. Older sets are very susceptible to change in potential at the field oscillator anode, the effect being first a reduction in height and then non-linearity.

The Ekco T433 series chassis employs a high-level contrast control in the video amplifier output circuit. Thus overloading (leading to crushing on whites) as a result of high input drive cannot be corrected by this control. A preset contrast control is however provided to take care of this situation and was the control adjusted by the technician.

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