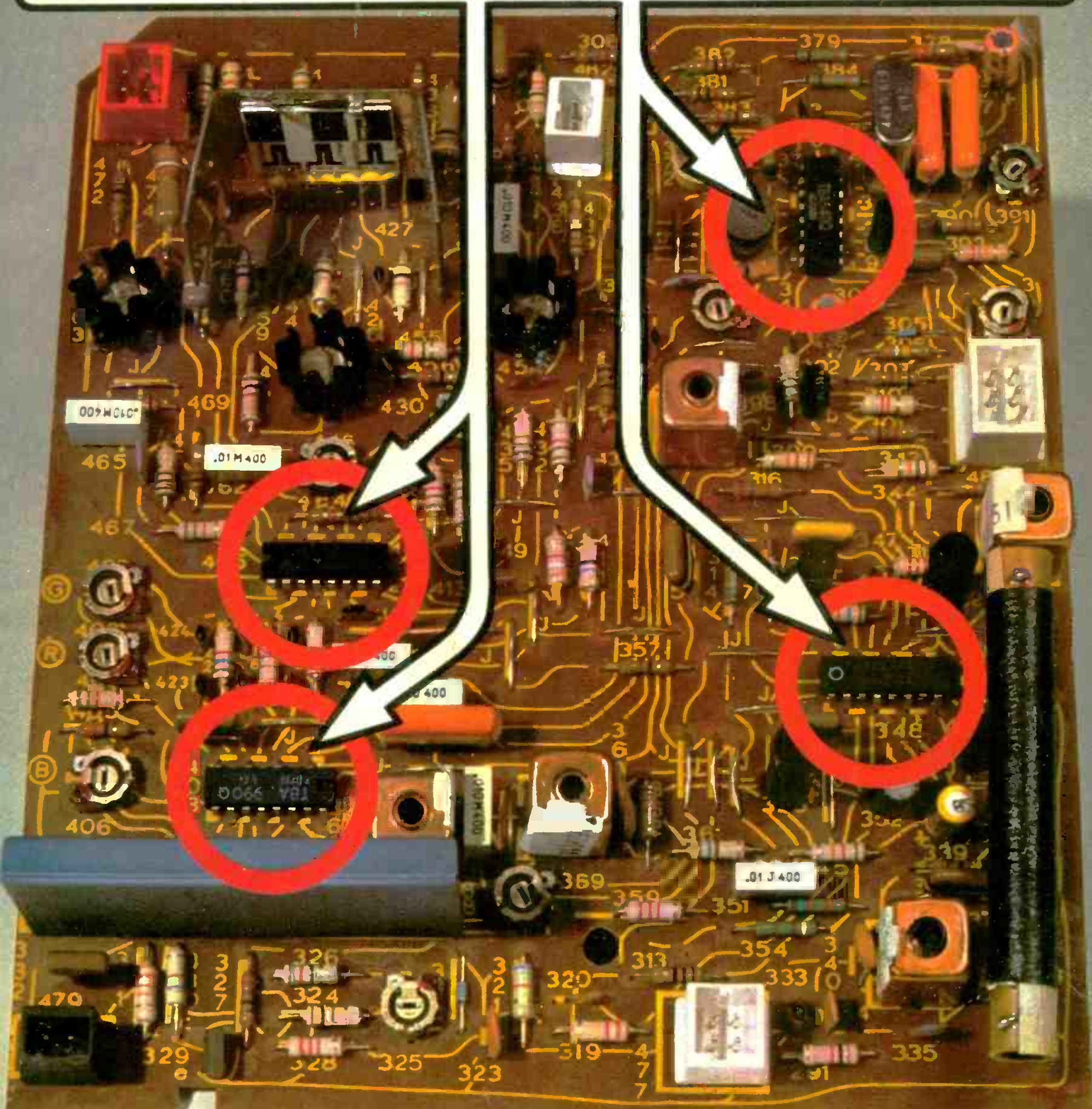
TELEVISION

20p

SERVICING · CONSTRUCTION · COLOUR · DEVELOPMENTS

SEPTEMBER 1973

Coping with ICs



ALSO:

DEALING WITH DROPPERS

TRANSISTOR FLYWHEEL SYNC UNIT

Still waiting for spares Tom?
You should have phoned

WHEREVER YOU ARE FOR BY RETURN DESPATCH. WILLOW VALE IS AS NEAR AS YOUR PHONE......

WILLOW VALE

The Wholesaler who knows what SERVICE is really about!

BY RETURN DESPATCH:- **HOT LINES: 01-567 5400/2971**

L.O.P.T's, TRANSISTORS, RECTIFIER TRAYS, COMPONENTS MONOCHROME and COLOUR C.R.T's, new and re-built.
HUGE RANGE OF VALVES up to 46% DISCOUNT

A FULL RANGE OF TEST - METERS, SERVICE AIDS, TOOLS, ELECTROLUBE and Servisol products. Multicore solders, plugs and sockets, capacitors, bias and smoothing electrolytics, volume controls, pre-sets, ½, 1 and 2 watt carbon film res.

We SPECIALISE in supplying the Service Engineer

Test equipment by : Labgear, Philips, Meteronic etc. Colour bar & Pattern generators, oscilloscopes & meters

68 PAGE CATALOGUE FREE ON REQUEST

Hot line orders:- **willow vale**
The Service Department Wholesalers

LONDON: 4/5 The Broadway · Hanwell · London W7 · 01-567 5400
GLASGOW: 74 Maxwellton Road · Paisley · 041-887 4949
SOMERSET: 42 West End · Street · Somerset · 045-84 2597

I would like a free copy of your catalogue:

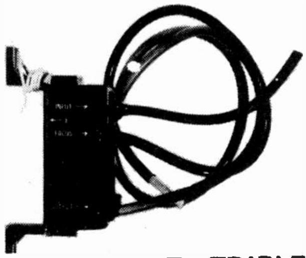
Name ______________________

Address ______________________

____

SOUTHEND ELECTRONICS

COLOUR 25 KV TRIPLERS



REPLACEMENT TRIPLERS
£1.70 + 17p VAT

PYE CT 72 SERIES
GEC 2028 SERIES
£3.00 + 30p VAT

200 + 200 + 100 + 32
X 80/150 D
70p + 7p VAT

E.H.T. RECTIFIRE STICKS
10p + 1p VAT

TRANSISTOR UHF VHF
Tuner Units
£3.00 + 30p VAT

SIX PUSH BUTTON UHF
Tuner Units
£4.00 + 40p VAT

SIX PUSH BUTTON
UHF VHF Tuner Units
£4.00 + 40p VAT

100 MIXED W/W RESISTORS
£1.00 + 10p VAT

300 MIXED RESISTORS
£1.00 + 10p VAT

250 MIXED CONDENSER
£1.00 + 10p VAT

40 MIXED POTS
£1.00 + 10p VAT

G6 SINGLE STANDARD CONVERGENCE CONTROL PANEL INCL. 16 CONTROLS SWITCHES ETC & CIRCUITS
£5.00 + 50p VAT

SOUTHEND ELECTRONICS
240 Rayleigh Road, Eastwood,
Leigh-on-Sea, Essex.
P.P. Paid U.K. Only
NO PERSONAL CALLERS, PLEASE

A. MARSHALL & SON (LONDON) LTD.,

SEMICONDUCTOR SPECIALISTS
42 CRICKLEWOOD BROADWAY, LONDON, N.W.2
Telephone: 01-452 0161/2 Telex: 21492 Cable: Coninst London
NEW LOW PRICES LARGEST RANGE BRAND NEW FULLY GUARANTEED

★

We Supply
COMPLETE KITS for the following units:

Television Kit No. 1 **£8.42**
PAL Decoder

Television Kit No. 4 **£8.26**
I.F. Strip

Television Kit No. 8 **£6.66**
R.G.B. Board

Television Kit No. 10 **£7.50**
Time-Base

SPECIAL OFFER
Recording Tapes Standard Play
$10\frac{1}{2}$" 2,400ft. £1.25 to clear
Package & Posting 20p

100-watt Guitar Amplifier—complete kit with case and all components **£23.50**

"SCORPIO"
Capacitor discharge ignition system (as described in *Practical Electronics*, Nov. 1971).
COMPLETE KIT £10.00 P. & P. 50p.

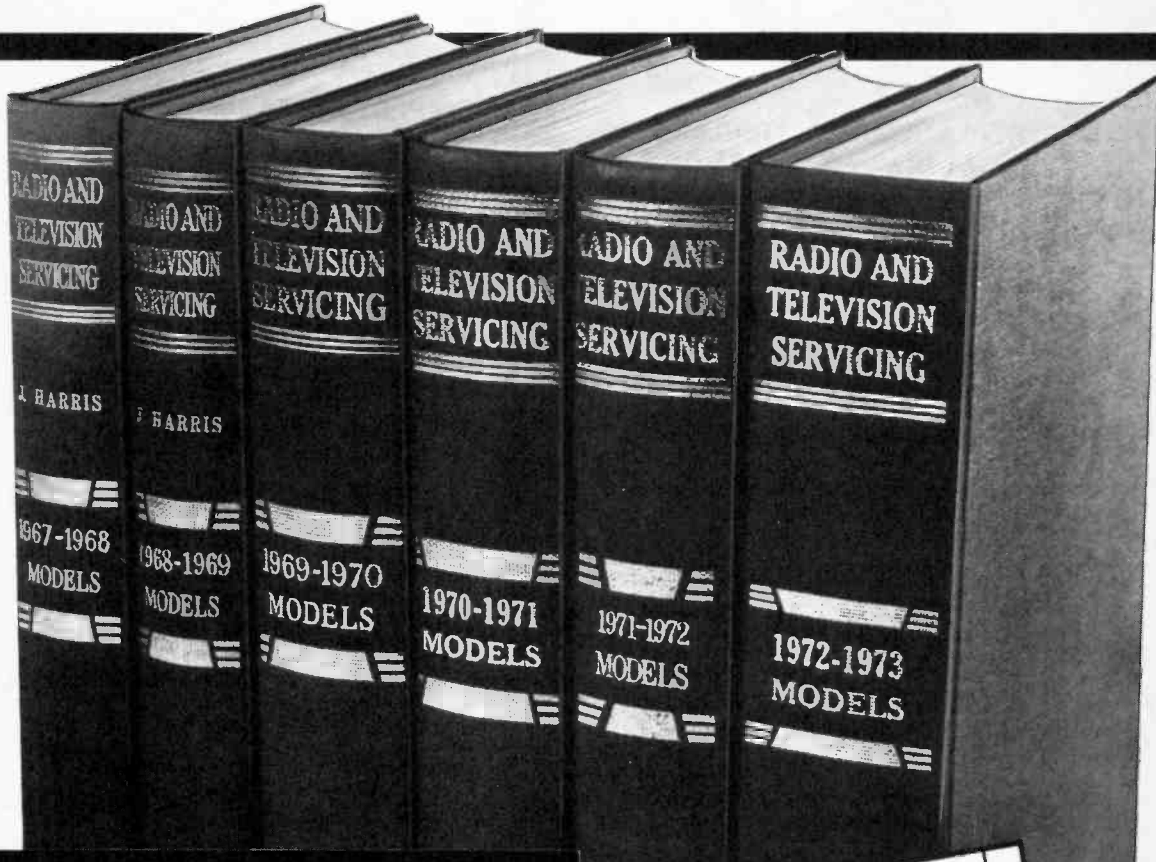
We Stock Full Range of:

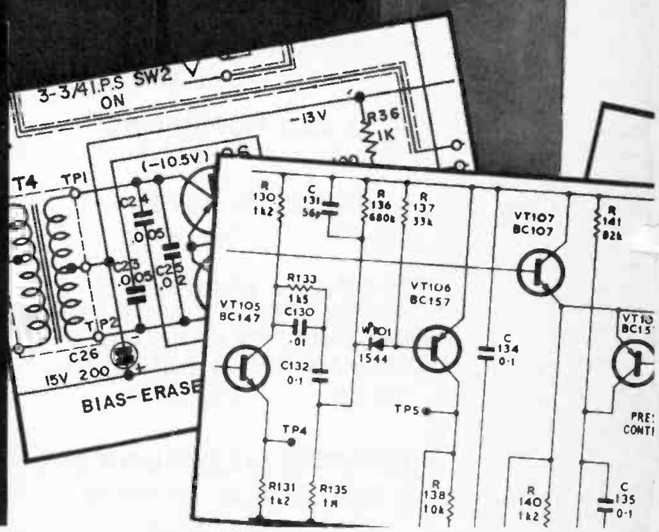
Motorola consumer I.C.s
RCA Cos-Mos
Signetics popular I.C.s

★

ALL PRICES EXCLUSIVE OF V.A.T.

RADIO & TV SERVICING





Essential data for over 1500 popular models

With this vast 6-volume library at your fingertips you have all the necessary servicing data you need covering almost every popular model from 1967 to the very latest on the market today. And not only radio and TV but stereograms, record players and tape recorders too. Much of the earlier information on this equipment is quite unobtainable elsewhere and *Radio & TV Servicing* is now the only available source of technical data. The 1973 edition, now ready, brings the library right up-to-date with abstracts from manufacturers' service bulletins issued during the past year. *Radio & TV Servicing* is the only work of its kind – a money-spinner that no service engineer should be without.

6 volume library '67-'73 is now ready

the only work of its kind anywhere

Speedier, more efficient servicing means increased turnover . . .

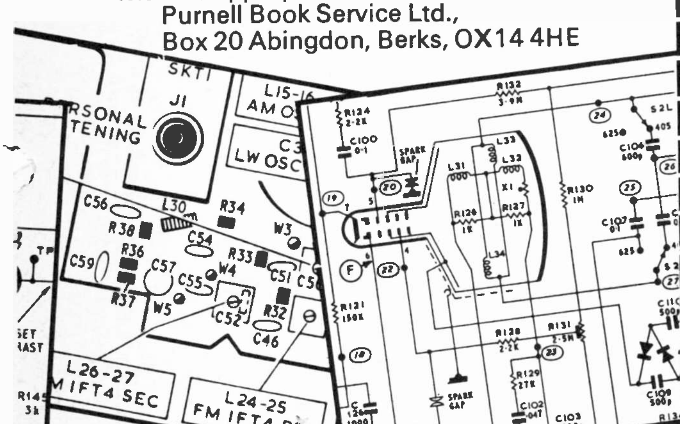
This library is a gold-mine of technical information. Six hard-bound volumes giving vital data on more than 1500 models of Television (colour and mono), Radios, Car Radios, Stereograms, Record Players and Tape Recorders. More than 4000 pages clearly display thousands of circuits, printed panel diagrams, component layout diagrams, waveform graphs, block diagrams, etc. Over 800 pages, devoted entirely to Colour TV, include installation instructions, new term explanations, purity adjustments, colour balance, static convergence and a wealth of invaluable information. Here, in fact, is all the data you need for efficient and speedy repair work.

Your Guarantee

Sending for these valuable books, even though you also enclose your remittance, commits you to nothing. Unless you are absolutely satisfied you are perfectly free to return the set and if you do so within 10 days of delivery your money will be refunded in full and without question.

How to get your 6-volume set

Detach the Order Form below and send it, with the appropriate remittance to:
Purnell Book Service Ltd.,
Box 20 Abingdon, Berks, OX14 4HE



Makes of Colour TV include:
Alba, Baird, Bang and Olufsen, B.R.C., Bush, Decca, Dynatron, Ecko, Ferguson, Ferranti, G.E.C., Invicta, H.M.V., Marconiphone, I.T.T./K.B., Masteradio, Murphy, Philips, Pye, Sobell, Stella, Ultra, Hitachi, Thorn Consumer Electronics, Korting, R.G.D., Sony, Telefunken.

All these makes of Mono TV, Radios, Car Radios, Stereograms, Record Players, Tape Recorders:
Aiwa, Alba, Baird, Bang and Olufsen, Beogram, Beolit, Blaupunkt, B.R.C., Bush, Cossor, Crown, Dansette, Decca, Defiant, Dulci, Dynatron, Eddystone, Ecko, Elizabethan, Ferguson, Ferranti, Fidelity, G.E.C., Grundig, Hacker, Halcyon, H.M.V., Hitachi, Invicta, I.T.T./K.B., JugoElektra, Klinger, Loewe Opta, Marconiphone, Masteradio, Monogram, Murphy, National, Nivico, Perdio, Peto Scott, Philco, Philips, Portadyne, Pye, Radiomobile, Radionette, R.G.D., Roberts' Radio, Robux, Sanyo, Sharp, Sobell, Sony, Standard, S.T.C., Stella, Stereosound, Telefunken, Teletron, Thorn, Sanyo, Ultra, Unitra, Van Der Molen, World Radio, Thorn Consumer Electronics, Elpico, Rigonda (USSR), Waltham.

Plus such developments as:
Mullard Integrated Units, Electronic Video Recording and Reproduction – EVR system, Radio Receivers – Car radios, Stereo Multiplex reception, Capacitance Diode Tuning, Colour Television Test Equipment – Crosshatch Generator, Degaussing Coil, E.H.T. Meter, Colour Bar Generator, Cathode Ray Oscilloscope, Power Supply requirements, Alignment, Circuit design.

To: Purnell Book Services, P.O. Box 20, Abingdon, Berks OX14 4HE

Please send me the 6-volume set of RADIO & TV SERVICING for which I enclose cheque/P.O. No.________ crossed and made payable to Purnell Book Services Ltd.

for the full cash price of £27.75 ☐ tick

for £10 deposit to be followed by 4 successive monthly payments of £4.75 (total £29) ☐ appropriate box

I understand that unless I am entirely satisfied I may return the volumes in good condition within 10 days and my money will be refunded in full.

BLOCK LETTERS PLEASE

Name________

Address________

____

TRADE APPLICATION (To be accompanied by Trade Order)

Please supply______6-volume set(s) of RADIO & TV SERVICING at £27.75 per set. (Credit 30 days)

BLOCK LETTERS PLEASE

Name________

Company________

Signature________

IMPORTANT: Individual volumes are available on application.

Please return entire form. Available U.K. only 024

Purnell Book Services Ltd. Reg London 958963, 49 Poland St., London W1

WITWORTH TRANSFORMERS

TV Line out-put transformers

(Discounts to Trade)

ALL ONE PRICE
£5.17 EACH V.A.T. & CARRIAGE PAID

ALBA

T1090	T1435
T1095	TD1420
T1135	TD1435
T1195	TD1824
T1235	TS 1320
T1395	TS 1724

BAIRD

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

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

COSSOR

CT1700u	CT1975a	CT1962-77*
CT1910a	CT1976a	CT1954-77*
CT1911u	CT2100u	CT1964-78*
CT1921a	CT2310a	
CT1922a	CT2311a	
CT1935a	CT2321a	
CT1937a	CT2331a	
CT1938a	CT2372a	
CT1972a	CT2373a	
CT1973a	CT2375a	
CT1974a	CT2378a	

*Two types fitted one has pitch o/w, the other has plastic moulded overwind—please state which type required as they are not interchangeable.

BUSH

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

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

PYE

1
2
3 or u

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

5P17	62
21f or uf	63
22uf	64
23uf	68
24uf	75
31uf	76
35uf	77
36	80
37	81
40f	83
48	84
49	85
53	86
58	95
59	96
60	
61	

PV110 — State Pt. No. required—771980 or 772013
V110

V210 or A
V220
V410 or A — State Pt. No. required—771927 or 771920
V420A
V430A
V510
V530

V200 or LB
V300s
V310 or s
V400
V600
V620
V630

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

PHILLIPS

1768u
1792u — Exchange Units
1796u
2168u
2192u
2196

17TG100	19TG122a
17TG102	19TG123a
17TG106	19TG125a
17TG200	19TG133a
17TG306	19TG142a
19TG108u	19TG148a
19TG111a	19TG152a
19TG112u	19TG153a
19TG114u	19TG154a
19TG116u	19TG155a
19TG121a	19TG156a
19TG178	19TG158a
19TG179	19TG164a
	19TG170a
	19TG171a
	19TG172a
	19TG173a
	19TG175a
	19TG176a
	19TG177a

21TG100u	G19T210	G23T210
21TG102u	G19T211	G23T211
21TG106u	G19T212	G23T212
21TG109u	G19T213	G24T230
23TG107u	G19T214	G24T232
23TG111a	G19T215	G24T236
23TG113a	G20T230	G24T238
23TG121a	G20T232	G24T300
23TG122a	G20T236	G24T301
23TG131a	G20T238	G24T302
23TG142a	G20T300	G24T306
23TG152a	G20T301	G24T307
23TG153a	G20T302	G24T308
23TG156a	G20T306	
23TG164a	G20T307	
23TG170a	G20T308	
23TG171a		
23TG173a		
23TG175a		
23TG176a		
23FG632		

ALL MAKES OF COLOUR TRANSFORMERS IN STOCK

KB

PVP20	QV30 (90°)	WV90	SV20	KV055	KV136
WV05	QV30FM (110°)	MV100/1	SV30	056	138
KV001	QV30-1	OF100	SV042	065	155
KV002	30	PV100	SV048	066	156
KV005	NV40	KV101	SV054	113	165
KV006	NF60	KV105	SV142	114	166
RV10	RV60	KV107	SV143	124	
O15	WV60	115	SV148	125	
TV15	XV60	117	MV818	126	
O17	NF70 or FM	119	MV819	127	
QV20	PV70	KT400A } VC1 or VC2	MV903	134	
WV20-1	QV70				
RV20	RV70	KT405A }			
TV20	VV70	by chassis No.—			
WV20	WV70	VC1 VC4 VC52	VC200		
QVP20	WV75	VC2 VC5 VC53			
OV30	QF80	VC3 VC51 VC100			

MURPHY

V310	V430	V520	V879 or C*	V789	V2015SS
V310A	V430C	V530	V923*	V153	V2016S
V310AD	V430D	V530C	V939 or L*	V159	V2017S
V310AL	V430K	V530D	V973C*	V173	V2310
V310CA	V440	V539	V979*	V179	V2311C
V320	V440D	V540	V653X	V1910	V2414D
V330 or D	V440K	V540D	V659	V1913	V2415D
V330F or L	V470	V649D	V683	V1914	V2415S
V410	V480	TM2 Chassis	V739	V2014	V2415SS
V410C	V490	V843*	V753	V2014S	V2416D
V410K	V500	V849*	V783	V2015D	V2416S
V420	V510	V873*	V787	V2015S	V2417S
V420K	V519				

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

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

E.H.T. RECTIFIER TRAYS

Suitable for: FERGUSON, ULTRA, MARCONI, H.M.V.

Series	Series	Series	1500 Series
850	950 MKII	980	3 stick £3.52 each
900	960	981	5 stick £4.29 each
911	970	982	
950 MKI	1400		When ordering, model number and series must be quoted.
£3.52 each	£4.29 each	£3.52 each	

(Prices include Carriage & V.A.T.)

FIXING: Direct BRC replacement, will clip into existing transformer.

GEC

BT302	BT314	BT321	BT336	BT449	2000	2015	2022	2043	2064
BT303	BT315	BT322	BT337	BT450	2001	2017	2023	2044	2065
BT304	BT316	BT324	BT342	BT451	2010	2018	2032	2047	2066
BT305	BT318	BT326	BT346	BT452	2012	2019	2033	2048	2082
BT308	BT319	BT328	BT347	BT455	2013	2020	2038	2063	2083
BT312	BT320	BT329	BT448	BT456	2014	2021	2039		

DECCA

DR20	DR34	DR71	DR505
DR21	DM35	DR95	DR606
DR23	DM36	DR100	666TV-SRG
DR24	DM39C	DR101	777TV-SRG
DR29	DR41	DR121	
DR30	DM45	DR122	MS1700
DM30	DR49C	DR123	MS2000
DR31	DM55	DR202	MS2001
DR32	DM56	DR303	MS2400
DR33	DR61	DR404	MS2401

SOBELL

T24	ST284 or ds	1010dst	1033
SC24	ST285 or ds	1012	1038
TPS173	ST286 or ds	1013	1039
TPS180	ST287 or ds	1014	1047
ST195 or ds	ST288ds	1018	1048
ST196 or ds	ST290ds	1019	1057
ST197ds	ST291ds	1020	1058
SC270	ST297ds	1021	1063
T278	1000ds	1022	1064
ST282	1002ds	1023	1065
ST283	1005ds	1032	1066

EKCO

TC403	TC437	T513	531
404	T442	514	T532
406	T500	515	533
T418	TC501	520	535
TC419	T502	521	536
T420	503	524	540
TC421	504	525	541
T422	505	526	
433	506	527	
434	510	528	
TC435	511	529	
T436	512	530	

FERRANTI

1075	TC1122	1163	1155	1175
1080	1123	1164	TC1157	1176
1081	1124	1165	1158	T1181
1082	1125	T1174	1159	T1182
1083	TC1126	T1175	TC1160	T1185
1093	1137	TC1135	1162	T1186
1094	T1154	1136	1163	
1095	T1155	1137	T1164	
1096	1157	1138	T1165	
1097	1159	1140	1173	
1121	1160	T1154	1174	

SPECIAL

L.O.P. Transformer as specified for "Television" Colour Set only.
£5.17 ea. V.A.T. & Carriage Paid

Every item listed stocked. Many newer and older models in stock. S.A.E. for quotation

For by-return service contact your nearest depot.

Tidman Mail Order Ltd., Dept. NA.	Hamond Components (Midland) Ltd., Dept. NA.
236 Sandycombe Road,	89 Meriden Street,
Richmond, Surrey.	Birmingham 5.
London: 01-948 3702 or 01-940 8146	Birmingham: 021-643 2148

TELEVISION

SERVICING·CONSTRUCTION·COLOUR·DEVELOPMENTS

VOL 23 No 11
ISSUE 275

SEPT 1973

ON RECORD

A considerable upsurge of interest in domestic video systems is expected in the near future. Much work has been carried out over the past few years in developing video recording systems for both broadcast studio use and for home entertainment purposes. But the by now only to be expected slow rate of development by British companies is likely once again to hand this new market when it opens up to American and Continental concerns. This is particularly regrettable in view of the fact that UK concerns were amongst the first, some years ago now, to try to bring video recording into the home.

Steady development on the continent combined with shrewd commercial judgement and a market which is enthusiastic towards new ideas look as if they will shortly pay off. Videocassette machines are already in quantity production there and the Germans at any rate are convinced that with increased groove density and electronic multiple picture processing in colour the videodisc is here to stay.

The "AV" (audiovisual) socket into which recorded video signals can be fed is already becoming a feature of continental receivers. As a further refinement stereo sound can be provided with videocassette systems though advantage has not been taken so far of this possibility.

The videodisc does not offer the domestic user recording facilities, but it does open up a whole new method of off-the-shelf home entertainment at a reasonable cost, side by side with the conventional gramophone record.

A scheme of standardisation is being undertaken by the DIN organisation and the International Electrotechnical Commission for half-inch tape videocassettes which are already interchangeable between various continental machines. It is expected that the Japanese will shortly be included in this scheme.

At the moment the UK appears, as so often, to be standing on the sidelines. Thorn at least are understood to be producing videocassette machines in fair numbers, exclusively for business and educational purposes at present. It seems to be the will to get out and do some marketing that is really lacking here.

M. A. COLWELL—*Editor*

THIS MONTH

THE NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED OCTOBER 5

Cover: Our cover photograph this month features the decoder panel, including the RGB output stages, used in the recently introduced **Pye** Model CT200 (713 chassis). Most of the decoding operations are carried out in the four 16-pin i.c.s. Our thanks to Pye of Cambridge for arranging to lend us this board for photographic purposes —see note on page 487.

© IPC Magazines Limited 1973. Copyright in all drawings, photographs and articles published in "TELEVISION" is fully protected and reproduction or imitation in whole or in part is expressly forbidden. All reasonable precautions are taken by "TELEVISION" to ensure that the advice and data given to readers are reliable. We cannot however guarantee it and we cannot accept legal responsibility for it. Prices are those current as we go to press. All correspondence intended for the Editor should be addressed to Fleetway House, Farringdon Street, London EC4A 4AD. Address correspondence regarding advertisements to Advertisement Manager, Fleetway House, Farringdon Street, London EC4A 4AD.

TELETOPICS

SOLID-STATE TV CAMERAS

An all solid-state colour TV camera—believed to be the world's first—has been designed and tried out by engineers at the Bell Telephone Laboratories. The incoming light is split three ways in the usual manner and then directed to three charge-coupled silicon sensing devices—each the size of a match head—which produce the three signals required for a colour TV system. While the camera is said to overcome the main problems associated with multi-pickup tube cameras—picture alignment, registration and colour fringeing—the camera has not so far achieved the resolution required for normal TV applications. The prototype camera measures 200 × 225 × 125 mm but versions small and light enough to be held in one hand are in prospect. Further development depends on how soon silicon charge-coupled device technology can achieve performance up to video requirements.

RCA are also developing a "wholly new kind of solid-state camera no larger than a cigarette package". A television display device consisting of a flat luminescent screen that can be hung on the wall is another project being worked on "high up on RCA's priority list" by RCA engineers. It is claimed that new technology has brought this goal considerably nearer.

MOS TRANSISTORS FOR TV USE

A series of m.o.s. field effect transistors manufactured by Signetics for use in u.h.f. and v.h.f. television tuners is being evaluated by European tuner unit manufacturers. There are two single-gate types (SD200 and SD201) which provide 10dB gain at 1GHz, with a noise figure at this frequency of 4.5dB, 0.13pF feedback capacitance and forward transconductance of 15,000μmhos; and two dual-gate types (SD300 and SD302) for use as mixers, providing 13dB gain at 1GHz with a noise figure of 6dB.

EUROPEAN INTERFERENCE STANDARD

Not satisfied with its decision to tell us what sort of beer we should all drink, the European Commission has now adopted a draft directive to harmonise the national laws of EEC members on the interference caused by radio and television sets. The aim is that only products conforming with a common standard could be marketed after a transition period to enable industry to adapt to the new rules; all equipment conforming to the common standard could be moved freely throughout the EEC with no national controls. The Commission points out that present laws concerning admissible interference tolerances, methods of measurement and so on vary widely. If the Commission succeed it will be following in the steps of the US Federal Communications Commission which has far wider powers than most organisations on this side of the Atlantic.

BBC ELECTRONIC TEST CARD

The BBC at present distributes Test Card F over programme circuits from London to all BBC transmitters. In order to make greater use of these programme circuits the BBC will in future be using an electronic test card from time to time in place of Test Card F. Details of this electronic test card have not so far been released but our guess is that it will be the PM5544 illustrated in this column last November. Its use will be almost exclusively on BBC-2 from transmitters outside London and the south east. There will be no regular schedule of its use which will be as occasion demands.

SINGLE-TUBE COLOUR CCTV CAMERA

A colour CCTV camera which uses a single camera tube has been introduced by Electrocraft Instruments Ltd. (Liss Mill, Liss, Hants.). The use of a single camera tube avoids the misregistration problems that occur with multi-tube cameras and gives ease of setting up, stability and minimal maintenance. There are only two main operational controls, red and blue level for colour balance. The video and black levels are automatically controlled. The camera measures a mere 10 × 3 × 3in.

NEW TV SETS

Three new models have been added to the **ITT/KB** range of colour receivers. These are the CK501 (20in.), CK602 (22in.) and CK702 (26in.) which are all fitted with the CVC5 chassis. Two 26in. colour models have been added to the **Dynatron** range: the Blenheim Model CTV15 is housed in a Queen Anne style cabinet and has a recommended price of £379; the Marlborough Model CTV17 is housed in a period reproduction style cabinet and has a recommended price of £399. Three models have been added to the **Marconiphone** range: Models 4715 (22in., £268) and 4717 (26in., £299) are colour sets with varicap tuners; Model 4831 is a 17in. mains only receiver at £76, again featuring a varicap tuner. **Brown Bros** have introduced a 9in. mains/battery monochrome portable called the "Starlet" at £55.52. **Decca** are to introduce a 15in. (Model MS1511) monochrome mains/battery portable later this year. Although television set sales appear to be stabilising at last nevertheless receivers still seem to be pouring in from all quarters: there are now two ranges of French made colour sets on the market and a range of Israeli made receivers has been announced.

AERIAL CODE OF PRACTICE

Details of the National Federation of Aerial Contractors' new Code of Practice which is already in operation have now been released. The Code has sixteen points which cover every aspect of domestic television aerial installation from the equipment that riggers should carry through exact installation methods to the correct way of dealing with the customer. An NFAC executive will "drop in" on at least two member firms a week and select four or five recent jobs from the work sheet for detailed inspection. Spot checks are also being carried out on members vans to ensure that the recommended equipment is being carried. Installation engineers covered by the scheme are required to carry identity cards and the Federation is investigating ways of ensuring the security of these. All installations carried out by member firms must be given a year's guarantee against defective materials and faulty workmanship and the Federation is underwriting these guarantees so that they will be implemented in cases where a firm ceases to trade.

99% UHF COVERAGE?

Following our recent comment about the many different prospective u.h.f. service coverage figures being bandied about, the IBA have now suggested that it may prove possible in practical terms to provide a u.h.f. service covering up to 99% of the population. This optimistic estimate is based on detailed measurements made by the IBA in areas shown as unserved pockets in the official transmitter coverage maps. The IBA comments that earlier estimates of likely total u.h.f. coverage were based on rigid interpretations from conservatively drawn transmitter coverage maps whereas with a reasonably good aerial installation satisfactory u.h.f. pictures can often be obtained in the so-called "gap" areas.

REPLACEMENTS FROM BEST

Best Electronics (Slough) Ltd. have been appointed authorised distributors for Plessey consumer integrated circuits and ITT consumer semiconductor spares. The following Plessey i.c.s. with direct equivalents indicated, are available:

Plessey i.c.	*Equivalent*	*Function*
SAA570	TAA570	Intercarrier sound channel
SAA700B	TAA700	Jungle circuit (a.g.c., sync, etc.)
SBA550B	TBA550	Jungle circuit
SBA750A	TBA750	Intercarrier sound channel

Amongst ITT semiconductor devices available from Best are the BF121/3/5/7 range of r.f. transistors, BT106 thyristor, BC170/1/4 plastic encapsulated transistors, a comprehensive range of zener diodes for TV set use, the BF257/8/9 range of video output transistors and the ZTK33 i.c. voltage stabiliser (in a, b and c grades) which is an equivalent to the TAA550. Enquiries to Best Electronics (Slough) Ltd., Michaelmas House, Salt Hill, Bath Road, Slough, Bucks. SL1 3UZ.

NEW COLOUR PICKUP TUBE

A new colour camera pickup tube called the Staticon has been developed by NHK (Japan). Instead of using a lead-oxide photocathode as in the Plumbicon the new tube uses a glass semiconductor photocathode made of a mixture of selenium, arsenic and tellurium. NHK have also shown a prototype single-tube colour camera using the Staticon: a cross-type filter consisting of yellow and cyan stripes is used to produce the colour signals along the lines described in our article on *Single-Tube Colour Cameras* in the June issue.

OPTIONAL CAPTION TRANSMISSION

A system of transmitting captions—text messages on the screen—has been produced in prototype form by the Swedish Telecommunications Administration (Televerket). This would enable the deaf or immigrants not familiar with the language of a country to follow programmes. Full details have not so far been released but it would appear that this is an arrangement in which the f.m. sound signal is amplitude modulated by the caption information, a technique which has been unsuccessfully tried before. An adaptor to separate the message and convert it into a video signal for display on the screen has been devised and from its size ("about the size of a matchbox") would appear to be based on the use of i.c.s—the availability of complex i.c.s at reasonable prices seems to be making all sorts of innovations possible as readers of this column will be increasingly aware. The system is sufficiently versatile to enable up to four independent texts, say in four different languages, to be transmitted, with optional reception of the various captions available.

SECOND LOCAL CABLE TV NETWORK

The second UK local cable TV network is now in operation. This is Rediffusion's set-up at Bristol which will initially provide a service to 23,000 homes with 15 hours of programming a week.

RCA TO MARKET SELECTAVISION

RCA are to start pilot marketing of their SelectaVision magnetic videotape equipment in the US towards the end of the year. The basic video player/recorder will be supported by an optional hand-held monochrome camera and a library of programmes for rent or sale, including feature films, sports events, documentaries, instructional "how-to-do-it" items etc. The basic machine is expected to have a recommended price of about $795 while the camera is expected to be priced at about $300. The equipment will be marketed nationally in the US later next year and if successful RCA may introduce it in the UK.

PYE CT200 DECODER BOARD

The printed circuit board featured on our cover this month is the decoder/RGB output panel from the latest Pye colour chassis (the 713 chassis) used in their 18in. Model CT200. The entire decoding circuitry—which uses four i.c.s—and the RGB output stages are incorporated on this board which is just $7\frac{7}{8} \times 6\frac{7}{8}$in. Yet the layout is quite open with easy access to all components. Interesting features of the board in addition to the complement of i.c.s are the use of a small multi-reflection type chrominance delay line and a thick-film assembly of load resistors (visible at top left) for the RGB output stages. These resistors are mounted on a sizeable heatsink and should certainly result in stable RGB output stage operation. We were surprised at the light weight of the set—little more than the average large monochrome receiver. Our thanks to Pye for lending us the board and to their advertising agents in London, M.S. and B. Advertising Ltd., who allowed us in something of a hurry to come along and pull their specimen set to pieces!

receiver debugging

E. J. HOARE

PART 2 SYNCHRONISATION ; PICTURE DISTURBANCES

TROUBLE-SHOOTING in a newly constructed television receiver is always a fascinating and rather tricky process. One inevitably learns a great deal because the problems are never the same: new performance peculiarities crop up every time you build a receiver. They tend to fall into two categories: those due to simple errors of wiring and choice of components, and others caused by defects in design or unwanted interaction between different circuits resulting in degradation of the overall performance.

It is the second category in which we are primarily interested here, and last month we discussed a number of problems associated with the c.r.t. display. We dealt with c.r.t. electrode voltages, flyback blanking, and several areas in the field and line timebases which commonly cause difficulties. Assuming that you now have proper field and line scanning we turn next to other aspects of timebase performance, with particular reference to synchronisation.

Line Synchronisation

Any fault in line synchronisation shows up on the picture as a horizontal displacement of one or more scanning lines from their correct position. In our assessment of TV receiver performance (see previous series) we listed several common defects such as tearing, squaring, hooking and wriggle. These terms slip off the tongue rather nicely, but in practice the faults they describe can be quite difficult to cure.

Tearing

Take tearing for example. This is the case where individual scanning lines are displaced to the left or right of their correct positions so that vertical lines of the picture are ragged instead of being clean and smooth. This is normally caused by electrical noise distorting or even blotting out completely individual sync pulses so that the line oscillator is triggered at the wrong instant in time or on some lines is not even triggered at all.

Line generators fall into two categories: those which are directly synchronised and those with flywheel sync. In directly synchronised types the oscillator is triggered on each line by an individual sync pulse. If this pulse is distorted or absent then clearly the line flyback cycle will begin at the wrong instant and the next line will start too early or too late. Hence the displacement.

This type of generator is not much used now but was common on older designs because of the savings in components. Its performance under fringe conditions is not particularly good but it can often be improved by integrating the sync pulse with a short time-constant *RC* network. All you have to do is to connect a capacitor between the feed point and chassis. In valve circuits the value will usually be around a hundred picofarads. It turns the square sync pulse into a curved triangular shape, and you apply as much integration as you can commensurate with retaining adequate hold range.

Integrating the sync pulse makes it smaller of course—hence the effect on the hold range—but the integration has much more effect on short noise pulses. The net result is a greater ratio of sync pulse to noise and this shows up as a marked improvement on the picture.

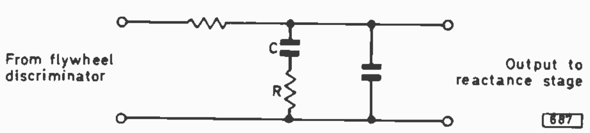


Fig. 1: Typical flywheel line sync filter network.

Flywheel Line Sync

This technique has to be applied in a different way to flywheel controlled line generator circuits. The oscillator generally has a tuned *LC* circuit which sets the basic frequency. Such circuits are controlled by applying a d.c. control voltage to a reactance stage which in turn alters the capacitance or inductance seen by the tuned circuit, thereby varying the oscillator frequency in sympathy with any changes of the d.c. control voltage. The d.c. control voltage is obtained by comparing the difference between the time of arrival of the sync pulses and that of the line flyback pulses.

The a.c. component at the output of this comparator circuit is smoothed (integrated) by an *RC* network having a carefully chosen time-constant and a damping resistor. This means that the oscillator is controlled by a voltage which represents the *average* error during a number of preceding sync pulses, not just one particular pulse. This is the flywheel effect, because if a sync pulse is missing for example (due to being blotted out by noise or interference) the effect on the average d.c. voltage is small.

Clearly we want to make the flywheel effect as large and effective as possible so that random pulse timing errors cancel out and the oscillator proceeds on its way undisturbed. If we make the *RC* time-constant too long however the pull-in range is small and the response time of the circuit too slow. Thus when you change channels the oscillator may take several seconds to pull into synchronisation with the new line sync pulse train. Also it may drift out of synchronisation as the circuit heats up.

A compromise is obviously needed, but your choice may be different from that of the original designer. Fig. 1 shows a typical flywheel *RC* network. Try increasing *C* by a factor of 2–4 times and then check the performance. You are looking for an improvement in tearing under noisy signal conditions, a slowing down in the rate of response of the circuit when you change channels, and a reduced pull-in range.

Now try changing *R* by a factor of ½–2 times and check again. You are looking for a slow response time in one case, and instability of the line sync in the other.

TV LINE OUTPUT TRANSFORMERS

ALL MAKES SUPPLIED PROMPTLY by our

RETURN OF POST MAIL ORDER SERVICE

All Lopts at the one price

£4.40 TRADE £4.95 RETAIL (INCLUDING V.A.T.)

Post and Packing 28p COD 33p

Except

BUSH MODELS TV53 to TV67 TV94 to TV101
EKCO MODELS TC208 to TC335, TV407 to TV417
FERGUSON MODELS 405 to 438, 506 to 546.
FERRANTI MODELS 1084 to 1092.
HMV MODELS 1876 to 1878, 1890 to 1896, FR 20.
MURPHY MODELS 653X to 789 OIL-FILLED
REGENTONE MODELS 10-4 to 10-21, 1718, R2, R3, 191, 192.
RGD 519—621, 710, 711.

ALL AT £2.75 + 28p P&P

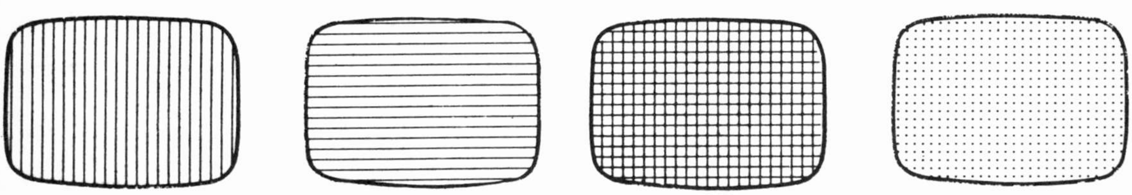
EHT TRAYS SUPPLIED – MONO & COL.

All Lopts NEW and GUARANTEED for SIX MONTHS

E. J. PAPWORTH AND SON Ltd.,
80, MERTON HIGH ST., LONDON, S.W.19

01-540 3955
01-540 3513

COLOUR TV



CROSS HATCH GENERATOR

Complete kit for Cross Hatch Generator as described in "TELEVISION" 1972 September issue

The only way to obtain 100% convergence of colour guns in any colour TV

£3.85
(inc 10% V.A.T)
COMPLETE KIT POST PAID

Please send me the free BI-PRE-PAK Catalogue ☐
Please send me kits of parts for Cross Hatch Generator ☐
I enclose cheque/P.O./M.O. for
Name
Address

BI-PRE-PAK LTD

DEPT. G. 222-224 WEST ROAD, WESTCLIFF-ON-SEA, ESSEX.
TELEPHONE: SOUTHEND (0702) 46344

Reg. No. 820919

If you do not mind having a slow response time the limiting factor in choosing your flywheel time-constant will be the frequency pull-in range. The amount you need is governed by the frequency stability of your line oscillator. If this is located in a very cool part of the cabinet, and good quality components are used, a pull-in range of about ±200Hz is quite practicable. This is considerably less than in many commercial designs, and the noise performance will be correspondingly better. It is simply a matter of choosing the compromise best suited to your own particular needs and preferences.

Squaring or Cogging

"Squaring" or "cogging" are terms applied to the rather tiresome defect whereby large portions of the picture are displaced sideways. On closer inspection it is found that these portions correspond to picture areas which either finish up at high brightness at the end of the scan (the right-hand side of the picture) or have a high average brightness throughout.

The first case is caused by inadequate response at the sync separator. This results in the sync pulses being delayed as shown in Fig. 2 so that the following line is displaced. Since a properly designed sync separator has plenty of bandwidth to spare the cause of this trouble is usually to be found elsewhere. The main thing to look for is extra capacitance at the input to the sync separator stage resulting from long leads, screened leads, plugs and sockets or a lead tightly encased in a cable harness.

The sync pulses can be distorted at an earlier stage of course, e.g. in the i.f. stages or more likely the video circuits. This however is more a problem of general servicing, where component value changes have upset the operation of a stage.

The second case arises when video information gets on to the line sync pulse train. This can happen if the clipping level at the sync separator is incorrectly set, but there are other ways. Picture areas of high brightness are caused by large excursions of the video signal. If this gets coupled into the sync circuits the level of the pulses will vary and therefore the instant in time when a certain triggering voltage is reached will also vary. This means that the oscillator will not fire at the correct instant and so the next line is displaced.

Video information usually gets into the sync processing stages by one of two means. The most common is probably airborne coupling between leads carrying the video output drive voltage—of up to 60V—and the sync circuits. The other is earth path coupling whereby the video output stage current of up to 20mA flows in an earth path which is also used by the sync separator. Thus voltages generated by this current flowing in the small resistance of a poor earth connection are injected into a high-gain pulse clipping stage. Inevitably the output is distorted.

Hooking

Hooking refers to bending of picture verticals at the top of the screen. Since it occurs only at the beginning of a field and nowhere else it can only be caused by something that happens during the field blanking interval. So what happens during field blanking? Answer—two things: field sync pulses and field flyback pulses.

Clearly if either of these are present in any form on the line sync pulse train the line timebase synchronisation will be disturbed. As we saw earlier it is likely that the line pulses will be of variable height due to this extra spurious information and the picture will be displaced. Field pulses, whether sync or flyback, can be coupled to the line sync by poor sync separator action; by airborne coupling from video, field deflection or field flyback leads; or by earth path coupling between any of these three circuits.

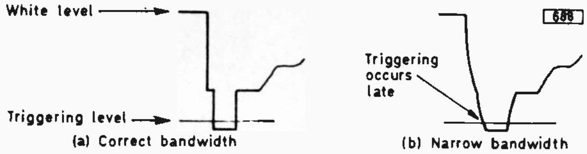


Fig. 2: Narrow bandwidth at the sync separator results in the line sync pulse being delayed when the video signal is at white level at the end of the line scan.

Wriggle

Flywheel line oscillators are notoriously prone to l.f. disturbances. Any component of mains hum superimposed on the sawtooth or fed into the reactance stage will appear on picture verticals. Since the transmitter is not synchronised to the mains on the 625-line system the verticals will sway slowly too and fro and you can see the mains hum travelling up or down the picture.

The flywheel loop involves several stages where phase changes can occur and has high overall gain. This provides the ideal circumstances for spurious oscillation or ringing. Any feedback of unwanted waveforms from outside the loop is liable to excite it and produce l.f. oscillations or rings on the line sync. This shows up as a sinewave displacement of the picture verticals which become wavy or "wriggly". Note that reactance stages are particularly prone to disturbance by even very small spurious voltages.

Field Synchronisation

Problems with field synchronising are similar to those in the line timebase with the exception that very few receivers are fitted with field flywheel synchronisation. An imported colour receiver is the only case that springs to mind.

With direct oscillator synchronisation the picture should be perfectly steady until either electrical noise or impulse interference distorts or swamps a sync pulse. When this happens the field will either bounce or roll over. If the disturbance continues the field oscillator will respond to the effect on each pulse and the receiver becomes unusable.

In most circuits it is possible to apply the same trick that we described in connection with the line oscillator, namely integration of the field sync pulse by means of a capacitor connected to chassis. The beneficial effects will be similar, as will the effect on the hold range. Be careful of the interlace however because the process of integration will enhance the effect of any line pulses present on the field sync pulse. This will result in the shape of the field sync pulse varying from line to line. In consequence the instant at which the oscillator triggers will vary. This in turn results in the spacing of the lines of alternate fields being different, giving rise to line pairing.

If you want to use a receiver under true fringe conditions, where the picture is very noisy and the field sync is inadequate, interlace is not important because you can't even see it properly! In this case the field sync pulse can be integrated quite heavily. The pulses will become smaller and rounded and the hold range will be smaller also, but the synchronising performance in terms of picture stability may be improved considerably.

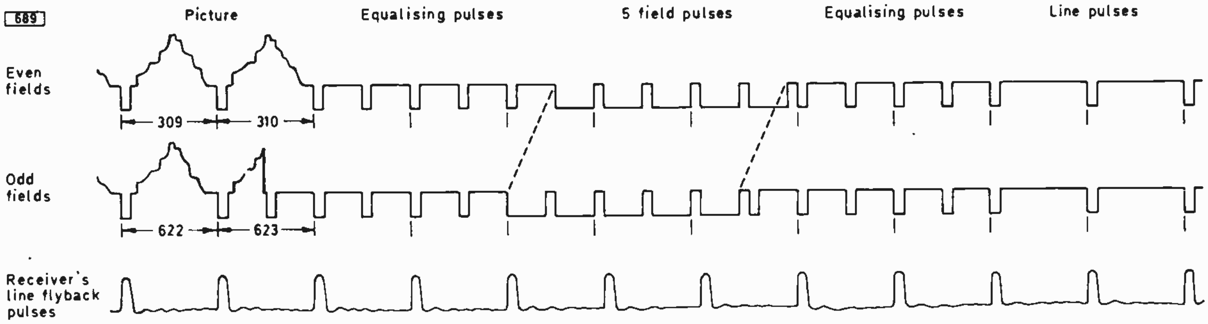


Fig. 3: The transmitted sync pulse train—625-line system. Note the half-line stagger of the field sync pulses on alternate (odd and even) fields.

Poor sync separator action may give rise to problems with interlace, field bounce (or jitter) and field twinning. In the latter case alternate fields are displaced by several lines and you get two complete fields spaced anything up to a quarter of an inch apart. The coupling in of various spurious pulses can produce the same effects in a similar way to that in a line oscillator.

Interlace

Reasonably good interlace is surprisingly important to the overall impression of good picture quality, particularly with larger c.r.t.s. A marked degree of line pairing gives the picture an appearance of lineyness and spoils the clarity of fine detail. It is not the pairing that people notice as such but its effect on the picture.

Difficulties with interlace arise from the fact that alternate fields are staggered by half a line, as shown in the illustration of the transmitted sync pulse trains for odd and even fields in Fig. 3. This means that the time of arrival of the line sync pulses, and hence the line flyback pulses also, relative to the field sync pulses varies from field to field.

The field sync pulse fed to the field oscillator is normally a composite pulse obtained by integrating the whole sync pulse train. The short line and equalising pulses give only a very small output from the field sync pulse integrating circuit but the five wide field pulses (625 line system) integrate into one quite large one. The equalising pulses before the field pulses make sure that the integrating circuit sees almost the same state of affairs on every field in spite of the fact that the line pulses are staggered (see Fig. 3 again). If line flyback pulses are picked up in the sync circuits (as they almost always are) however they too will get integrated and will contribute to the composite field sync pulse. Since their time of arrival is different on alternate fields the field sync pulse will vary in amplitude—see Fig. 4.

Now this variation in amplitude is quite small: in fact it looks insignificant. But consider the accuracy needed. The correct "stagger" is half a line (32μsec) and we need ideally to keep within one tenth of this to avoid visible line pairing, i.e. about 3μsec. One field is 20msec so the accuracy of triggering which we want is 3/20,000 or about one part in seven thousand! For a consumer product this is pretty good going.

Clearly any line flyback pulses picked up in the sync circuits or the field oscillator will affect the triggering and hence the interlace. Once the pulses are inside the circuitry there is nothing much that can be done. Prevention is easier than cure so pay attention to the following points of technique.

Circuit Precautions

First ensure that the field sync and oscillator circuits are situated well away from the line timebase—particularly the line output transformer. Make sure that there are no line oscillator coils, line width or linearity coils, or leads of components carrying line pulses anywhere near. Secondly decouple all h.t. or l.t. lines feeding the field circuits with a small series resistor and a good h.f. capacitor to chassis. Next make sure that all wiring to or in the field circuits is short and compact. Avoid loops by keeping any go and return leads close together. Also make sure that the sync circuits are joined to the field oscillator by a really good, short earth connection: this lead must be joined to the main receiver earth and must not carry any line timebase currents of any kind.

As a final step study the field oscillator circuit carefully and note whether there are any undecoupled d.c. points. For example some oscillators have a d.c. potential divider on one grid or base electrode. If so decouple it! Bearing in mind that line pulses get fed back from the field deflection coils via the output stage to the oscillator see if it is practicable to decouple the appropriate leads with a small capacitor. The techniques listed above are summarised in Fig. 5.

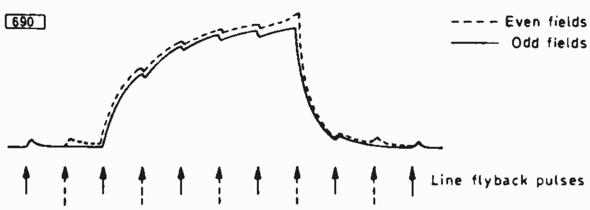


Fig. 4: Line flyback pulses picked up in the sync circuits will contribute to the composite field sync pulse. The contribution will be different on alternate fields.

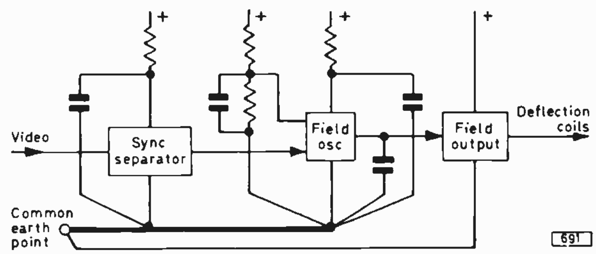


Fig. 5: Summary of some of the circuit precautions which reduce difficulties with interlacing.

It is not generally realised that there are two other mechanisms by which interlace can be impaired (forgive the pun!).

The instant at which the oscillator finishes its flyback stroke and starts the forward cycle can be triggered by line pulses. Since these vary from field to field so too will the start of scan and hence the degree of interlace. The other mechanism concerns the field sawtooth charging capacitor. This is seldom completely discharged at the end of the flyback. If it picks up line pulses the charge will vary from field to field and so the *amplitude*—not the timing—of successive field scans will be different. This results in the degree of line pairing being different between the top and bottom of the picture—a useful feature in diagnosis.

Noise & Cross-Modulation

Fundamentally the noise performance of a receiver is governed by the noise performance of the tuner and by the phase and amplitude response of the i.f. channel. The amplitude of the noise present on the picture depends upon how good the tuner is, but the appearance of this noise can be made subjectively worse if the performance of the i.f. stages results in the noise pulses being smeared into elongated smudges instead of looking more like pinheads. Up to a point you can judge the quality of the i.f. and video circuits by the characteristics of the noise.

There is a small amount of freedom available however, by means of the a.g.c. crossover control. Under fringe conditions when the receiver is operating at full gain the picture is noisy and there is no a.g.c. control of the tuner. If the signal is increased the signal-to-noise ratio gets better and the picture noise improves too. If you carry on increasing the signal the noise continues to improve until the tuner overloads and cross-modulation occurs. This causes an effect similar to sound-on-vision and a buzz on the sound.

A.G.C. has to be applied to the tuner r.f. stage therefore to prevent the mixer overloading. In doing so the noise at the medium signal levels is made worse due to the reduced gain before the mixer.

For a particular aerial installation the a.g.c. crossover potentiometer should be adjusted for the highest tuner gain consistent with freedom from cross-modulation. The gain can then be reduced to the point where the noise just begins to get worse. This gives the best noise performance and the maximum a.g.c. action for this condition.

If any noise can be seen on the picture under strong signal conditions with the a.g.c. potentiometer correctly set it is likely that this is being generated in the i.f. stages. The easiest cure is to reduce the i.f. gain by about 10dB, or more if it is practicable.

Tonal Gradation

It is unusual to find any fault in the tonal gradation of the picture although an imperfect vision detector diode will produce this symptom. Crushing of the highlights can occur if the video circuits have a high gain, the ouput of the detector is correspondingly small and a diode is used

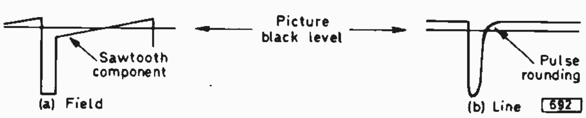


Fig. 6: Blanking pulse waveforms shaped like these can cause shading at the top and left-hand side of the picture.

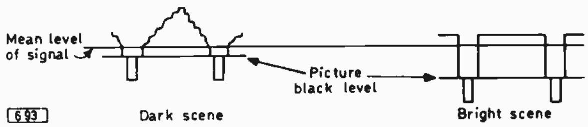


Fig. 7: With a.c. coupling the mean level of the video signal stays constant but the black level moves up and down with variations in picture content.

which has a large forward voltage. If this voltage is a significant proportion of the maximum i.f. carrier excursion the detector output at low carrier amplitudes will be compressed. A diode should be chosen that has a toe in its characteristic at about 0.3V rather than the 0.6V typical of most diodes.

Shading

Shading sometimes occurs at the top or the left-hand side of the picture. Since this is stationary the voltage that causes the effect *must* be directly related to the field or line scanning respectively. It is nearly always due to poor shaping of the field or the line flyback blanking pulses. The field pulse probably has a sawtooth waveform during the scan because this is usually present at the point of origin—see Fig. 6(a). The line pulse may have been integrated a little to make it wider and inevitably the end of the pulse, corresponding to the beginning of scan, becomes rounded off—see Fig. 6(b).

Moving Bars

Any bar, band or line—white or black—which moves slowly up or down the picture is caused by an a.c. mains voltage component present either in your receiver or on the transmission. Yes, even the BBC is not entirely blameless, so switch channels and see if the bar is still there.

Generally speaking any ill defined grey band moving slowly up or down is caused by mains hum getting into a sensitive circuit. It may be a valve with faulty heater-cathode insulation, or a valve located too far up the heater chain for its own good and thus having too much heater-cathode voltage. Inadequate h.t. smoothing to the video output stage and c.r.t. electrodes will also cause the same trouble.

Switching Transients

A clearly defined bar or narrow band is usually caused by switching transients from the h.t. rectifier. Each time the diode conducts or turns off quite large amplitude pulses or wideband h.f. disturbances are produced. These can be picked up by signal circuits and modulated on to the picture information.

Any rectifying diode should have a small high-voltage r.f. capacitor of a few hundred picofarads across it to bypass voltage transients. Take care with the earthing and make sure that the diode current has a good path back to the common earthing point and not through the earth of the signal circuits. You may avoid several other possible difficulties by doing this.

Black Level Stability

If the vision detector output is a.c. coupled via a capacitor to the video output stage then the black level will vary with picture content and there is nothing much that can be done to improve things (see Fig. 7). Some people like the black level to rise when a dark scene is transmitted but strictly speaking this is wrong. Perfect d.c. coupling gives a constant black level and this is essential for good colour reproduction.

D.C. coupling and transistorised circuits do not go well together however, because as transistors warm up the base-emitter voltage falls and hence the d.c. output falls too. Any change in the h.t. or l.t. line voltages during the warming up period may also cause a change of black level.

Good circuit technique such as stabilising l.t. lines and providing good cooling for the transistors and i.c.s involved will go some way to reducing black level drifts. In some cases however it may be necessary to incorporate a negative temperature coefficient resistor in a video stage to produce a d.c. change equal and opposite to that caused by thermal changes elsewhere in the circuitry.

Breathing

As you turn up the picture brightness the e.h.t. falls due to the source impedance– usually 3 6MΩ—of the e.h.t. generation circuit. If the line scanning current stays unchanged the picture will increase in size therefore. To counter this effect we want a low e.h.t. source impedance and an h.t. or line timebase stabilising circuit that causes the line scanning current to fall with increased e.h.t. load. Clearly this is a design problem however and there is not much scope for improving matters by small circuit modifications.

Switch-off Spot Suppression

A bright spot sometimes forms at the centre of the screen at the instant of switching off. This is caused by the c.r.t. e.h.t. capacitance discharging as a result of emission from the still hot cathode after the scanning currents have stopped. In bad cases it will cause a permanent spot burn on the screen.

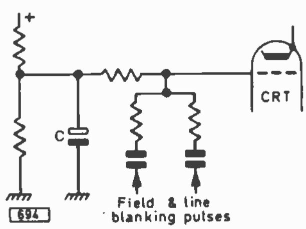


Fig. 8: A switch-off spot will be prevented by the charge retained on capacitor C after the h.t. collapses.

The way to prevent a spot being formed is to make sure that the e.h.t. is completely discharged before the scan currents stop. This can be done by incorporating a long time-constant in the d.c. feed to the c.r.t. grid. The grid then stays at a positive potential after the cathode voltage supplied by the anode/collector of the video output stage has fallen. The c.r.t. conducts harder therefore as its cathode voltage falls, discharging the e.h.t. quickly. In addition to preventing switch-off spots this also leaves the c.r.t. in a safe, discharged condition for handling. Fig. 8 shows a possible circuit arrangement.

Next Month

Next month we will take a careful look at the i.f. and video circuits to establish the basic requirements of the response curve shape and the ways in which picture distortions are introduced.

NEXT MONTH IN

TELEVISION

IN FULL COLOUR!!!

BASIC COLOUR FAULTS GUIDE
Next month's issue contains a special centre insert — which you can pull out and keep for reference — showing by means of off-screen colour photographs the basic colour fault conditions. The accompanying text explains the causes and cures.

VARICAP TUNING SYSTEM
Some month's ago Roger Bunney decided to re-equip his long-distance TV receiving installation using varicap diode tuners. The units evolved for this purpose are continuously tuneable over the TV Bands — there are u.h.f. and v.h.f. versions — and incorporate the necessary metering to check on tuning position. They have proved highly successful in operation.

110° COLOUR
An opportunity to get acquainted with the new techniques necessary with 110° colour tubes. This article takes a detailed look at the new RRI (Bush/Murphy) chassis, the first 110° colour chassis to come from a UK setmaker, describing both the chassis and its circuitry. The Mullard Phase II circuitry adopted is likely to be found in other chassis now in the pipeline.

SERVICING TELEVISION RECEIVERS
Les Lawry-Johns describes the various faults which crop up in the ITT/KB VC200 single-standard monochrome chassis. Amongst the interesting features of this chassis is the use of grid c.r.t. modulation.

PLUS ALL THE REGULAR FEATURES

ORDER YOUR COPY ON THE FORM BELOW

TO NICOLA COX EDD.
(Name of Newsagent)

Please reserve/deliver the OCTOBER issue of TELEVISION (20p), on sale OCTOBER 5, and continue every month until further notice.

NAME A KNEEL JOHN (SON)
ADDRESS 25 ABBEY DRIVE
PYRFORD WOKING SURREY.

DEALING WITH DROPPERS

PETER GRAVES

Most television receivers in use today use some form of mains dropping resistor assembly to save the cost and weight of a mains transformer. Few text books devote more than a few lines to its operation, despite it being the heart of the heater and h.t. supplies, and it is sometimes difficult to know where to begin when confronted with a crumbling dropper resistance and a rats nest of fragile wires that snap off at the slightest touch.

Circuit Operation

Functionally the mains dropper resistance consists of two separate parts with a common supply from the mains on/off switch. Fig. 1 shows a typical arrangement. R1-R4 provide compensation for varying mains input voltages. Suppose a set is designed to work best with a mains input voltage of 200V. If the set is then operated from a 230V or 250V input more current will flow and the h.t. and heater circuits will be overloaded. Conversely if the set is designed for best results with an input of 250V everything will be under run and best results not obtained if the set is connected to a lower voltage supply.

This explains why the mains voltage selector should always be set to the mains voltage to which the set is connected. The appropriate compensating resistors are connected in circuit (or the unwanted ones shorted out) by means of movable clips or some sort of plug and socket panel where the position of the plug determines the tap selected. The values of the resistors used are chosen so that if the set is operated at any mains input voltage other than the lowest the difference in voltage between the lowest voltage and the voltage in use is dropped across the resistor or resistors brought into circuit. Thus the set is always operating under optimum conditions. The h.t. current and the heater current are different of course, so the values of the series resistances used in each branch of the circuit differ (in Fig. 1 R1 and R2 are the resistors for the h.t. circuit while R3 and R4 are those for the heater circuit).

The wiring necessary for the selection/switching arrangements often makes the connections around the resistance and this part of the circuit diagram look complicated. Careful tracing of the wires will always reveal a basic arrangement similar to that shown in Fig. 1 however. The mains dropper gets very hot in operation and as a result of this the insulation of the wires and the wires themselves are often in a crumbling and fragile condition. The switching/selection arrangement can also become intermittent. If it is known that the receiver will spend the rest of its life in one locality (that is on one mains voltage) the connections can be made straight to the appropriate tapping point on the dropper and all the unused wiring cut away. Details of wiring and connecting techniques will be covered later.

R5 in the h.t. circuit (Fig. 1) acts as a surge limiter to protect the h.t. rectifier (MR1). R8 represents the total load resistance that the receiver circuits present to the h.t. supply. It will be seen that the heater circuit has two resistors (R6 and R7) in series with the heaters, which are also connected in series—this arrangement is referred to as a series heater chain. R7 has a black dot above it which indicates that it is a negative temperature coefficient resistor (thermistor). These devices are made of a mixture of various semiconductor materials and have a high resistance when cold, dropping to a low value when hot (typically from 600Ω down to 30Ω). The valve heaters are metal and have a positive temperature coefficient, their resistance being low when cold and high when hot. If a thermistor is not present and the set is turned on from cold there will be a high current surge in the low-resistance heater circuit. The thermistor has a high resistance when cold, limiting the current which then flows in the circuit. Subsequently the current flow through the thermistor heats it up and its resistance falls. As a result of this the heaters warm up slowly.

The thermistor can easily be recognised as a thick black resistor with no markings (it gets hot enough to burn any markings off) and gives very little trouble, sometimes going open-circuit by splitting across. If this is suspected prod it gently with a screwdriver. In some chassis the thermistor actually falls out of circuit from its mountings. Ensure that replacement thermistors are of the same type as the original.

Since the heaters are in a series circuit the total voltage across the heater chain must be equal to the sum of the individual voltages across each valve heater. The voltage across R6 therefore is the difference between the voltage across all the heaters and the thermistor (when hot) and the lowest incoming mains voltage. Its value is typically a few hundred ohms. R1-R5 all have values measured in tens of ohms.

Fault Conditions

The resistors are often all mounted on a common aluminium former (in which case they must be insulated from it) or on a ceramic tube. Individual resistors, or sections, are separated by metal bands which also form the connecting tags. There is normally a ceramic coating painted over the top of the sections. The stresses and strains set up as the whole assembly heats up and cools down result in the resistance wires breaking. Thus an open-circuit section is the most common fault with mains droppers. An open-circuit section in the heater circuit

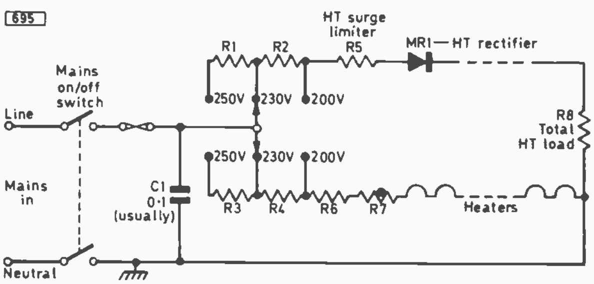


Fig. 1: Typical mains dropper circuit.

will prevent any of the valves lighting up while an open-circuit in the h.t. side will make the set completely dead. A quick way of checking this if no meter is available is to turn the volume control up full and listen: if the h.t. is present there is usually a faint hiss from the loudspeaker (this assumes that there are no audio faults). Since the h.t. sections and the mains compensating sections in the heater supply are of low value they can be momentarily shorted out in turn to locate the faulty one. The heater series resistance (R6) and the thermistor must not be shorted—the effect could be disastrous! A neon tester provides a simple way of checking the circuit.

A break somewhere down the heater chain will of course also prevent any of the valves lighting up. Tracing it can be a long job. First check that no valves are missing. It is then a question of methodically tracing out the circuit until the break is located. Again, a neon tester helps. It may be possible to take resistance measurements from the centre of the valve chain to the dropper and to the chassis, in this way partly isolating the break. Valve heaters are pretty tough and the fault may be due to a wire broken off somewhere. If it comes to testing the valves one by one it is very easy to tell which is the faulty one—it will be the last one you check!

A short-circuit to chassis somewhere along the heater chain is not common but can arise if a valve heater shorts internally to its cathode or if two valve base pins touch or are shorted by a stray lump of solder or wire. If the short is at the chassis end of the chain most of the valves will light, perhaps a little more brightly than usual. A short at the dropper end of the chain will produce a gross overload of the part of the chain between the dropper and the short and result in one of the heaters or the fuse blowing. Remember that if some of the heaters are alight the fault may be in the last valve alight along the chain.

The valves in the r.f. side of the circuit are fitted with bypass capacitors to the chassis from the heater pins to short any stray r.f. to earth. These occasionally go short-circuit. The heater leads to the tuner pass through feed-through capacitors which sometimes get damaged causing intermittencies and short-circuits. A cracked feedthrough capacitor should always be replaced. These are generally soldered to the chassis and a high-power iron is needed to remove or replace them (say over 100W). The greatest care must be exercised to prevent damage to other components during repair.

C1 in Fig. 1 is the mains filter capacitor usually fitted. It can short, blowing the fuse and leaving everything dead. The short may be present only when the full mains voltage is applied (i.e. a resistance check will not always reveal it).

Repairs

The value of the individual dropper sections is sometimes printed on the outside of the element. If not reference must be made to the circuit diagram. It is important that replacements are not only of the right resistance value but also of the correct wattage rating. If this is not given it can be calculated from the quoted h.t. or heater current and the resistance value. For greater reliability a component with the next higher wattage rating may be fitted. Ordinary wire-wound resistors are suitable and it is possible to buy replacements in the form of a ceramic cylinder with a hole down the middle and the resistance element cemented inside, two tags forming the connections. These are very reliable and if necessary a complete replacement dropper can be made up by threading the appropriate values of resistance on a length of brass studding.

All connections should be bolted with 6BA nuts and

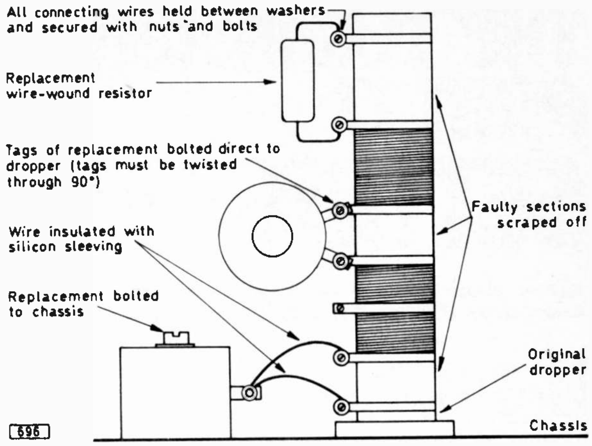


Fig. 2: Fitting replacement sections.

bolts using washers to clamp the wires (see Fig. 2). The dropper gets hot enough to melt ordinary solder so the use of this will result in unreliable connections. A wire-ended resistor can be mounted between the two end tags of the faulty section. The cylindrical type can be mounted in the same way, or it can be bolted to the chassis and wires run up to the connecting tags of the faulty section. These leads should be bare wire insulated with silicon sleeving which is heat resistant. The same method can be used for replacing old wires. All these connections to the dropper should be by means of nuts, bolts and washers. The faulty winding should be scraped off the former to prevent any trouble should the broken ends touch.

While working on this part of the circuit check that the mains and any h.t. fuses are of the correct value and that the mains selector is set correctly.

Some modern sets use fusible resistors which consist of a resistor having two springy wires which lie across the resistor and are connected in series with it and hence the circuit. The junction of the two wires is held together by a blob of low melting point solder. If a fault occurs the current through the resistor exceeds its usual value and results in the resistor dissipating enough heat to melt the solder. Thus the wires spring apart breaking the circuit. After the fault has been cleared the wires may be soldered back together. Unless specified by the manufacturers ordinary solder should not be used. Use either a low melting point solder the same as the original or remelt the original blob with a clean, hot soldering iron.

Safety Aspects

It must be emphasised that the principle disadvantage of the mains dropper resistor system is that the chassis is connected to one side of the mains supply and may therefore be live if the mains plug is reversed or the socket wired incorrectly. Sometimes one pole of the mains on/off switch may have failed and been bridged over. This means that the chassis may be live even when the set is switched off. The voltage to a known good earth from the chassis should always be checked before starting work and the mains leads reversed if the chassis is live. An insulating mat should be used on the floor and it is advisable to keep one hand firmly in a pocket (to prevent a current flow across the chest and heart in case of shock) while working on switched on equipment. Never rely on the mains switch for isolation, always unplug the equipment. ■

THE 'TELEVISION' COLOUR RECEIVER PART 17 SETTING-UP PROCEDURE

However skilled the constructor and however clear we make the important parts of the construction there will inevitably be errors either in the assembly of the individual modules or in the interconnections between them. The effects produced by such errors will depend on the care taken in following the setting-up instructions. With care, any possible damage should be minimised. Ensure that at all stages of the procedure no item is skipped or rushed in order to accelerate the process—it will not and you may very well lengthen the entire process because of additional faults being introduced. Between any operations involving connection, disconnection or reconnection switch the receiver off at the mains and leave any unconnected leads insulated and unable to touch either you or the chassis.

The starting points in each part of the setting-up are important: they have not been chosen just to increase your difficulties. So it is vital to follow them. The whole system has been thoroughly checked out on a batch of "guinea-pig" sets built by a group of constructors and by this means we hope that mistakes have been eliminated. It is assumed that the i.f. strip has been fully aligned, either through the Alignment Service or otherwise.

An oscilloscope or the use of one is an obvious requirement for the alignment of the complete receiver. A multimeter is also essential of course. Although many meters are suitable it is essential if the readings are to correlate reasonably with those given in the instructions that the d.c. resistance of the meter used is at least 20,000Ω/V on the lower ranges and that it has reasonable a.c. current ranges. Suggested units to use are the Avo Model 8 or the Philips Multitester.

Before starting ensure that all corrections and modifications to the published circuits have been carried out. These appeared on the following pages: July 1972 page 412, September 1972 pages 485 and 509, October 1972 page 567, November 1972 page 7 (the note here on the 2N5492 transistor is not correct however), February 1973 page 177, May 1973 page 316, July 1973 pages 402-4, August 1973 page 468 and the end of this month's instalment. Note also the comments on i.c. soldering on page 259 of the April 1973 issue.

Initial Stages

Disconnect the following power supply output feeds: 6E, 6F, 6G, 6L, 6Q; also remove fuse FS502. Disconnect the feeds from 6J to 4B and 5P but leave the feed to 8J.

Apply mains to the receiver and check with a neon tester that 6B on the board is neutral and not line. Check that 6C is at earth potential. Check that point 6N is at +20V to earth.

With an off-air signal or a test generator connected to the aerial input socket observe the luminance output at point 2I of the i.f. module on an oscilloscope or picture monitor. Tune in the varactor control panel on one push-button for maximum signal definition. If necessary adjust the a.g.c. threshold control R125 to give sufficient output level. Check that there is chrominance output at point 2D of the i.f. module and if necessary adjust the a.c.c. control R149 for maximum output. Check that there is audio output at point 2C.

Switch the receiver off and reconnect 6L on the power supply board with your test meter temporarily in series on a d.c. range suitable for reading up to 30mA. Check that on switch-on with no input signal to the receiver the quiescent current due to noise does not exceed 15mA. If all seems well reconnect 6L permanently and reconnect the r.f. signal to the aerial socket.

Adjust the a.g.c. threshold control to give about 4V peak-to-peak at the luminance output point (2I) and then the a.g.c. crossover control (R133) to give minimum picture noise consistent with minimum background noise on sound. While monitoring the chrominance output (point 2D) adjust R149 for approximately 100mV peak-to-peak burst signal amplitude.

Apart from setting up the notch filter L114—see later—the tuner/i.f. alignment should now be complete.

The next step logically is to set up the decoder. This cannot be done yet however since it requires line pulses and auxiliary supplies derived from the line output stage.

Timebase Checks

Reinsert fuse FS502 and disconnect 6H from the power supply module. Apply power and check that +220V is present at point 4A on the timebase module. Check for separated line and field sync pulses at the junctions of C313/C314 and R309/SCS301 anode gate respectively. If all right set the midpoint adjustment control R328 about half way and reconnect the lead from 4B to 6J on the power supply board. Monitor the collector of Tr302 and adjust R309 for field synchronism. Adjust R328 to give a distortion-free output voltage swing at 4F with a fairly high setting of the height control R316.

If not already fitted insert the three valves in the timebase module and with FS301 removed from circuit reconnect 4C to 6G and 4U to 6E (power supplies). Check for +295V at 4C. Bypass the flywheel sync circuit by connecting a flying lead from C313 (junction with C314 etc.) to R338. Adjust the line oscillator coil L301 for synchronism, monitoring pin 1 or 8 of the PL509 line output valve. Then remove the flywheel sync shorting lead.

Remake the connection to 6Q on the power supply board so that the c.r.t. heaters are in circuit and set the boost/width potentiometer R349 to mid-travel. Connect R605 from the e.h.t. tripler to tag 4 of the line output transformer and reinsert fuse FS301. A raster should appear. If any arcing takes place around the line output transformer or any of the e.h.t. components switch off immediately and locate the faulty connection or component. Note that arcing will occur at the c.r.t. outer coating if there is not good connection between the earthing springs and the c.r.t. degaussing shield.

Using an e.h.t. meter or a multimeter with an e.h.t. probe insert the probe tip under the e.h.t. cap to measure the e.h.t. If more than 25kV check the assembly and e.h.t. circuit. If more than 750V below 25kV change the connection of R605 from tag 4 of the line output transformer to tag 3. If the e.h.t. is more than 1.5kV below 25kV change the connection of R605 to tag 1 of the line output transformer.

Decoder Alignment

Reference pulses should now be arriving at the decoder board at point 1D. Monitor the junction of D13/L5 and adjust L5 for the correct ringing waveform (see page 317, May 1972). Check that this waveform is approximately 8V peak-to-peak.

Monitor pin 1 of T1 and adjust L1 for maximum burst level. The tuning is relatively flat but a quite definite peak should be located.

Next monitor the emitter of Tr5 and adjust L3 for maximum subcarrier output (4.43MHz). Desolder one end of the 4.43MHz crystal and connect a meter between Tr3 collector and chassis. Adjust the a.p.c. bias control R11 for 6V d.c. Reconnect the crystal and adjust C14 until the voltage reading at Tr3 collector is again about 6V. The reference oscillator should then be operating at the correct frequency.

Looking at Tr11 collector (pin 2 of the DL20 chrominance delay line) tune L6 for maximum chrominance and L7 for minimum 6MHz output between periods of active line time.

Disconnect C42 and connect a flying lead from Tr5 emitter to D15 cathode. Adjust the saturation control and L10 for minimum output at point 1E. Connect links between pins 2 and 4 of the delay line. If necessary adjust L10 very slightly to minimise line "twitter" (line by line change of chrominance amplitude) on the output at point 1E.

WARNING!

Further tests have been made on the published power supply circuit shown in the January issue (Part 10). The results are being evaluated but indicate that the specified voltages and currents may not be obtained. We cannot recommend therefore that readers supply power to the whole receiver in the first instance. Check carefully, preferably with an Avo meter, that the current and voltage supplies to each individual board are as specified.

When the timebase board is powered check that the BD131 field output transistors do not run excessively hot. It may be necessary to add extra heat sinking. Start with the height control at minimum (maximum resistance).

Repeat this procedure for the output at point 1F, adjusting C38 for minimum output and to minimise line "twitter".

Repeat the 1E output adjustment and recheck.

Remove the shorting link from the delay line and adjust the delay line drive control R75 to give outputs at 1F and 1E in the ratio 3:5 respectively. Adjust L14 and L15 for minimum subcarrier outputs at the two points.

If during the above adjustments no chrominance outputs are seen check the bias on Tr10. If the colour-killer is holding Tr10 off connecting a 10kΩ resistor between Tr10 base and the 20V rail should turn it on and keep it on for these adjustments.

The ident coil L4 is adjusted for maximum output monitored at Tr7 emitter.

Monitor T4 pin 2 and adjust L13 for minimum subcarrier at this point.

The decoder alignment should be repeated. Then set the saturation control to mid-level and the a.c.c. bias control R149 (on the i.f. module) to give about 500mV output at point 1E. Check the reference oscillator locking by removing the aerial signal and then holding the r.f. lead close to the aerial socket to give weak signal pick-up. The chrominance should lock almost immediately after a recognisable but noisy luminance waveshape can be seen on the oscilloscope.

RGB Reconnection

Next reconnect the power supply for the RGB output stages at 6H on the power supply board. Avoid contact with the output transistor heatsinks as they are at h.t. potential. Some form of poorly converged, poorly colour-balanced picture should now have appeared.

Turn the contrast control to minimum. Switch off the three c.r.t. first anode feed switches SW401–SW403. Disconnect the luminance and chrominance inputs to the RGB module at 3C, 3D and 3E. Adjust the brightness control, R603 to give 140V at Tr209 collector. Switch SW401–SW403 on again and with the inputs to 3C, 3D and 3E reconnected adjust the first anode presets R435, R436 and R437 to obtain a recognisable image.

Degaussing

Restore the connection to 6F on the power supply board, with a meter in series to read a.c. current. Apply power. At switch on the current through the degaussing coils should be about 2.3A and should decay quite rapidly. If the switch-on current is greater than this check the circuit. If the readings are correct leave 6F permanently connected. Restore the connection to 5P.

Picture Geometry

Adjust the width control R349 to give a display just overlapping the edges of the screen. Centre the picture horizontally using R354—change over the position of plug PL301 if the shift is in the wrong direction. Check the field and line hold.

Adjust the midpoint control R328 for 20.5V at 4F. The field linearity control R321 should then be adjusted for optimum linearity of the displayed picture. Adjust the height control R316 to give an image that just overscans at the top and bottom of the screen, then recheck the midpoint control setting. Centre the picture vertically by means of R425.

Adjust L408 and R423 (pincushion controls) to obtain straight horizontal lines at the top and bottom of the screen.

Adjust the focus control—knob on the Erie focus unit—for the best overall focus with the picture brightness slightly higher than previously set.

Convergence

The convergence procedure must be carried out after the receiver has warmed up for at least 20 minutes. Set the convergence controls initially to mid-position.

First switch off the blue and green guns (SW401 and SW402) and disconnect the connections to 3C, 3D and 3E of the RGB module. Cancel the field produced by the purity rings by setting the notches or the two marked tabs of the two rings in line. Loosen the wing nuts holding the deflection coils in place and push them fully forward towards the front of the receiver. The red area displayed can now be shifted to the centre of the screen by adjusting the purity rings with respect to one another and also by moving both rings together. Then move the deflection coils back so that the red area expands to cover the entire screen area. Any small purity errors at the corners of the screen can be removed by small readjustments of the rings.

Check the purity of the green and blue rasters in turn. Restore the connections to 3C, 3D and 3E.

For static and dynamic convergence a crosshatch generator to which the receiver is tuned to show clearly defined vertical and horizontal lines is required. Note that the various convergence controls interact to some extent: for this reason the complete convergence procedure, including the purity adjustment, should be repeated at least twice to obtain best results. An optional "built-in" crosshatch generator is being prepared.

Static convergence is carried out first and involves adjusting four magnets, three on the radial convergence assembly and one on the blue lateral assembly (see Figs. 2, 3 and 7 page 257 April, and Fig. 7 page 317 May). These magnets are adjusted by rotation. Static convergence is concerned solely with the centre of the screen: the aim is to superimpose the red, green and blue crosshatch pattern lines to give a single white-line crosshatch pattern at the centre of the screen. The order of adjustments is as follows. First switch off the blue gun (SW401). Adjust the red and green magnets on the radial convergence assembly to superimpose the red and green crosshatch pattern lines at the centre of the screen to give a yellow crosshatch pattern there. Switch on the blue gun and adjust the blue magnet on the radial convergence assembly to converge the blue horizontal lines then the blue lateral rod magnet to converge the vertical blue lines to give a white crosshatch pattern at the centre of the screen.

Dynamic convergence can then be carried out. The point to remember here is that you must concentrate on getting as good convergence as possible along the centre vertical and horizontal lines of the pattern. You cannot get perfect convergence at the corners of the picture but provided the convergence is not too far out this will be barely noticeable on picture transmissions. If the corner convergence is badly out it is possible to spread the convergence errors for optimum overall results. But to start with concentrate on what happens along the centre vertical and horizontal lines: this is after all the area you mainly notice when viewing.

The order of adjustment and the effects of the controls are as follows: First switch off the blue beam in order to converge the red and green lines. Adjust the field R-G amplitude control R430 to remove vertical line bowing mainly at the bottom, then the field R-G tilt control R434 to remove vertical line bowing at the top of the picture. Set the field R-G difference control R432 to close up the horizontal lines at the top of the picture and the field R-G symmetry control R427 to close up the horizontal lines at the top and bottom of the picture. Adjust the line R-G amplitude control R418 to close up the vertical lines at the left-hand side of the screen and the line R-G tilt control R420 to close up the vertical lines at the right-hand side of the screen. When happy with the verticals adjust the line linearity control L403 to give an even horizontal spacing of these verticals: this is preferable to adjustment of linearity on a completely unconverged display. A non-magnetic tool of the correct shape should be used to adjust L403—the core of this coil is very easily broken, particularly near the base, and it should be treated with care. Adjust the line R-G difference control R416 to remove horizontal line bowing and the line R-G symmetry control L402 to remove horizontal line crossover.

This should give you a reasonable yellow crosshatch pattern. Next switch on the blue gun in order to converge blue with yellow. Adjust the blue field tilt control R429 and blue field amplitude control R428 to close up the horizontal lines at the bottom and top of the screen. Set the blue line amplitude control R415 to correct horizontal blue line droop and the blue line tilt control R421 to correct horizontal line crossover. Adjust the blue line shape control L406 to remove blue horizontal line undulation and finally the blue lateral amplitude control L405 to close up the vertical lines at the sides of the screen.

As already mentioned these adjustments must be repeated until optimum results are obtained. You will not get a perfect white crosshatch pattern over the entire screen, especially at the corners: the aim is to minimise errors—which should certainly not be noticeable at the centre of the screen.

Grey-scale Adjustments

The inputs to 3C, 3D and 3E on the RGB board must next be disconnected again. Switch off the blue and green guns (SW401 and SW402) and adjust the c.r.t. red first anode preset R437 for a barely visible red raster (the brightness control should be left at the setting established earlier—to give 140V at Tr209 collector). Repeat this process for the blue and then green c.r.t. guns in turn. Next switch on all three guns and restore the inputs to 3C, 3D and 3E on the RGB board. With a grey-scale r.f. input adjust the RGB drive controls R401, R402 and R403 for a neutral white with a reasonable contrast range between black and white. Do this with the contrast control set to mid-travel. If an Illuminant D source is available use this as a reference.

The contrast, brightness and saturation controls can then be adjusted to taste on transmission pictures.

Advance the contrast control by a further ten degrees or so and adjust R706 (beam limiter) to the point at which the yellow bar just starts to go "plastic". Return the contrast control to its viewing position.

Finally adjust the notch filter L114 (i.f. panel) on a colour transmission for minimum subcarrier crawl visibility.

Conclusion

You should now have a completed and fully set-up receiver. If you have come unstuck in the process our Fault Finding Service is at your disposal, but before you use it do check your interconnections most carefully. Bear in mind too the difference between a home-constructed receiver and one coming off a manufacturer's assembly line. Setmakers keep a very close control over components and mechanical assembly tolerances so that the receivers coming off the line are much the same. With home-constructed sets each one, even where a single design is followed, will differ and probably have its own bugs to sort out. The component pack system adopted for the project has provided a considerable measure of control over component suitability though inevitably the stringent testing setmakers adopt has not been possible—and of course many constructors will have used components from other sources. Then despite the use of printed board modules the wiring of individual sets will differ to some extent leading to different interaction possibilities, earthing faults etc. The boards have been laid out so as to reduce the possibility of such difficulties to the minimum but even so constructors should be prepared for a certain amount of trouble-shooting.

Remember that although the chassis of the receiver is isolated this does not make it any safer for the prying paws/fingers of pets or children: until you have completed construction by putting a back and base on be very careful whenever the set is connected to the mains.

Corrections

Heater dropper resistor: In last month's issue the correct calculated value for R501 was given (260Ω, 25W). The use of an RS 250Ω 0·3A section is suggested.

Field blanking: The field blanking waveform to 9M on the c.r.t. base panel should be taken from Tr303 emitter via a 560Ω resistor.

Interconnections: Convergence board 5B also connects to tag 4 of the line output transformer (as in Fig. 2, July).

NEXT MONTH: TEST VOLTAGES AND WAVEFORMS

"TELEVISION" COLOUR RECEIVER PROJECT: FAULT FINDING ADVISORY SERVICE

Please complete the whole form in ink in capital letters, attach to your letter describing fault symptoms and send with TWO stamped self-addressed envelopes to: Fault Finding Advisory Service, "TELEVISION", Fleetway House, Farringdon Street, London EC4A 4AD.

NAME ....

ADDRESS ....

....

....

FOR OFFICE USE ONLY
1st Ref.
2nd Ref.
3rd Ref.

1st Ref. number ....(if known).

BRIEF FAULT SYMPTOMS (use additional paper if necessary):

TEST PROCEDURES CARRIED OUT:

PLEASE TELEPHONE ME BY TRANSFER CHARGE CALL DURING THE EVENING OR WEEKEND BETWEEN (times)

....ON TELEPHONE NUMBER ....

I UNDERSTAND THAT THE PHONE CALL MAY BE CHARGED FROM CORNWALL OR LONDON. I HAVE READ AND UNDERSTOOD THE CONDITIONS OF THE ADVISORY SERVICE AS GIVEN IN THE AUGUST 1973 ISSUE OF "TELEVISION". I ALSO UNDERSTAND THAT THE MAGAZINE PUBLISHERS CANNOT BE HELD RESPONSIBLE FOR ANY LOSS OR DAMAGE TO THE COLOUR RECEIVER.

SIGNATURE ....

DATE ....

For Office use only.

DATE ....

NAME ....

REF ....

Dear Sir,

We acknowledge receipt of your form for the Fault Finding Advisory Service. This is being dealt with. Please quote the above reference number in all communications on the Colour Receiver Project.

Yours faithfully,

FOR TELEVISION MAGAZINE

VOLTAGE STABILISATION IN SOLID-STATE RECEIVERS

by H. K. Hills

Voltage stablisation is essential in solid-state receivers in order to maintain the picture size, contrast and brilliance constant despite changes in the mains or battery voltage. In most current full-size solid-state colour receivers, which require a considerable power input, voltage stabilisation is achieved by varying the conduction duration of a controlled rectifier (thyristor). In small-screen colour (e.g. Sony, Hitachi) and monochrome models however regulation is achieved by varying the conductance of a power transistor connected in series with the d.c. supply, a control transistor being used to vary the bias on the power transistor. A representative example of this type of circuit is the regulator used in the GEC "Junior Fineline" portable Model 2114, see Fig. 1. Here Tr401 is the series power regulator transistor and Tr402 the control transistor.

The stabilised output voltage is 11V while the output from the bridge rectifier with 240V input is 14V and a fully charged nominally 12V battery may provide an output well in excess of 13V. The power transistor with its shunt resistor R406 must therefore take up the surplus voltage between the stabilised output and the input from the battery or bridge rectifier. The function of the control transistor is to detect any tendency for the stabilised output to change and to convert this to a control voltage to regulate the conductance of the power transistor. Thus although the output is stabilised there must be some slight voltage variation either way—though naturally very much smaller than the variations in input voltage—otherwise the system could not operate. The simplest way of looking at the circuit is to regard Tr402 as a common-base amplifier whose collector load resistor R402 determines the bias applied to Tr401: the input to Tr402 is the voltage across R403.

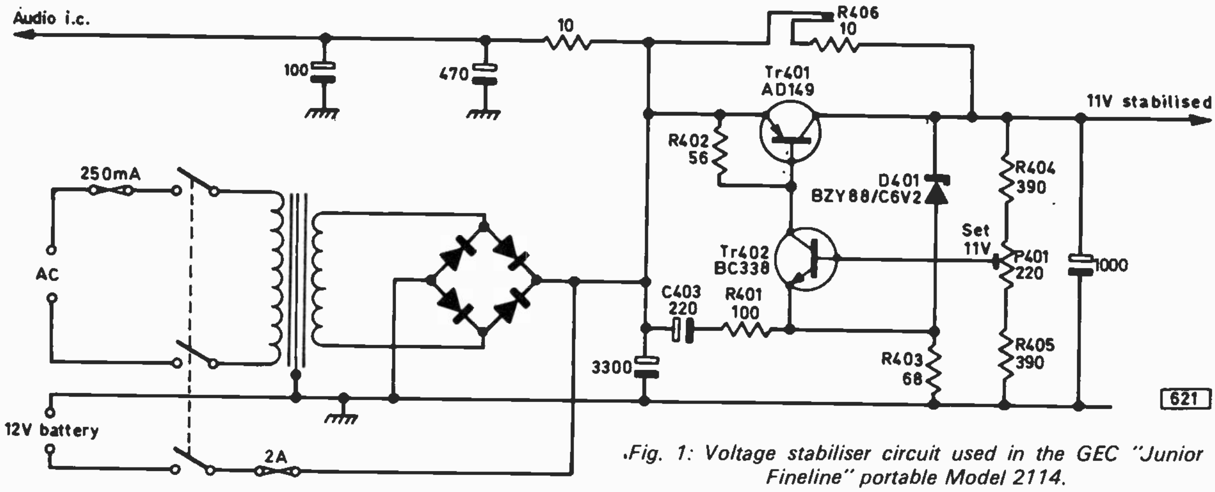


Fig. 1: Voltage stabiliser circuit used in the GEC "Junior Fineline" portable Model 2114.

The zener diode D401 maintains a constant voltage between Tr402 emitter and the stabilised l.t. rail: thus any variation in the stabilised output appears across R403, altering the bias on Tr402. Variations in the output will also appear at Tr402 base since this is fed from a potential divider network across the stabilised output. The main variation in Tr402 bias however is the variation in voltage across the emitter resistor R403. As the bias on Tr402 varies so the current through and the voltage across its collector load resistor R402 varies, in turn varying the base-emitter bias on Tr401 and consequently its conductance. The voltage dropped across Tr401 is in this way varied to compensate for variations in input voltage.

There is also an a.c. coupling from the input to Tr402 emitter, via C403 and R401. Thus any a.c. ripple on mains operation will appear at Tr402 emitter and produce slight variations in bias so that the conductance of Tr401 is varied in sympathy to improve the output smoothing.

The forward bias to Tr402 base is set by P401 which must be adjusted to give a stabilised output of 11V ±0.2V. Since the line output transistor is driven to saturation when it conducts its output is proportional to the supply rail voltage: thus the setting of P401 controls the picture width. It must not however be used for this purpose: if the width is incorrect P401 must be set to give the correct stabilised rail voltage and the cause of the trouble sought in the line timebase.

PRACTICAL WIRELESS DATACARD SYSTEM 1973

Practical Wireless is launching a series of illustrated, colour datacards which provide essential background technical data. The first six cards will be included free of charge with the October, November and December issues of *Practical Wireless*—two in each issue.

The first pair of **P.W. Datacards** is designed to enable resistor and capacitor values to be read at a glance, showing also how to determine quickly the combined values of two or more of these components. The second pair, in the November issue, will appeal to all audio enthusiasts while the third pair in the December issue will include data on d.c. circuits.

For further details of these **P.W. Datacards** see the September and October issues of *Practical Wireless*.

Coping with ICs

PART 1

HAROLD PETERS

AN integrated circuit (i.c.) is the thing that turns up just where you want to measure something, the thing for which you have no equivalent in the toolbox, the only component you haven't changed but you know that when you do the fault will be just the same. Small wonder that the introduction of i.c.s into domestic equipment gets a mixed reception. They are here to stay however so we ought to try to come to terms with them.

There are a number of popular misconceptions.

(1) "They either work or they don't." Untrue. I.C.s can produce some funny symptoms so a section will be devoted in a later part to the habits which various types have acquired.

(2) "They are difficult to replace." Untrue. With a little care an i.c. can be replaced up to three or four times. The copper print gives in first.

(3) "They are delicate." Again untrue. I.C.s are surprisingly robust. Most of all they dislike e.h.t. flashovers from shadowmask tubes.

The internal limitations of i.c.s are caused mainly by the impossibility of incorporating any but the smallest capacitor inside; this is offset however by lavish use of integrated transistors and diodes. Some 60 or more transistors can be diffused on one silicon i.c. chip and within any one i.c. these are all substantially identical to each other.

Handling ICs

When inserting an i.c. preform the pins so that they drop straight into the board vertically. The round wire-ended i.c.s may not need all 10 leadout wires but it is wise to bend unwanted ones out of the way until after fitting so that if you make a mistake—such as reading the numbers the wrong way round from the keyway—you stand a good chance of putting the matter right.

Round i.c.s can be unstable if stood off the board to the full extent of the leads supplied. Perversely they may cook if pulled too close to the board. An ideal compromise is to allow about $\frac{1}{4}$in. of free air beneath them. You may find a small plastic sleeve fitted on the wires. This is to facilitate insertion into holders, by being slid down the cropped legs thus holding the free ends steady. No harm comes by leaving this sleeve fitted.

Rectangular i.c.s are usually 16 pinned, eight pins a side. The locating keyway (see Fig. 1) is always provided on the top of the moulding, and if you hold the i.c. looking down on it with the keyway on your left pin 1 is below the keyway and pin 16 above, the numbers running anticlockwise as viewed from above. DIL (dual-in-line) i.c.s have two straight rows of pins and are intended for fitting to i.c. holders. QUIL (quad-in-line) i.c.s have their pins staggered in zig-zag pairs to facilitate the copper-work of the boards into which they solder directly. You may receive a DIL i.c. for fitting to a QUIL position: it is quite easy to offset the pins with a pair of long-nosed pliers, bending the pin at the end of its thick shoulder so that its thin shank enters the board dead vertical. The pins of modern devices—Fig. 1(d)—zig-zag in pairs, i.e. 1 and 16 "upwards", 2 and 15 "downwards" and so on. Beware! This type can be fitted the wrong way round, with the keyway on the right, so mark the keyway end on the board if it does not indicate the correct way round clearly. Early television i.c.s such as the TAA700 jungle (sync separator, a.g.c. etc.) combination had pins 1 and 16 close, 2 and 15 spread etc.: this type cannot be fitted incorrectly.

Power i.c.s may have a built-on heatsink with the type labelled on the edge of the fin. Usually the keyway and pins 1 and 16 are to your left when the type label is nearest to you, but it pays to double-check by looking at each end. The keyway on the plastic moulding can be seen at one end beneath the heatsink.

When soldering i.c.s use a small bit and work quickly on the individual joints—it is important to avoid applying excessive heat to an i.c. Try not to bend the i.c. pins beneath the board: it will come out again easier if the pins are straight. If you drill out your own panel scrub the i.c. area with a suede brush before fitting the i.c. to remove wisps of copper. Low-voltage soldering irons with earth-free wiring are ideal but small mains irons are just as efficient. The writer favours an earth-free iron used on a wood bench, with an isolated floor to work on. This is not generally regarded as the safest of ways, but it destroys the minimum number of i.c.s. Apply just enough solder to fill the hole between the pin and the board. Draw off any surplus solder along the leadout wire—this will strengthen

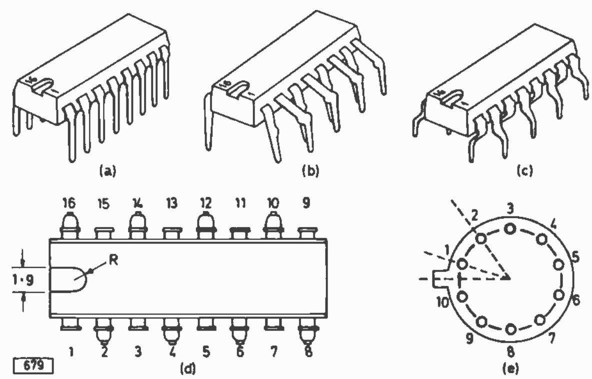
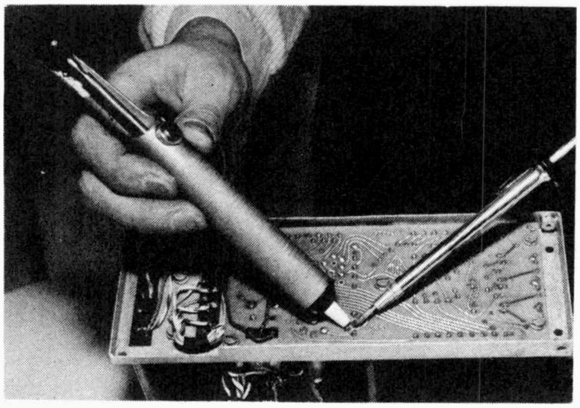


Fig. 1: I.C. encapsulations in common use. (a) DIL (dual-in-line) 16-pin package suitable for i.c. holders; (b) early QUIL (quad-in-line) configuration—pins 1 and 16 close, 2 and 15 spaced out etc.; (c) current zig-zag QUIL with pins 1 and 16 "upwards", 2 and 15 "downwards", etc.—this type can be fitted the wrong way round if the keyway position is not checked; (d) QUIL pin numbers looking down from the top; (e) 10-pin round base viewed from beneath.



The type of desoldering gun shown here is strongly recommended for use when removing i.c.s.

the weakest point which is around the pin hole.

When removing an i.c. bear in mind that 50% of your troubles will not be in the i.c. but in its peripheral circuitry. Always remove i.c.s therefore with a view to refitting them shortly afterwards. A desoldering tool is a must and if carefully used the device will fall out intact. Having tried all manner of aspirated irons with air lines and rubber bulbs the writer has settled on a simple separate tool like a small bicycle tyre pump but working in reverse (see photograph). It has a plastic nozzle which is held against the work—having first cocked the pump by depressing the plunger until it clicks. Apply the soldering iron to the work with one hand and when the solder melts apply the nozzle of the desolderer to the same point, press its button, and the joint becomes immediately clean. The nozzle is replaceable but will change over 50 i.c.s and provided the plunger is kept oiled no tinning takes place inside.

If you haven't got a desoldering tool tip the work upright and run solder off the joints on to a wick made from 6in. of coaxial cable braiding. Work rapidly to avoid pulling the board copper and clip off the tip of the braid as it becomes tinned.

Engineers will argue over the necessity of i.c. holders till doomsday. Experience shows that once working an i.c. is more reliable than the surrounding components. The writer—a natural butterfingers—damages more devices by plugging them in and out of sockets than if he had soldered them in. A pluggable panel is a useful aid to anybody constantly working on the same type of board however.

Testing

When testing i.c.s voltage checks are all-important—manuals should provide a full voltage table. Allow about 10% error and ensure that your test conditions match

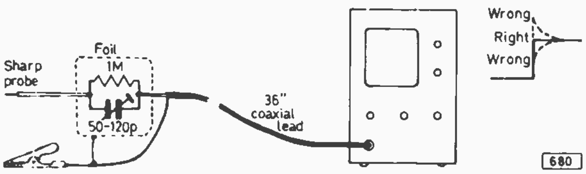


Fig. 2: This ×2 probe reduces the loading of the probe on the circuit without loosing too much sensitivity. Adjust the capacitor on a squarewave for square shoulders on the 'scope screen.

those given in the manual. Resistance readings to chassis cold are sometimes quoted and if you use these check that your battery polarity is right. Neither voltage nor resistance checks tell you for sure whether the trouble is inside or around the i.c.

Whichever side of the board you work on there is always a chance that your meter lead will bridge two adjacent i.c. pins. This converts a doubtful i.c. into a "dead" certainty. Either use adjacent components as test points or extend the meter probe with a sleeved darning needle which will slip between the pins of the device with impunity as the hand starts to tremble.

The fastest service tool to use on a panel with which you are familiar is a 'scope. In fact it is the only tool which will reveal some unstable conditions on sound i.c.s. A good 'scope not only reveals instability at decoupled points but will also let you see the intercarrier sound entering the i.c. together with any video modulation that could cause buzz. Since i.c.s are current-operated devices their waveforms are generally small, calling for good 'scope sensitivity. To see the truth you also need a low-capacitance × 10 probe which of course reduces 'scope sensitivity by a decimal point. A × 2 probe with an impedance of 2MΩ and an input capacitance of around 60pF will work wonders in 99% of applications. Fig. 2 shows the idea for anybody keen enough to try one.

The high gain of i.c. amplifiers means that circuit layout is critical with respect to stability. Designers' chassis points should be rigidly adhered to and checked for hairline copper cracks. On boards with more than one i.c. the earth paths should form a "tree" with the common or take-off point nearest the high-signal end. Avoid earth loops. Each i.c. should be decoupled close to its l.t. input pin. A few ohms here may generate an h.f. oscillation which gives funny faults you can't trace.

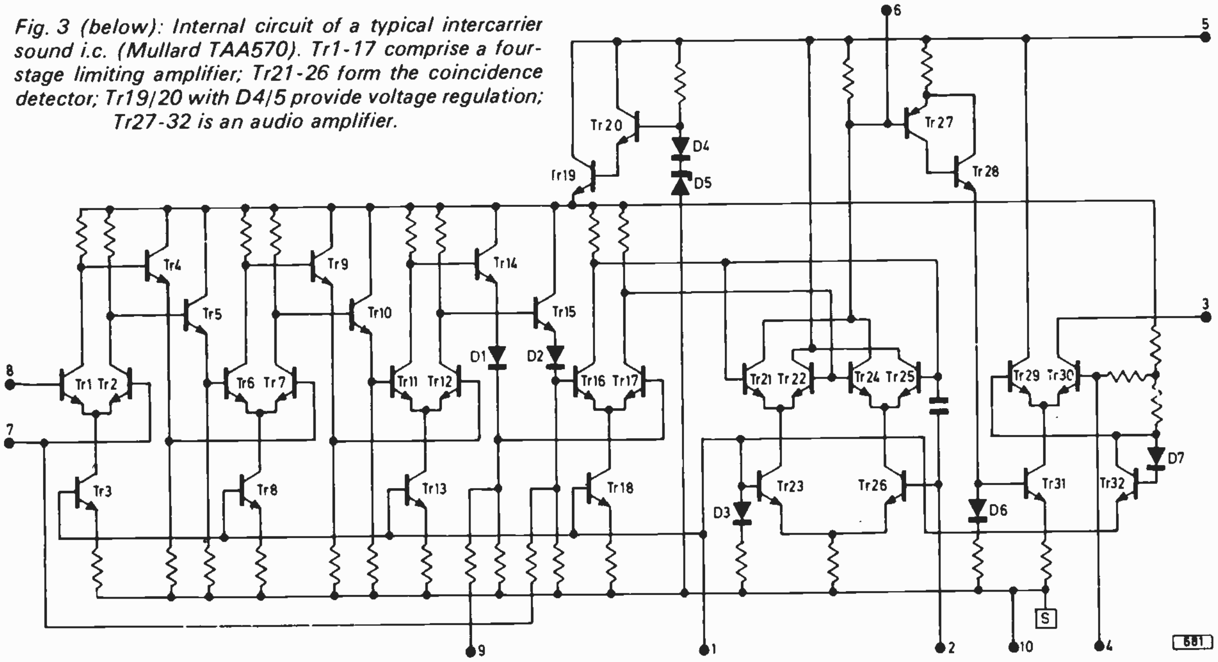
What's Inside?

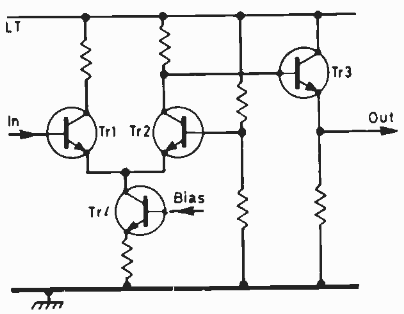
The internal circuit of a typical i.c. (the TAA570 intercarrier sound channel) is shown in Fig. 3—it looks a bit bewildering at first so let's try to break it down into a few compartments each typical of current i.c. technique.

The left half comprises a four-stage differential amplifier. One such stage is shown in Fig. 4, the emitter-coupled differential amplifier pair being Tr1 and Tr2. Differential amplifier stages are widely used in i.c.s because of their good d.c. stability which is necessary with the d.c. coupling employed. Tr2 is coupled by an emitter-follower (Tr3) with zero gain used to match into the d.c. condition of the following stage. Tr4 in the common emitter load circuit has its gain controlled by the voltage applied to its base: in our case (the TAA570) this comes from the detector stages and produces the limiting which the f.m. strip requires. On amplifiers for other purposes such an arrangement could be used to control the volume, contrast or colour.

On the right of the complete circuit (Fig. 3) is the f.m. detector (Tr21-Tr26). It is a coincidence type detector and is shown in its basic form in Fig. 6. Limited and squared-off f.m. signals are applied in antiphase to the bases of Tr1 and Tr2. The signal from the preceding limiter amplifier stages is also taken outside the i.c. to the quadrature coil which is of high Q and tuned to 6MHz. Not only does this coil smooth out most of the modulation, due to its resonance at the carrier frequency, but it also produces a phase shift at its output to something in between that of the signals present at the bases of Tr1 and Tr2. This regular phase-shifted signal is applied to Tr3 base and results in this transistor conducting during the tips of the positive half cycles only. Tr1 and Tr2 can only conduct when Tr3

Fig. 3 (below): Internal circuit of a typical intercarrier sound i.c. (Mullard TAA570). Tr1-17 comprise a four-stage limiting amplifier; Tr21-26 form the coincidence detector; Tr19/20 with D4/5 provide voltage regulation; Tr27-32 is an audio amplifier.





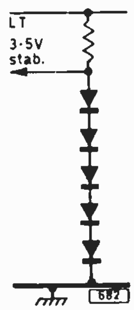


Fig. 4 (left): Typical i.c. amplifier stage: Tr1/2 form an emitter-coupled differential amplifier with the bias applied to the base of the emitter transistor Tr4 controlling the stage gain; the emitter-follower Tr3 provides matching to the following stage.

Fig. 5(right): Generating internal voltage stability: a silicon diode drops 0.7V regardless of the current when forward biased—five in series will thus simulate a (5×0.7) = 3.5V zener diode.

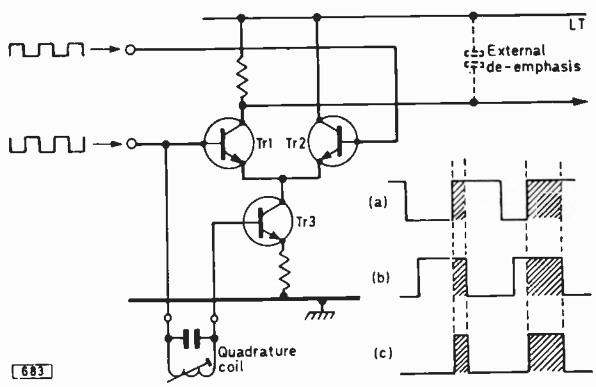


Fig. 6: Typical coincidence detector (alias synchronous demodulator) circuit. The f.m. input (a) is applied in anti-phase to the bases of Tr1 and Tr2. The input is also smoothed of its f.m. by the external quadrature coil to give regular phase-shifted pulses (b) which are fed to Tr3 base. Conduction occurs only when (a) and (b) overlap, producing pulses of varying width (c) at Tr1 collector. The external de-emphasis capacitor smooths these to produce the audio signal.

is conducting of course, and then only for as long as their input signals overlap Tr3's conduction period. This period of time varies with the f.m. of their base signals. The output at Tr1 collector is thus a series of pulses of varying width which when smoothed by an external de-emphasis capacitor results in the original audio frequencies being reproduced.

If you look back to Fig. 3 you will notice that the detector bridge is very much a "belt and braces" affair. Everything is duplicated. This is done—as with differential amplifier pairs—to prevent thermal drift inside the i.c. Each pair of transistors which is together on the circuit diagram is arranged diagonally on the chip. In this way any rise in temperature influencing the i.c. from any direction will equally warm each one of each pair of the detector transistors and the bridge will remain balanced regardless of heat arriving from any direction.

With all this d.c. coupling i.c.s are fussy about their voltage supplies and although the receiver usually supplies a steady l.t. certain parts of the internal circuit are often zener stabilised. In Fig. 3 the stabiliser is D4, D5, operating a voltage regulator Tr19, Tr20. The zener diode D5 could equally well be a simple chain of diodes as shown in Fig. 5. All silicon diodes drop about 0.7V when forward biased regardless of the current taken. Thus to stabilise a point at say 3.5V all we need to do is diffuse a chain of five silicon diodes into the i.c. chip.

There are of course many other unfamiliar circuit ploys adopted by the i.c. designer, but the three outlined above crop up so often that to be able to spot them right away on a circuit makes life a lot easier.

CONTINUED NEXT MONTH

THE 'TELEVISION' RECEIVER FAULT FINDING COLOUR IF STRIP

R. FISHER

SOME constructors who have attempted to align their own i.f. strips have had difficulty tracing faults caused mainly by incorrect construction. The purpose of this article is to outline the basic fault finding procedure adopted by the Alignment Service and list the common faults found on constructors' boards.

There are a few points that must be checked before any systematic fault finding is undertaken. The first point has already been made several times but it is worth making again: check all the coil continuities. Many boards the Alignment Service receives have open-circuit coils and this can only be attributed to the constructors concerned having failed to read the assembly instructions published in the July 1972 issue of the magazine.

The second point concerns soldering. Many constructors, and we are not going to be popular in saying this, obviously find difficulty in soldering correctly. The most common fault encountered is that constructors have not scraped the component leads before soldering them into the circuit board. If your i.f. strip has had any part of it resoldered by the Alignment Service you would be well advised to check your soldering on the other modules you have constructed.

The final point is that some batches of ready-wound coils have been found not to tune sufficiently high in frequency and may be 2MHz low. If this problem is encountered you can shift the whole amplifier response down 2MHz in frequency. This makes no difference to the gain, stability or noise figures of the strip.

Test Equipment Required

The equipment needed is listed on pages 317–318 of the May 1973 issue under the heading "Sweep Alignment". In addition to this equipment you will need a multi-test meter (such as the Avo Model 8 or Philips Multitester) and a demodulator probe for the oscilloscope. If you don't have a suitable probe one can easily be constructed on a small piece of Veroboard: details are given in Figs. 1 and 2.

Setting Up

The equipment and i.f. module should be set up as described on page 318 of the May 1973 issue under the heading "Setting Up". When the constructor proceeds to align the board any error that has been made in constructing the i.f. amplifier or the luminance amplifier will show up in the first few stages of alignment. The most obvious of these is no output at all from the module.

No Luminance Output

Absence of luminance output is by far the most difficult fault to trace: to locate the faulty stage or stages you will need the demodulator probe and oscilloscope. Lock the dual-trace oscilloscope to the sweep output of the wobbulator and display the marker pulse on the top trace. With a sweep from 30MHz to 45MHz feed the output of the wobbulator into the preamplifier section of the tuner panel (with C522 removed) and set the output level of the wobbulator at 10mV. Connect the demodulator probe to the second channel of the oscilloscope and place the probe tip on the base of Tr101. By adjusting L101 and L104 the lower limits of the response can be set when viewing the output of the demodulator probe on the oscilloscope. Similarly the upper limit of the pass band can be set by adjusting L102 and the pass band shape altered by adjusting L103. The overall response shape after these adjustments have been made should be similar to that shown in Fig. 3. If there is no output from the probe at this point then a fault lies in the input filter or in the tuner preamplifier and these should be checked and repaired before continuing.

Assuming that the response shown in Fig. 3 is present at the base of Tr101 the next check is to monitor the output of the first i.f. amplifier with the probe on the collector of Tr101. The output should be similar to that shown in Fig. 4. If no output is present then the fault lies in the first i.f. amplifier or in the a.g.c. circuitry (experience has shown that the latter is the more likely).

AGC Fault Finding

To determine whether the fault is due to incorrect operation of the a.g.c. system measure the base voltage of Tr101. With no signal input and the a.g.c. threshold and delay controls R125 and R133 set in the fully clockwise position (looking at the board with the input point to your left) the voltage should be 8.2V. With the delay control R133 in the fully anticlockwise position Tr101

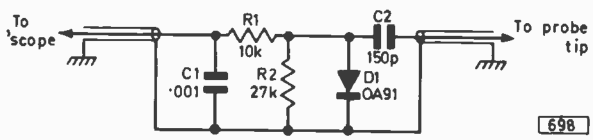


Fig. 1: Suitable demodulator probe circuit.

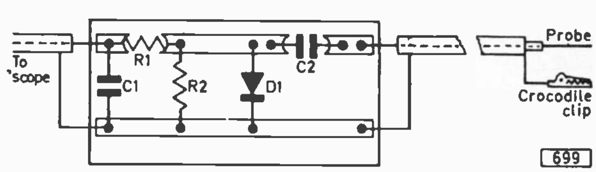


Fig. 2: Probe layout. For simplest probe tip peel back the output coaxial cable for 2in., form the chassis connection from the braiding and tin the inner conductor to make it stiff.

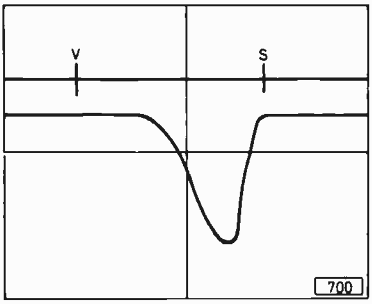


Fig. 3: Correct waveform at Tr101 base. S is the sound marker and V the vision marker. A.G.C. `delay control set midway. Y amplitude 20mV/cm., X timebase speed 1msec/cm.

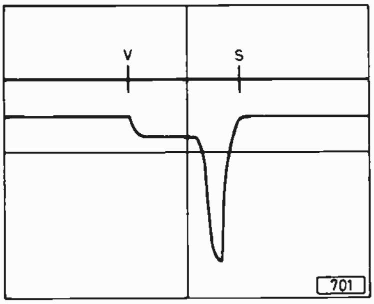


Fig. 4: Correct waveform at Tr101 collector with a.g.c. delay control set midway. Y amplitude 20mV/cm., X timebase speed 1msec/cm.

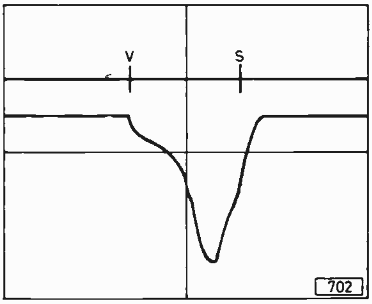


Fig. 5: Correct waveform at Tr103 collector—a.g.c. delay control set midway. Y amplitude 500mV/cm., X timebase speed 1msec/cm.

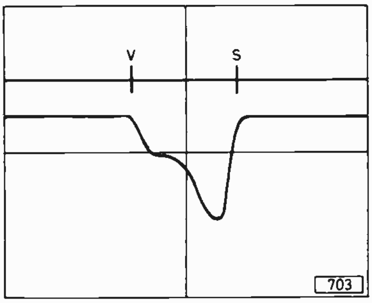


Fig. 6: Correct waveform at Tr102 collector—a.g.c. delay control set midway. Y amplitude 10mV/cm., X timebase speed 1msec/cm.

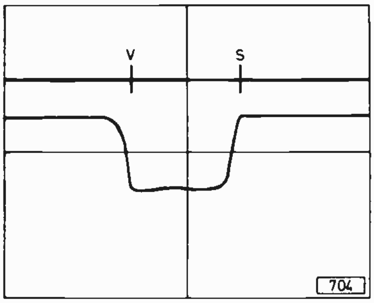


Fig. 7: Correct waveform at Tr104 collector, taken with probe placed on the body of R115 and R133 set midway. Y amplitude 200mV/cm., X timebase speed 1msec/cm.

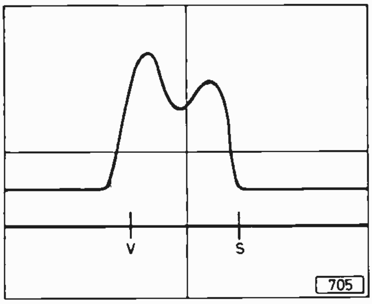


Fig. 8: Correct waveform at D101 cathode—a.g.c. delay control set midway. Y amplitude 2V/cm., X timebase speed 1msec/cm.

base voltage should rise to 8.6V. If the base voltage does not lie within these two limits then the fault lies in the a.g.c. system and the voltages at Tr106, Tr107 and Tr108 should be measured and compared with those given in Table 1. In this way the faulty stage can be isolated and the associated components then checked. If the base bias of Tr101 is correct then the fault must lie within the first i.f. amplifier.

It is not easy to fault find in the a.g.c. circuits so it may be as well to mention the most common faults that the Alignment Service has encountered. First of all check whether the link has been added between D106 cathode and Tr106 collector. This is by far the most common fault and results in the base potential of Tr101 rising to a steady 9.8V. If the base potential of Tr101 is too low (a typical measurement would be 5V) check the base voltages of Tr107, Tr106 and Tr105. If all these voltages are too high the fault is usually caused by L108 being mounted on the circuit board laterally reversed. This error results in winding E–F being between the l.t. rail and the top end of R119 and as the a.g.c. transistors are d.c. coupled all the base potentials rise. If Tr101 base voltage does not change when the delay control R133 is adjusted Tr108 and its associated components should be suspected. A dry-joint in the potential divider R132, R133 and R134 is the most common cause of this fault.

Cascode Stage

With an output at the collector of Tr101 we move on to the cascode amplifier. This stage does not seem to give as much trouble as the other stages and the faults we have encountered here have been easy to clear. The first step is to monitor the output of the amplifier at the collector of Tr103, see Fig. 5. If this waveform is not present check all the voltages of the two transistors: this will give an indication as to the faulty area. If all the d.c. potentials are correct then we have to isolate the faulty transistor. When the demodulator probe is placed on the collector of Tr102 the display should resemble that shown in Fig. 6. Note that the amplitude of this waveform is less than that present at the collector of Tr101—this is because Tr102 is a current amplifier working into the very low input impedance of Tr103. If the response is not present at this point then the fault lies in Tr102.

Final IF Stage

Once operation of the cascode amplifier has been confirmed we can move to the last i.f. amplifier Tr104. It is not possible to monitor the collector of this stage with the demodulator probe because the shunt capacitance of the probe causes the stage to become unstable as the transistor is working into a high-impedance load. A very reasonable trace can be produced however by resting the tip of the probe on the body of resistor R115. The radiated i.f. from this component is capable of producing the display shown in Fig. 7. If there is no output from this stage then checking the bias voltages on the transistor will reveal the cause of the fault.

Post Detector Stages

Fault finding from the detector stage onwards is far less of a problem as we can work with a video display and cast the demodulator probe to one side. A luminance sweep, such as the one shown in Fig. 8, should be present at the cathode of D101 using a conventional high-impedance

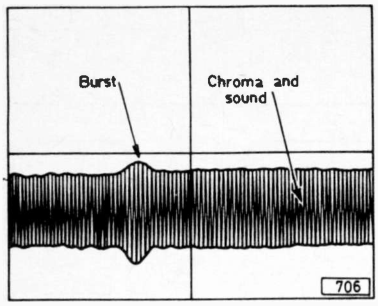


Fig. 9: Signal at Tr110 base. Y amplitude 50mV/cm., X timebase speed 10µsec/cm.

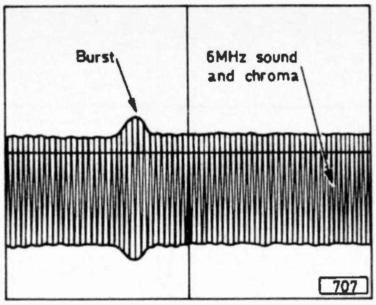


Fig. 10: Signal at pin 2 of the TAA350 intercarrier sound i.c. Y amplitude 50mV/cm., X timebase speed 10µsec/cm.

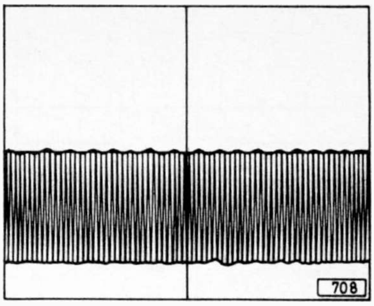


Fig. 11: Signal at pin 6 of the TAA350 intercarrier sound i.c. Y amplitude 200mV/cm., X timebase speed 20µsec/cm.

probe. (Note the change in the polarity of the signal.) After the detector it is just a matter of using standard fault finding techniques to trace the signal through the luminance amplifier Tr105 and the emitter-follower Tr109 to the output of the board.

Chrominance & Sound Faults

Chrominance and sound faults are covered together because both signals are derived from the same detector (D102) and most of the faults encountered have been common to both the sound and chrominance channels.

Once the operation of the luminance channel has been established, align the i.f. amplifier as described in the May issue. Then connect the tuner to the input of the i.f. strip and tune to a local channel. Adjust the a.g.c. threshold control for correct picture contrast on the monitor and the a.g.c. delay control for minimum picture noise. By placing the high-impedance probe on the junction of L116 and R145 a negative-going video waveform of 0.2V peak-to-peak should be obtained. Move the probe to the base of Tr110 and the waveform shown in Fig. 9 should be seen. If it is not the fault obviously lies between these two points. If the waveform is present and there is no chrominance output then Tr110 must be suspected and the bias voltages will usually indicate the cause of the trouble.

It is just as easy to trace faults in the sound channel. If you have a chrominance output and no sound output then the fault must lie from L118 onwards. The first check is to monitor the waveform at pin 2 of the sound i.c. It should appear as shown in Fig. 10. If the waveform is not present at this point suspect L118 or C147.

By far the most common fault encountered in the sound channel is a defective i.c. (see notes on i.c. soldering in the April 1973 issue). This can be checked by monitoring the output of the device at pin 6—the output should take the form of a 600mV peak-to-peak limited f.m. signal as shown in Fig. 11. If you find that there is no output at pin 6 check the 6V supply to the i.c. (pin 9) and also the feedback loops C152/R154 and C149/R156. Only when all these tests fail do you pay out for a new i.c.

If an output is present at pin 6 the fault must lie between this point and the output of the board. The most common trouble is a fault in the slope detector circuit L126/C155/C154/D103.

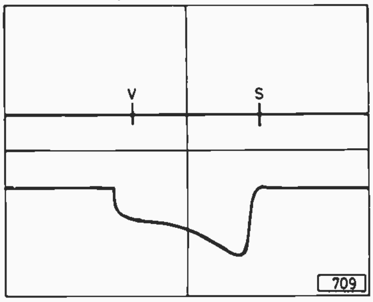


Fig. 12: Correct waveform at Tr111 collector with R133 set midway. Y amplitude 0.1V/cm., X timebase speed 1msec/cm.

AFC Circuit

To obtain the correct a.f.c. ramp (see May 1973 issue page 320) the whole i.f. amplifier must be operational *and aligned*. Once the strip has been correctly aligned proceed as follows. Using the demodulator probe check the signal at the collector of Tr111—it should take the form shown in Fig. 12. If no output is present the fault lies in the a.f.c. amplifier and the bias voltages should be checked. If an output is present at the collector the coil continuities should be checked, also the discriminator. One of the most common faults we have found in this stage is that the a.f.c. ramp slopes in the wrong direction. This is caused by incorrect internal connections in the a.f.c. transformer. Great care must be taken if you correct this fault by rewiring the coil former; the fault can be cleared far more easily by reversing the diodes D104 and D105.

Instability

Most constructors after building an i.f. amplifier and finding it unstable utter a few choice words and use it for spares or throw it in the dustbin. There is no need at all for this drastic action with your i.f. module. If the problem does arise disconnect the board from the test equipment and check that all the components are mounted flush with the board and that all the component leads are as short as you can make them. The most critical components are C116, C121, C118 and C120. By shortening the length of the leads on these components the problem will in nine cases out of ten be resolved. We have also found that if mica capacitors are not used this can give rise to some problems, especially in the case of C116. Thus if instability persists and you have used ceramic or any other type of capacitor you would be well advised to change them (there is no need to make such changes on a board that is otherwise working happily of course).

If after checking all these points you still have instability, life becomes a little more difficult. The Alignment Service has found that the home etched board is by far the most likely to give problems and it is usually a case of

—*continued on page 517.*

LONG-DISTANCE TELEVISION

ROGER BUNNEY

JUNE 1973 produced a varied selection of signals ranging from tropospheric to exotic Sporadic E propagation. Added to this is news of yet more F2/TE reception in the UK from Rhodesia! Very warm settled weather gave a decided lift to tropospheric reception particularly from the 22nd to the 26th when the Swedish v.h.f./u.h.f. networks were being received along the East coast in addition to the more "normal" West German v.h.f. and u.h.f. networks. Sporadic E declined to some extent during the month in both frequency and duration, with several days of no-go reception. One important reception that occurred was of Albania ch.IC in Holland on test card, also subsequent suspected reception of this transmitter in the UK on June 16th—this was reported by several readers in addition to my own observations. Now to the log of reception noted here in the Romsey area:

2/6/73 CST (Czechoslovakia) ch.R1—SpE; NOS (Holland) E4—trops.
3/6/73 TSS (USSR) R1; CST R1; TVP (Poland) R1; JRT (Yugoslavia) E3; RAI (Italy) IA, IB; TVE (Spain) E2, 3, 4; also unidentified signals—all SpE.
4/6/73 DFF (East Germany) E4—MS (meteor shower/scatter); TVP R1; CST R1 twice; RAI IA, IB—all SpE.
5/6/73 DFF E4—MS; NOS E4—trops; also unidentified SpE signals.
6/6/73 TSS R1, 2, 3, 4; TVP R1; DFF E3; YLE (Finland) E2, 3; NRK (Norway) E2; SR (Sweden) E2, 4—all SpE.
7/6/73 DFF E4; TVP R1; CST R1—all MS; TSS R1; TVE E2, 3, 4; RTP (Portugal) E2; RUV (Iceland) E4—all SpE; NOS E4—trops.
8/6/73 DFF E4; CST R1—both MS; RAI IA twice, IB; NRK E2 twice, 3, 4; TSS R1—all SpE.
9/6/73 TSS R1; CST R1, 2; MT (Hungary) R2; TVR (Rumania) R2; DFF E4; RAI IA, IB; JRT E3, 4; TVE E2, 3, 4; SR E2—all SpE; NOS E4—trops.
10/6/73 DFF E4—MS; RAI, IA, IB; TVE E2—all SpE.
11/6/73 CST R1—MS.
12/6/73 DFF E4—MS.
13/6/73 TSS R1; TVP R1; CST R1; DFF E4; WG (West Germany) E2—all SpE; BRT (Belgium) E10—trops.
14/6/73 TSS R1; TVE E2, 3; RAI IA twice, IB twice—all SpE; BRT E8—trops.
16/6/73 MT R1, 2; JRT E3, 4; TVE E2, 3, 4; RAI IA; plus many unidentified signals (including suspected Albanian ch.IC at 1810-1829 BST).
17/6/73 TSS R1, 2; CST R1; TVE E2, 3; RAI IA; plus unidentified signals—all SpE; improved trops.
18/6/73 TVE E3—SpE; NOS E4—trops; improved tropospherics into N. France v.h.f./u.h.f.
19/6/73 DFF E4—MS; TSS R1; CST R1—both SpE; BRT E8, 10—trops.
20/6/73 CST R1—MS; TSS R1, 2; YLE E2; JRT E3 twice, E4 twice; RAI IA; TVE E2, 3, 4; SR E2, 3; plus unidentified signals—all SpE.
21/6/73 TSS R2; CST R1; WG E2; ORF (Austria) E2a—all SpE.
22/6/73 TSS R1; TVP R1; CST R1—all SpE.
23/6/73 CST R1—MS; TVE E2, 3; RTP E3—all SpE.
24/6/73 DFF E4; CST R1—both MS.
25/6/73 TSS R1; NRK E2; TVE E2—all SpE; NOS E4—trops.
26/6/73 BRT E8, 10—trops.
27/6/73 DFF E4—MS.

The YLE ch. E3 reception on the 6th was a new station for me (Tervola)—a welcome visitor indeed! An interesting TSS reception on the 8th occurred at 2145 BST/CET. The news—network—was followed by the "Minsk" caption and then local news, followed in turn by the station closedown. This is the first time that I have been able to identify definitely a regional transmission. Graham Deaves mentions that he received Rumania ch. R4 (Suceava 4kW e.r.p.) on May 20th—the first time to my knowledge that this has been seen within the UK. Another interesting note from Graham indicates that SECAM colour reception has now occurred via SpE from TSS (USSR), MT (Hungary) and Poland—the latter on news.

Following several reports of a mystery electronic pattern on ch. R1 resembling the NDR-3 square electronic pattern we have now been able to confirm that TSS is using this pattern—it has been seen floating over the normal 0249 card. The CST electronic pattern type CSU 01 has been noted with varying identifications—CST 59, R5 1H and EE571. The latter is something of a mystery since another report states that the pattern was noted with EESTI (Estonian TV). I feel that the "EE571" pattern was actually EESTI—an easy mistake with a weak signal.

We have reports from two correspondents of suspected Jordan ch. E3 reception—Geoffrey Chapman noted a suspect on May 23rd with Arabic music but no video; Derek Waller reports a suspect with video on June 7th from 1540 GMT onwards. We are awaiting confirming letters of these two receptions from the appropriate authorities.

Whilst on the subject of exotics our friend in Cyprus—A. Papaeftychiou—reports reception of a ch. E4 signal with Indian music and songs at noon in Cyprus which coincides with the opening times of various Indian transmitters!!

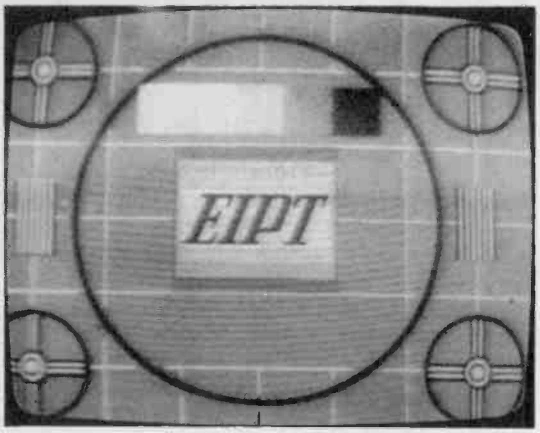
Following a query relating to the RAI test card identification numbers (top right-hand corner within the centre corner circle) we confirm as follows: for ch. IA 14 is Mt. Caccia, 23 is Mt. Cammarata, 31 is Mt. Nerone; while for ch. IB 3 is Mt. Penice and 11 Mt. Faito.

Finally in this round-up we understand that Mullard are shortly to introduce an i.c. wideband amplifier with 40-860MHz coverage having a gain of 25dB, noise of 5.5dB and requiring 24V at 35mA. As soon as further information on this unit comes to hand it will be featured.

UK Rhodesian TV Reception Again

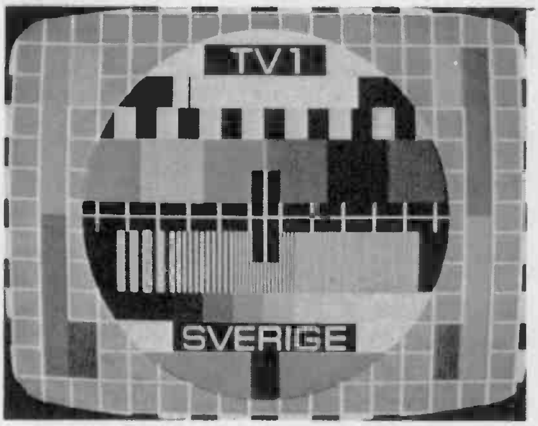
We mentioned recently that Hugh Cocks of Mayfield, Sussex had successfully received Gwelo, Rhodesia ch. E2. We are now pleased to report that Derek Waller of

DATA PANEL 26-2nd series



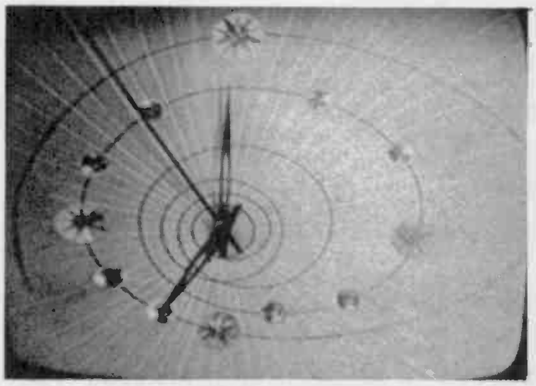
Greece: Ethnikon Idryma Radiophonias Tielorasseos, test card (left), station identification slide (right).

Greek Armed Forces Information Service test card—Ypiressia Enimerosseos EnoplonDhynameon Helladhos (Yened).



The PM5544 colour test card as used by Sweden—Sveriges Radio.

Intervision caption—Czechoslovakia.



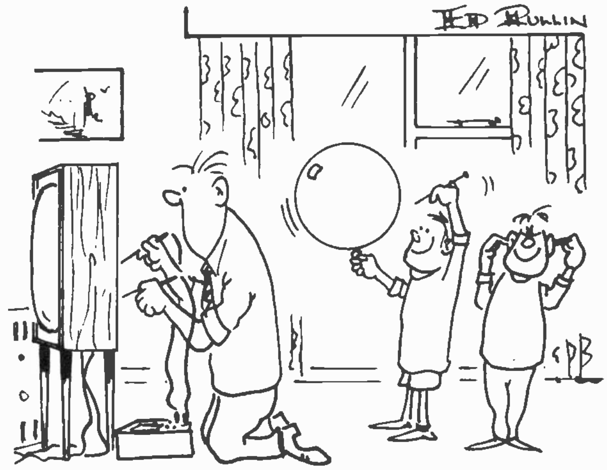
ORTF (France) 1st chain clock.

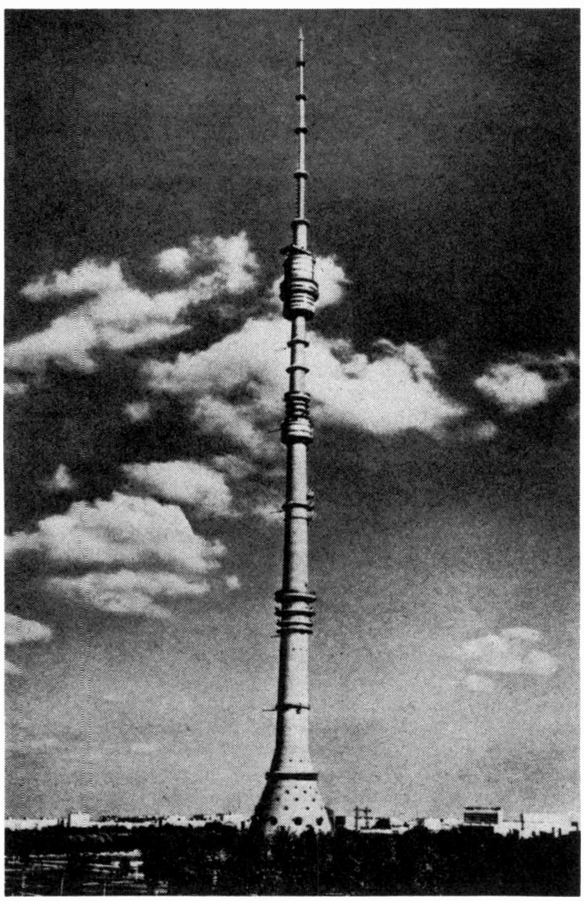
Photographs this month, courtesy Paul Gardiner, Michele Dolci, Yened TV, Clive Cathowe, P. F. Vaarkamp (Holland) and Radio Moscow (opposite).

Consett, Co. Durham has also succeeded in this extreme distance reception. Strange to relate this reception happened on May 24th—Hugh's was on April 24th. Derek comments that between 1600-1716 GMT he noted programmes in English, starting with the news, rugby, various adverts and songs from Julie Andrews. His notes on the sound reception are very detailed—he was using an Eddystone communications receiver type 770R (v.h.f. type) for the sound and for video a Bush Model TV183. Sound quality was fair but video was "fuzzy". A letter from the chief engineer at Rhodesian TV confirms that his reception was from the Gwelo transmitter. Derek now joins the exclusive club of extreme TV-DXers—I think this is the farthest that Rhodesian TV has been received. Our congratulations to Derek.

News and Latest EBU Listings

USSR: One of the most Northerly TV stations has gone into service at Tixie (an Arctic Harbour), operating via the Orbita/Molniya satellite link.
Lebanon: Tele Orient studios at Beirut are to equip with colour equipment and this should be in operation shortly. From information to hand we understand that the SECAM system has been adopted for this country.
Yugoslavia: A considerable expansion of TV coverage will be taking place over the next three years with the completion of the second chain. RTV Skopje will have extra transmitters for both v.h.f. and u.h.f. (four u.h.f., two v.h.f.). The Pristina area (North of Macedonia) which at present has no TV service will have four transmitters—two u.h.f. and two v.h.f. An interesting footnote is that Marconi have recently completed a transmitter which is inaccessible during the Winter months atop the 8,500ft. Mt. Pallister. A further u.h.f. transmitter is to be installed there.





The Moscow TV tower at Ostankino.

West Germany: Following recent comments on twin sound channel working proposals we understand that the Bayerischer Rundfunk transmitter at Regensburg is to be equipped for such operations, using 5.5MHz and 5.742MHz vision/sound spacing.
France: Lille Bouvigny ch.E24 1000kW; Mulhouse ch.E24 100/500kW; Nancy ch.E26 500kW; Paris—Tour Eiffel ch.E28 1000kW; Strasbourg ch.E43 1000kW. These transmitters carry ORTF-3 programmes and the transmissions are all horizontally polarised.

From our Correspondents . . .

With the excellent conditions this past month we have had an extremely full post bag. Dr. E. Duncan of St. Andrews, Fife has written to report reception in Scotland. He notes that TVE (Spain) has dominated many days with at times excellent reception. His receiver consists of a modified Thorn 850 chassis which is fed via an external v.h.f. tuner into its u.h.f. input socket—an extra i.f. stage is thus obtained. The large quantity of photographs included with his letter indicates that the signals obtained with this receiver and an Ian Hickling type wideband Band I array have been really excellent.

P. F. Vaarkamp of Lunteren, Holland has also been noting the improved conditions of the past few weeks. He has received signals at high levels from all over Europe and notes that TVE-2 ch. E2 Santiago is still on the air—we heard last year that this transmitter would be "going u.h.f." but fortunately the work seems to be incomplete to date. Another useful tip is that commercials from RAI (Italy) are called "Giro Tondo". A large quantity of photographs came with this letter and we hope to include these in coming months: one is featured in fact this time—the Intervision caption indicating programme origination from Prague, Czechoslovakia.

As ever our Derby friends Keith Hamer and Garry Smith have been forwarding information and it is to their credit that several mysteries have been cleared up. One has still to be solved however: a pattern roughly similar to the Philips PM5552 (NOS colour blockboard) was noted on ch.R1/E2a on June 4th. Did anyone else see this??

RENOVATING the RENTALS

17 PHILIPS G6 CHASSIS

CALEB BRADLEY B Sc

THE LINE OUTPUT STAGE

Poor Field Performance

A VARIETY of field faults such as vertical jitter, intermittent field collapse or critical setting of the hold control can be caused by a faulty V4002 (ECC81) and/or R4092 changing value. Field bounce with variations in picture content is a misleading fault caused by poor smoothing in the a.g.c. circuit—replace C2040 and C2041 (see Fig. 2 pages 408–9 July). Excessive height with poor linearity can be caused by either of the two resistors which make up R4119 (82kΩ total) going open-circuit.

A peculiar fault occurs if X7323 (c.r.t. bias supply rectifier) on the c.r.t. base goes high-resistance: the top inch of the picture is dark.

Line Output Stage Operation

The line output stage, e.h.t. and focus circuit is shown in Fig. 7 and the component layout in Fig. 8. H.T. is supplied to the line output stage via a spring-off resistor R1073 which is accessible at bottom left of the chassis when in the servicing position and an interlock switch operated by a plunger on the line output stage cover. This latter arrangement disables the line output stage if the cover is removed —a precaution because of the danger of X-ray radiation from the e.h.t. rectifier (GY501) and shunt stabiliser (PD500). The interlock *must not* be tampered with or defeated.

The line output stage uses a desaturated transformer arrangement in which the d.c. path from h.t. to the line output valve (V5001) anode is via the boost diode (V5002) and a high-inductance choke L5502. V5001 is switched on and off at line frequency by the line drive fed to its grid and the a.c. voltage component produced across L5502 is coupled to taps 14 and 15 on the line output transformer by C5015 which prevents d.c. flowing in the transformer. An isolated secondary winding (taps 6 to 11) drives the line scan coils via linearity controls for each standard. Only a simple two-position width control is provided since the width should be nearly correct after the line stabilisation controls R5040 and R5041 have been set. Stabilisation works in the conventional manner: a 1kV line pulse from tap 13 is fed via C5017 to the v.d.r. R5038 whose non-linear resistance provides rectification resulting in a negative bias which is applied to V5001 grid via R5039 to prevent the line amplitude exceeding a certain level. This level is established by R5040 or R5041 which in effect control the efficiency of the v.d.r. as a rectifier.

The anode current of the boost diode is passed through R1070 which provides the horizontal shift voltage applied across the line scan coils via the a.c. blocking choke L1517. The shift direction can be changed by reversing a plug, similarly to the vertical shift arrangement shown in Fig. 3 last month. Since the scan winding (taps 6 to 11) is at the d.c. level of h.t. the voltage across the boost capacitor C5013 is the difference between h.t. and the boost h.t. supply generated at tap 12 by the standard flyback-energy conservation action of the boost diode. It is vital that the voltage across C5013 (measured at SK12 between pins 3 and 5) is set by means of R5040/1 to *no more than* 570V and preferably somewhat less if good focus can still be obtained. This establishes the correct width and e.h.t. voltage. If the boost voltage is set too high the life of the line output transformer will be short.

Focus Supply Circuit

The focus supply is provided by V5005 which rectifies the pulses at V5001 anode. The focus voltage fed to the c.r.t. base is varied by R5045 which forms part of a divider chain of high-value resistors. The function of C5018 is to add either positive (625) or negative (405) line pulses at the output side of V5005 to augment or reduce its output respectively for the two line standards. V5005 is an EY51 which is wired to tags on a paxolin panel across which arcing can occur. The only cure is to chop away all parts of the panel which have carbonised. Arcing can also occur inside R5045 and may be caused by C5019 shorting or by tracking occurring across the focus spark gap on the c.r.t. base. Poor focus is sometimes caused by a resistor on the earthy side of R4045 going open-circuit.

EHT System

E.H.T. is obtained from an overwinding into which the rectifier V5004 plugs directly. The e.h.t. stabiliser V5003 keeps the e.h.t. voltage constant by ensuring a constant current (1.2mA) through V5004 regardless of changes in c.r.t. beam current with changes in picture content. To set the circuit up the three c.r.t. beams are first switched off by means of the first anode switches on the convergence box; R5053 is then adjusted to give 1.2mA cathode current in V5003, checked by measuring 1.2V across R5054 which is accessible on the tagstrip on top of the line output compartment. The conditions at V5003 grid should then be as follows. R5035 supplies a constant approximately 0.9mA from the boost h.t. rail. The 1.2mA cathode current is drawn through V5004 and the overwind whose earthy end is connected to V5003 grid. Therefore 1.2 − 0.9mA is drawn through R5053 and R5052 and V5003 grid is at about −16V. Now when the c.r.t. beams are switched on and beam current is drawn from V5004, V5003 grid is driven further negative so that its cathode current decreases thus maintaining constant current in V5004. In this way the e.h.t. voltage is stabilised for beam currents from 0 to 1.2mA. Higher beam current which could damage the c.r.t. is prevented by the negative voltage on R5052 which is fed back to the beam limiter circuit on the i.f. strip (Fig. 2, July).

If an e.h.t. voltmeter is available the e.h.t. voltage

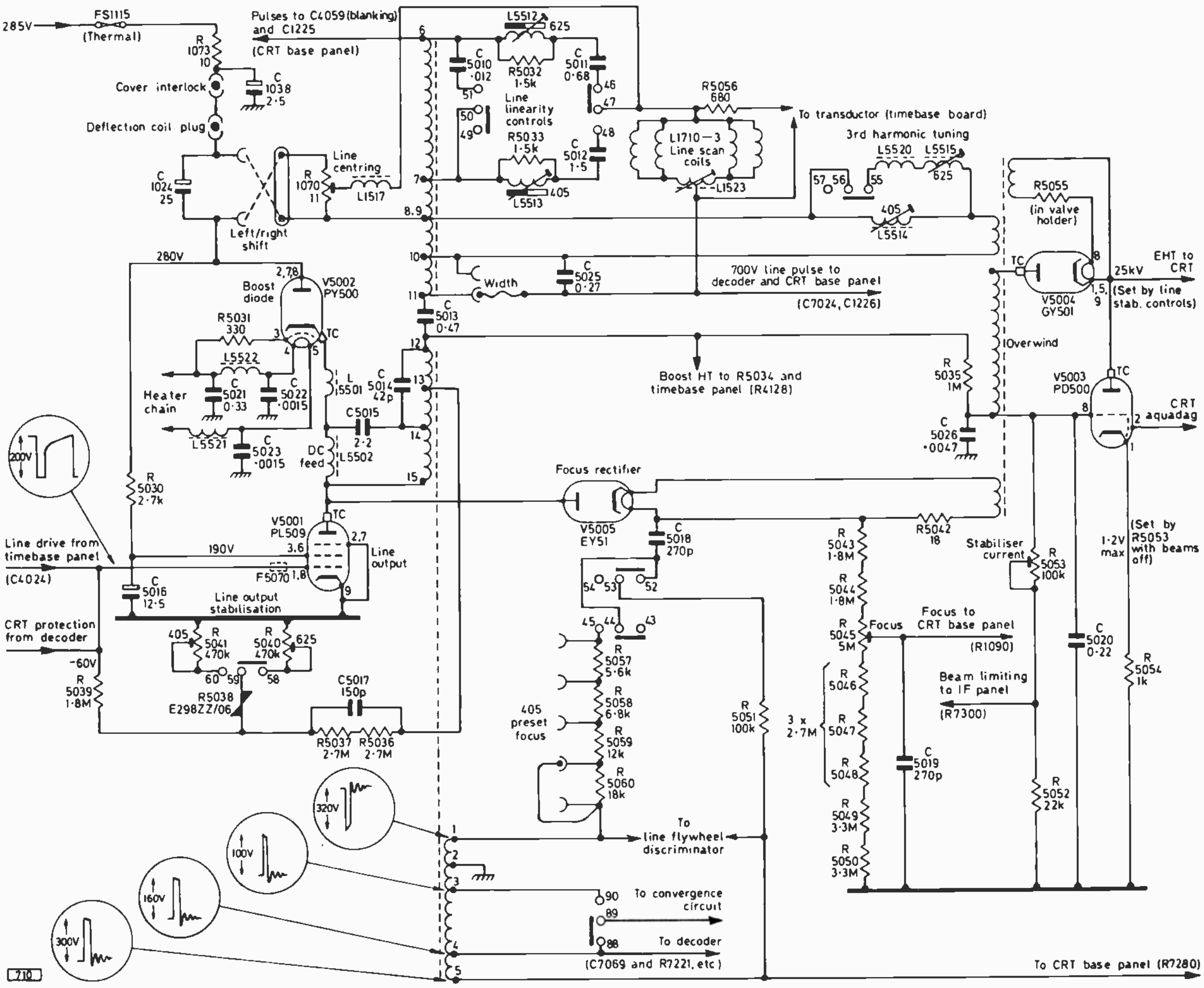


Fig. 7: Line output stage, e.h.t. and focus supply circuit. The system switch is shown in the 625-line position. Most connections to the line output transformer are via PL/SK11 and PL/SK12, see layout (Fig. 8, page 513). In later versions R4040 and R4041 (line stabilisation) are 220k Ω. C5014 may be 100pF or in later versions omitted. C1038 and C5026 are on later versions only. R4042 may be wired between V5005 heater and the junction C5018/R5043 and the heater winding on the line output transformer.

should be checked: although the circuit is designed to give 25kV it makes sense with all older colour chassis not using solid-state e.h.t. multipliers to set the line stabilisation for as low an e.h.t. as practical, thereby extending the life of the e.h.t. overwinding. Most 25in. tubes give a good picture with as little as 22kV.

Common Line Faults

The common fault of reduced width almost always indicates that a new PL509 is needed. Very slow warm-up is usually due to a worn out boost diode (PY500)—it is an excellent idea to replace both these valves when renovating the chassis. If with good valves R5040/1 fail to control the boost voltage properly (too high or too low) check for value change in R5036, R5037 and R5039, or C5017 open-circuit or C4024 (on the timebase panel) leaky. Failure of the v.d.r. is not very common.

If V5001 shorts internally the excessive current should cause R1073 to spring open: unfortunately this does not always happen and L5502 may go up in great smoke.

Vertical Striations

Vertical striations can be caused by R5032 or R5033 going open-circuit, a cracked line output transformer core or C5016 (PL509 screen grid decoupler) drying up. Access to C5016 is rather difficult since it is mounted under the line output compartment.

Blank Screen: Procedure

Much time can be wasted trying to cure blank screen (no e.h.t.) faults on this chassis unless a logical procedure is used. Disconnect the top cap of the PL509 and check that there is h.t. at both ends of L5502. Check with a meter on an a.c. range that there is line drive at C4024—absence of drive causes both the PY500 and the PL509 to overheat until their emission deteriorates. If both these checks are o.k. but the line output stage is still dead disconnect the "c.r.t. protection" feed to the PL509 grid from R7209 on the decoder (this circuit is omitted in later chassis). The function of the c.r.t. protector triode V7004B is to disable the line output stage by means of a heavy negative bias to the PL509 grid if the field scan should fail. Hence the line output stage may now burst into life and a bright horizontal line appear on the screen, revealing the supposed line fault to be a field fault.

If there is still no line scan and the valves are known to be good, suspects to check are the screen feed resistor R5030 and the boost capacitor C5013. The latter is mounted inside the line output compartment as shown in Fig. 8 or outside it beneath SK12. If only V5002 overheats suspect C5015. If this is o.k. and L5502 is in good condition (and no broken connections can be found) a new line output transformer is probably needed. Before spending the housekeeping money however try cutting out C5014 since this could be short-circuit and the set works well without it (it was deleted in later versions).

Line failure on one standard only points almost certainly to C5010, C5011 or C5012.

EHT Faults

If something like the correct boost voltage can be obtained and the white plastic overwinding appears intact (search for cracks caused by internal arcing) but there is no e.h.t. replace the GY501. This also cures a picture shimmer effect caused by corona inside the valve. Be sure to leave a shorting clip lead between chassis and the c.r.t. final anode connector *throughout* this operation which involves loosening the screws securing the line output compartment so that the PD500 can be raised clear of the GY501 base. Also check whether C5020 has shorted and the actual value of R5035. If C5020 goes open-circuit R5053 burns out and the sky-high e.h.t. causes a shrunken picture and eventually a Guy Fawkes display from the line output transformer.

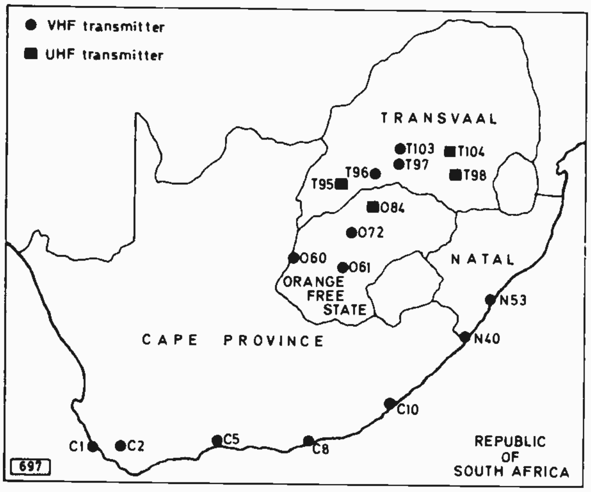
FORTHCOMING ATTRACTION:
G6 DECODER FAULTS REVEALED!

S. AFRICAN TV SYSTEM

Details of the South African television system are now available and are set out below. The transmitter channel assignments have been planned assuming the use of the following receiver i.f.s: 38.9MHz vision and 32.9MHz sound.

Transmitters	*Channels Assigned*	*Polarisation*
C1 Cape Town	5 8* 11	V
C2 Villiersdorp	4 7* 10	H
C5 George	5* 11	V
C8 Port Elizabeth	4 7* 10	H
C10 East London	6 9* 13	H
N40 Port Shepstone	5 8 11*	V
N53 Durban	4* 7 10	H
060 Kimberley	4* 7 10	H
061 Bloemfontein	6 9* 13	H
072 Theunissen	5* 8 11	H
084 Kroonstad	53 57* 61 65	H
T95 Hartbeesfontein	37 41 45* 49	H
T96 Welverdiend	4 7* 10	H
T97 Johannesburg	6 9 13*	H
T98 Davel	22* 30 34	H
T103 Pretoria	5* 8 11	V
T104 Middelburg	37 41* 45 49	H

*First channels to come into operation.



Locations of the first S. African transmitters.

Band III Channels

Channel	*Vision Carrier (MHz)*	*Sound Carrier (MHz)*
4	175.25	181.25
5	183.25	189.25
6	191.25	197.25
7	199.25	205.25
8	207.25	213.25
9	215.25	221.25
10	223.25	229.25
11	231.25	237.25
13	247.43	253.43

Channel 12 not used.

Bands IV and V

Channel	*Vision Carrier (MHz)*	*Channel*	*Vision Carrier (MHz)*
21	471.25	46	671.25
22	479.25	47	679.25
23	487.25	48	687.25
24	495.25	49	695.25
25	503.25	50	703.25
26	511.25	51	711.25
27	519.25	52	719.25
28	527.25	53	727.25
29	535.25	54	735.25
30	543.25	55	743.25
31	551.25	56	751.25
32	559.25	57	759.25
33	567.25	58	767.25
34	575.25	59	775.25
35	583.25	60	783.25
36	591.25	61	791.25
37	599.25	62	799.25
39	615.25	63	807.25
40	623.25	64	815.25
41	631.25	65	823.25
42	639.25	66	831.25
43	647.25	67	839.25
44	655.25	68	847.25
45	663.25		

Channel 38 not used.
Sound carrier is 6MHz above the vision carrier.

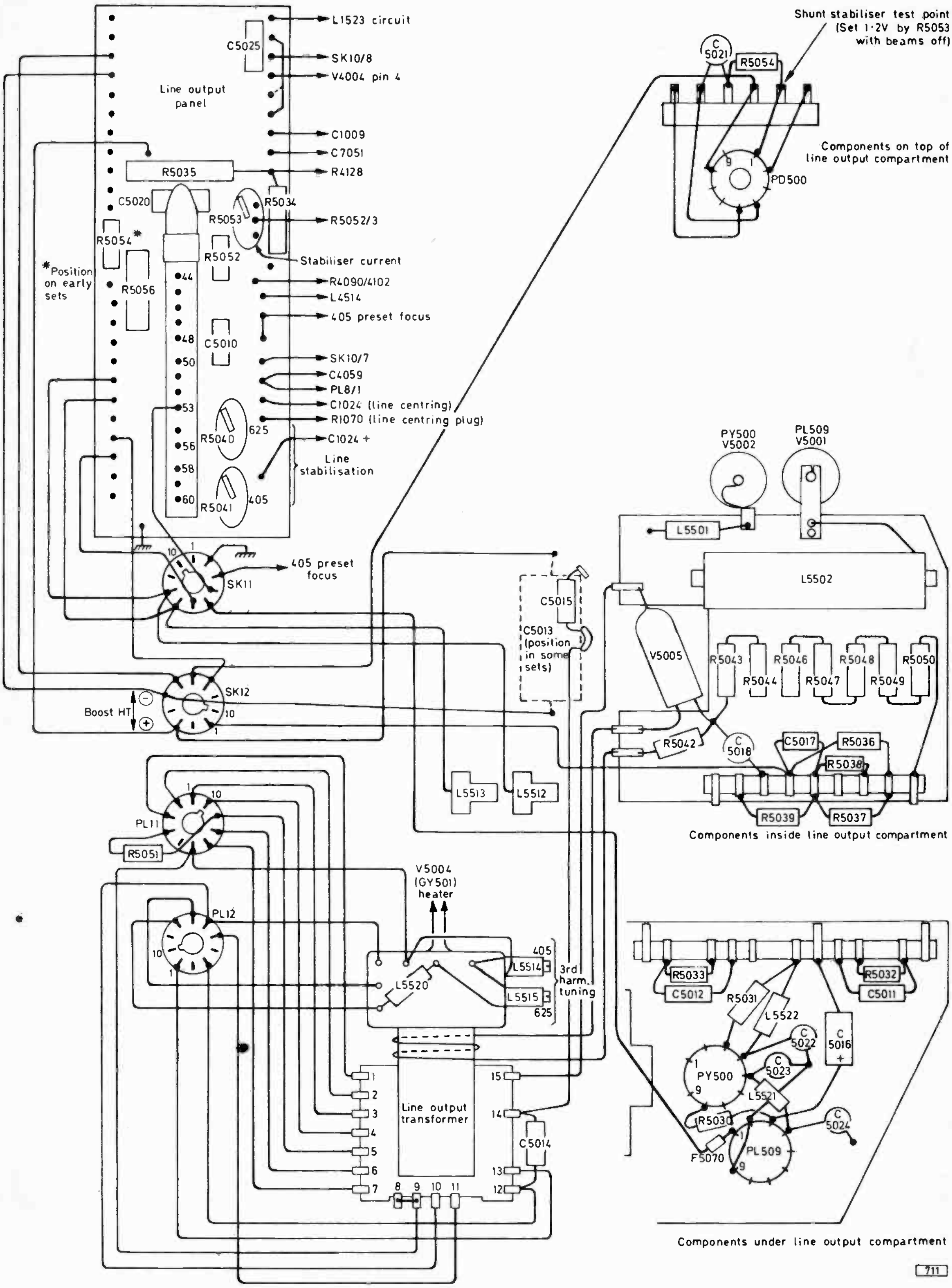


Fig. 8: Line output compartment component layout.

MONTREUX '73

PHILIP ROSS

WITH each Montreux Television Symposium and Technical Exhibition the exhibition has become more dominant: without doubt it provides at present Europe's No. 1 showplace for new capital equipment for broadcasting. The same cannot unfortunately be claimed for the symposium. This year with the two sections now physically separated and the exhibition improved by the new Conference Centre it has become more than ever difficult to take the technical papers altogether seriously, unfair though this judgement is to some of them.

So this year saw an exhibition larger than ever and a symposium shrinking still further in stature. The broadcasting delegates are keenly interested however in the hardware being offered if less so in design philosophy and research. One notable exception to this generalisation was the considerable interest shown in a session devoted to Cable Television and its implications for the future.

For many delegates the hardware is not only important but ulcer-inducing. A wrong appraisal of trends can cost a broadcasting organisation many hundreds of thousands of pounds. Yet often delegates come away from Montreux even more bemused than when they arrived—demonstrations of equipment are not the same thing as operational use. Brochures no matter how lavish may conceal as much as they reveal. And what will the unions say about this or that new machine?

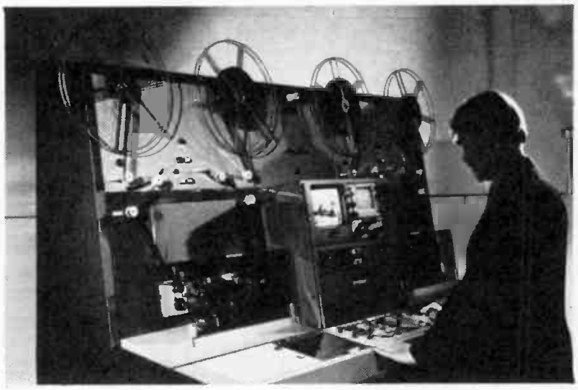
Current Questions

Questions, questions, questions. Will the new broadcast quality helical-scan videotape recorders with their promise of lower capital and operating costs take over in future from quadruplex machines? If so will the preferred tape format be 1 inch or 2 inch? How extensive will the influence of the cassette VTR machines now coming into use be? (London Weekend has had an RCA machine in operation for months while Southern Television has recently brought the first Ampex ACR25 machine in UK broadcasting into use.) What about the new RCA cassette machine for film? Are simple but stable cameras more satisfactory than those with automatic control circuits? Will the lightweight "hand-held" (in practice shoulder carried or used with simple tripods) cameras give electronic picture generation the mobility of the film camera? Which of the many new forms of computer editing of videotapes will prove the most cost-effective for different companies? And what about all the new lenses being offered?

These are the questions of the moment and it is too soon to be able to guess at the likely long term answers. Montreux confuses as much as it elucidates, but it cannot be ignored. New cameras, new telecines, new VTRs, new computer editing, new special effects equipment were shown, introduced to provide new programme facilities, higher reliability or in deference to the fashionable trends of automation and digitalisation.

The new RCA TK45A camera with emphasis on automatic circuitry introduces such concepts as "scene contrast compression"—a form of processing claimed to cope with low light details without altering the colour balance—and "chromacomp" for better matching between different cameras.

IVC VCR100 1in. helical-scan cartridge VTR.



The new Marconi telecine equipment.

A new British camera, the Link 110, depends on the other hand on inbuilt stability rather than automatic correction and features a new light-splitting block. A somewhat similar design trend can also be seen in the new Gates TE201 camera, a new venture for an American company that has quickly made a marked impression in the television transmitter field.

Among the lightweights is the new Philips LDK15 which is a "hand-held" version of the now well-established LDK5. But rather surprisingly in these days of weight-watching the camera has put on some kilogrammes compared with the earlier LDK13 lightweight, although providing more facilities.

Two interesting developments showed that film can still fight back at the encroaching combination of TV camera plus VTR. The new Marconi telecine equipment has a projector mechanism which has been specifically developed for television—rather than adopting the usual practice of using a modified film projector. Then RCA have developed an automatic film cartridge unit. This is a film equivalent of their TCR100 VTR system but holds instead 24 film (16mm) cartridges each with up to two minutes of film. Cassettes are used for runs of commercials, programme promotion and for inserts.

In VTRs the battle is now well and truly joined between the traditional quadruplex broadcast machines and the new generation of high-performance helical-scan units, both for outside-broadcast recording and for studio use. At present, of course, only limited operational experience has been gained in the use of these helical-scan machines. One inch helical-scan machines are now being offered by Ampex and by a joint Philips/Fernseh development. But this format is already being challenged by the new Rank/IVC 9000 series with its two inch tape, two-head system which provides a video writing speed of some 1500in./sec at a tape speed of only 8in./sec. This machine also features "super high-band" recording in which the video signal is recorded as a frequency-modulated signal with the unusually high carrier frequency of from 9 to 12MHz. This super high-band offers an opportunity to reduce Moiré patterning significantly below that of the current generation of "high-band" quadruplex machines. In other words the helical-scan approach to videotape recording already seems to be aiming not just at being a lower cost substitute for quadruplex machines but at outshining—at least in some respects—the best that the present generation of big machines can offer. Lurking in the background is the further possibility of digital video recording but that subject was not much aired at Montreux.

Interesting also is the new IVC series of cassette machines which can be banked up, as the BCR100, to form a multicassette machine.

Tape editing with the help of various forms of special purpose and process computers has rapidly become a science in its own right, with a wide variety of different systems now on offer—all designed to make VTR editing as precise and as flexible as film editing. The film buffs can claim however that as of now they still have an edge over the opposition.

The most remarkable of the tape editing systems in recent years has been the CBS/Memorex CMX600 random access video editor (RAVE) but so complex is this unit that so far only one machine has been installed in Europe (Rank Video Laboratories). So at Montreux there was interest in a new simplified version, the CMX300, at a price more appealing to European broadcasters. Ampex, Fernseh, Central Dynamics and others are all offering various forms of computer-based editing systems.

The IVC BCR100 broadcast cassette VTR makes use of a bank of VCR100 recorders.

The computer also forms the basis of such lighting control systems as the new Thorn Q-Master and the Dynamic Technology DataLite system. The Q-Master is a smaller unit than the well-established Q-File system. Computers also turn up in such applications as electronic titling, and some flexible equipments for this purpose are now available.

The Papers

Many of the papers at the symposium were in effect extended sales talks on the new equipment—of which we have been able to mention only a small part. But at least some papers were not linked directly to commercial hardware. Broadcasting organisations such as the IRT German broadcast research centre and the ORTF French broadcasting organisation put in several papers on new developments. From the UK there were several IBA papers including one on their recently developed digital standards converter which is now in regular operation with ITN. A number of survey papers described the present TV situation in the UK, France, Germany, Japan and the United States: the UK paper was delivered by Neville Watson of the BBC on behalf of The Royal Television Society.

But it was undoubtedly for the massive hardware exhibition at the new Conference Centre that Montreux will be remembered this time. ■

Ampex VPR7903 1in. helical-scan VTR.

transistor FLYWHEEL SYNC circuit

Keith Cummins

The very widely used Thorn 900 chassis was available with or without a flywheel sync unit. The basic chassis was used by many rental organisations and this version was supplied less the flywheel unit. Large numbers of these receivers are now available ex-rental and are worth renovating. Unfortunately the direct locking arrangement is not particularly happy, especially under noisy conditions, but the performance can be greatly improved by converting the receiver to flywheel sync operation.

The original optional flywheel unit, a small subchassis carrying an EF80 which acted as a d.c. amplifier, is no longer available however. While it would be possible to make up such a chassis a simpler approach using a transistor d.c. amplifier can be adopted.

The original test-bed for the circuit to be described was a "schools" receiver. This particular set was a 27in. version fitted with a mains isolating transformer. It also had doors and a flap covering the controls, and could be completely locked up. We were asked whether it would be possible to modify the receiver for use as a video monitor and accordingly the video arrangements were modified by incorporating the writer's circuit which appeared in the August 1971 issue of TELEVISION.

Because the CCTV system did not include synchronisation to broadcast standards the picture displayed on the directly locked receiver unfortunately had a great bend to the right at the top of the screen. It soon became apparent that a flywheel timebase was essential if the receiver was to be able to cope with the CCTV signal and display a normal picture.

The original optional flywheel circuit was studied and it was realised that a transistorised equivalent circuit could fairly easily be built up. This would eliminate the problems associated with physically mounting a valve and as a result the transistorised circuit could be wired up on a tag panel which could be mounted on the side of the line output transformer screening can, adjacent to the line oscillator which is situated on the printed panel below.

Description

Fig. 1 shows the original directly locked oscillator circuit used in the Thorn 900 chassis and Fig. 2 the circuit of the transistorised flywheel unit devised. Sync pulses from tag 30 on the main printed board (anode of the sync separator) are fed to the cathodes of the discriminator diodes D1 and D2 via R1 and C1. D1 and D2 are loaded by R2 and R3 and C2 is included to improve the balance of the system. Flyback pulses from the line output transformer are taken from tag 51 on the main printed board and passed via the network C7, R10 to the junction of C3 and C4 which are connected in series across D1 and D2. By this means an integrated sample of the line flyback is introduced across the discriminator. Under balanced conditions, that is when the timebase is running at the same rate as the incoming sync pulses, both diodes conduct equally when switched on by the sync pulses and the net discriminator output is zero. The d.c. output produced becomes positive or negative depending on whether the timebase is running too fast or too slow, and is filtered by R4 and C5. R5 and C6 form the usual anti-hunt network of the a.f.c. system.

The a.f.c. signal is applied directly to Tr1 base. A BF178 transistor which is capable of operating at the voltage required is used. A control bias from the hold controls—taken from tag 35 on the main panel—is also

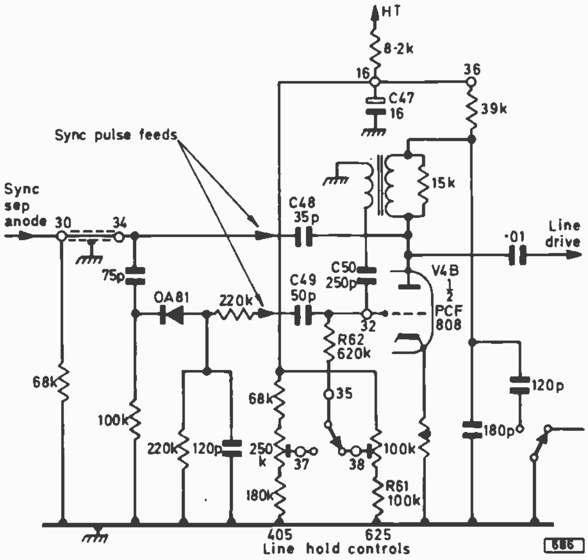


Fig. 1: The line blocking oscillator circuit used in the Thorn 900 chassis, with direct synchronisation.

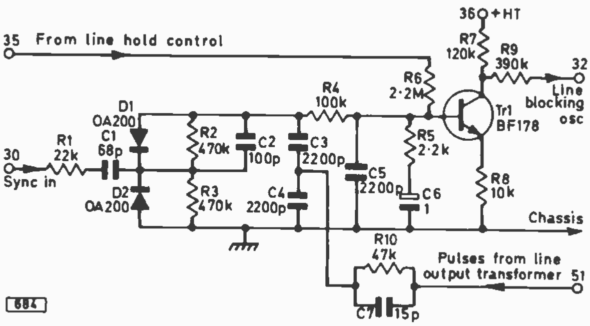


Fig. 2: Flywheel line sync circuit with transistor d.c. amplifier (Tr1) devised for use with the circuit shown in Fig. 1—replacing the direct sync system.

introduced at this point and sets the transistor's operating point and thereby its standing collector voltage which in turn controls the line blocking oscillator speed by varying the rate at which the blocking oscillator timing capacitor C50 (Fig. 1) discharges via R9.

The main chassis tags—termination posts—are identified in Fig. 2 by the numbers used on the actual board. Tag 30 on the 900 chassis is connected to point 34 via a length of screened cable. This should be disconnected from point 34 and connected instead to R1 in Fig. 2. The sync coupling capacitors C48 and C49 (Fig. 1) should be located and physically removed from the main panel, also R62 which in the original circuit links the hold controls to the junction C50/V4B grid. Leads from the flywheel unit are then taken to the points indicated in Fig. 2.

Because of the inverting action of the d.c. amplifier it is necessary to alter the d.c. operating points of the two line hold controls. The original circuit requires the 625 line hold control to operate over a higher d.c. voltage range than its 405-line counterpart. The inversion produced by the d.c. amplifier means that this requirement is reversed, that is the 625 line hold control's d.c. level has to be lower.

The resistors which set the d.c. control range of the hold controls are situated behind the control potentiometers themselves. R61 (100kΩ) instead of connecting the lower end of the 625 line hold control to chassis should be fitted between the supply rail and the top end of this control. The bottom end of the control is then taken directly to chassis.

It should be possible to set the hold controls to their correct operating positions easily enough by first adjusting to the apparent middle of the pull-in range, then interrupting the aerial signal and checking that the picture locks without readjustment being necessary.

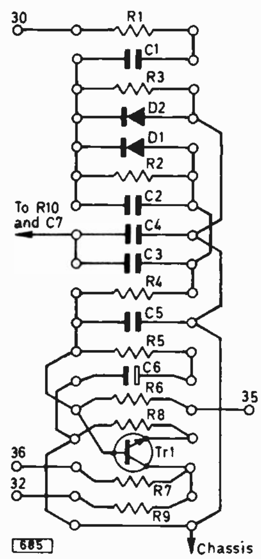


Fig. 3: A suggested circuit layout.

Components list

R1 22k Ω
R2 470k Ω
R3 470k Ω
R4 100k Ω
R5 2.2k Ω
R6 2.2M Ω
R7 120k Ω 1W
R8 10k Ω ½W
R9 390k Ω 1W
R10 47k Ω 1W
All 10% ¼W unless otherwise indicated
C1 68pF silver mica
C2 100pF silver mica
C3 2200pF 400V polyester
C4 2200pF 400V polyester
C5 2200pF 400V polyester
C6 1μF 35V tantalum
C7 15pF silver mica
D1 OA200 or 1SJ50
D2 OA200 or 1SJ50
Tr1 BF178

Results Obtained

The stability of the circuit is good since a high degree of negative d.c. feedback is applied to the d.c. amplifier by the use of the emitter resistor R8. By this means other variations in transistor parameters that could cause d.c. level drift are effectively swamped. R7, R8 and R9 should be good quality components since any variation in their values is likely to result in line frequency drift.

The circuit has been tested under both CCTV and off-air conditions and has proved satisfactory in both. If the modified timebase shows a tendency to weave, that is has a hum bar moving up or down with the verticals bent, C47 (Fig. 1) which smooths the supply to these circuits may be faulty.

Suggested Layout

While the constructor may have his own ideas a suggested layout is shown in Fig. 3. Note that it is advisable to mount C7 and R10 as close to the line output transformer as possible—they can be wired in parallel and soldered to termination post 51 on the main printed board with the free ends soldered to a lead taken to C3 and C4 and sleeved up. ■

IF STRIP FAULT FINDING

—continued from page 506

using the detector probe to isolate the unstable stage and then "fishing around" until the fault is found. Some constructors have used printed circuit lacquer: this has given rise to endless problems and the only advice we can give is "don't"!

Conclusion

By following the general procedure outlined in this article you should be able to find and repair any faults present in your i.f. module. It is not possible for us to mention all the various different types of faults we have met and some constructors are going to have quite a few problems that have not been dealt with here. The Fault Finding Advisory Service will be able to deal with any problems that remain but we would like to say that if you write to us regarding a fault in your i.f. module please follow the test procedure outlined here and *send the results of your tests* to us. This will make life a little more comfortable for the staff of the Advisory Service. ■

Table 1: Transistor Voltages

All readings taken with an Avo Model 8 with the threshold, delay and a.c.c. controls in the maximum clockwise position (board viewed with the delay line on the right-hand side). All figures are d.c. voltages. No signal input applied.

Transistor	*Base*	*Collector*	*Emitter*
Tr101	8.2	10.6	7.4
Tr102	3.8	11.1	3.5
Tr103	11.5	19.6	11.1
Tr104	3.8	19.1	3.2
Tr105	1.0	18.6	0.6
Tr106	0.6	8.1	6.0
Tr107	1.3	0.7	0.58
Tr108	7.8	7.2	7.8
Tr109	5.5	17.2	5.0
Tr110	0.6	14.2	0.0
Tr111	8.2	18.5	7.6

SERVICING television receivers

L. LAWRY-JOHNS

GEC 2032/2033 SERIES-cont.

Further Signal Faults

Hum bar on picture, sync weak and hum on sound: check transistor supply line (20V) smoothing capacitor C159 (250μF) by shunting a known good capacitor across it. Repeat with C311 and C312 using higher-value capacitors.

Due to transistor tolerances in early production models in this series poor signal-to-noise ratio may be exhibited under certain conditions. Where this difficulty is experienced shunt R103 with a 6.8kΩ resistor and check that the value of R110 is 470Ω if it is 680Ω connect a 2.2kΩ resistor in parallel with it.

Power Supplies

The mains supply is through a 1.5A fuse to the on off switch, thence to the mains dropper, the arrangement of which differs from earlier well known models. Two sections of 54Ω and 40Ω feed the heater circuit thermistor and rectifier D301 which provides the heater current and the 20V positive transistor supply line. The h.t. sections are a little more involved with R312 (15Ω) and R313 (19Ω) feeding a.c. to the rectifier D302 and R307 (87Ω) and R308 (56Ω) providing h.t. smoothing at d.c. potential. Moral: never short out a dropper section or connect to the next.

A blown fuse is the best thing which can happen here. Carefully check which dropper sections do which job. Note the separately smoothed h.t. lines (HT1, HT2 etc.) as it is quite common for one part of the set to cease functioning owing to an open-circuit feed resistor. Since these are all on one panel with the rectifiers and thermistor etc. it is a matter of moments to check each item and remove any doubt.

Line Timebase

The line timebase is where the majority of troubles can and do occur. Probably the most common complaint is lack of width and before any other action is taken the set boost control P206 should be checked. The trouble may be nothing more than a dud point on the track where adjustment may show nothing between overscan and underscan. The control must be replaced or the line output transformer may be ruined. It is also essential to check the series 470kΩ resistor R239 as the value of this tends to drop thus overloading the set boost control and burning it out in a very short time after it has been replaced.

If the control is not at fault check the PL500 (PL504) which may be tired. The PY800 can be at fault but this usually makes its protest by arcing over inside to produce a sizzling effect on the screen.

Unfortunately however lack of width and ballooning when the brightness is turned up will often not be cured by replacement valves or components. Shorted turns in the line output transformer are all too often the cause of this condition and replacement is the only cure. It is sometimes the case that the effect is more pronounced on one standard (say 625) than the other but the net result is the same if the transformer is in fact at fault. Don't forget to check the capacitor C232 (0.11μF) which being in series with the scan coils has a profound effect on the shape of the scanning stroke.

If the PL500 is seen to be overheated and there is no raster the first action should be to remove any loads which can be removed. Take the top cap off the DY86 for example as it is often the case that this valve is shorted inside. If this has no effect disconnect the line scan coils to clear them of suspicion and then remove the PY800 top cap. The effect of this last action is to remove the supply to the transformer and the PL500 anode if all else is well – i.e. the boost capacitor C228 (0.1μF) is not shorting and leave the screen feed resistor R229 taking the load. It is quite normal for R229 to overheat in this condition and it will continue to do so until the PY800 is brought back into operation by putting his hat back on.

The next test is really not on – to check for line drive: the point is that low line drive will still give some sort of action and a poor raster whilst total lack of drive will drastically overheat the output stage in no uncertain way (not merely overheating in a milder sense). It is one of those things which we do however, usually with the same result – the drive is there and is not responsible for the complaint. Once again we reluctantly conclude that the line output transformer is at fault and a ring check will show the damping effect of the shorted turns.

The society for the prevention of unjust accusations against line output transformers may say that I am prejudiced against these items. To this charge I must plead guilty me lud, but must claim some justification to which end I produce this box (exhibit A) which contains some twenty million dud transformers (an estimate which could be wrong) and a hot telephone line to suppliers of re-

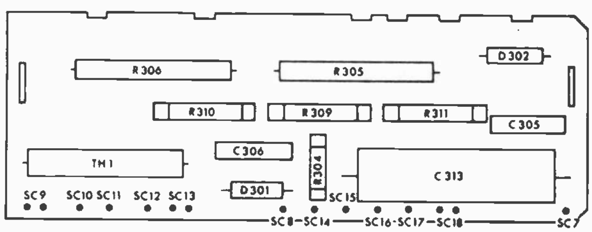


Fig. 2: Layout of the power supply panel. TH1 = TH300.

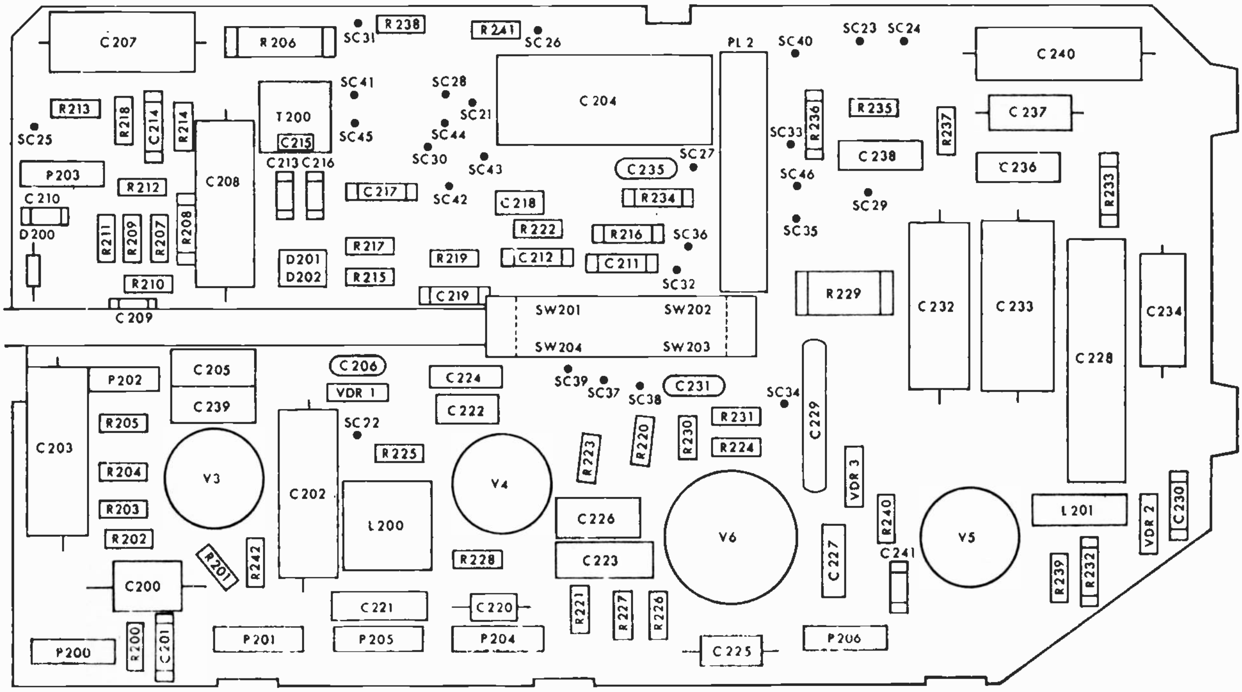


Fig. 3: Layout of the timebase printed panel, viewed from the component side.

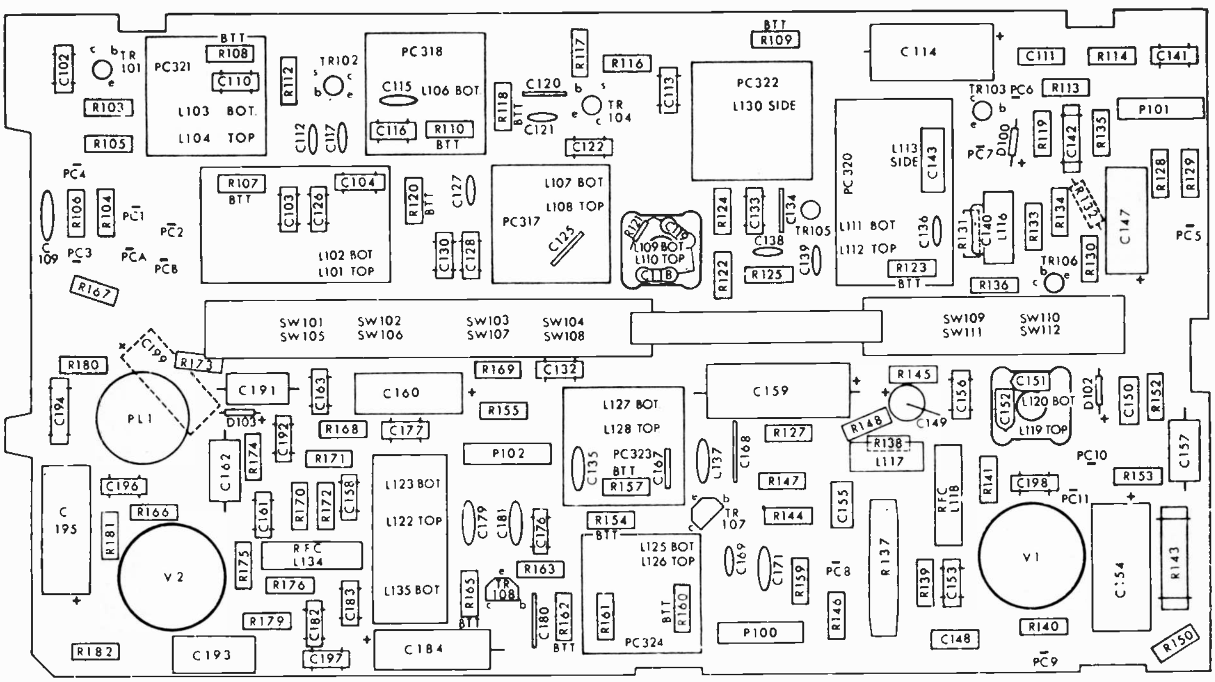


Fig. 4: Layout of the i.f. printed panel, viewed from the component side.

placement transformers (plus a pile of VAT invoices, exhibit B). I must hasten to add that I am not talking about GEC transformers in particular: as inspection of the box will show, there is a goodly selection of most makes.

The line oscillator is the well tried PCF802 circuit which has been described many times in past issues of this journal. The valve itself is usually the cause of line hold troubles, with the line sync discriminator diodes D201 and D202 a less frequent cause. The capacitors in this circuit are often reputed to cause trouble but this has only occasionally been the case as far as the writer is concerned. In this connection however we must plead guilty to being colour conscious: if it's silver, replace it; if it's grey suspect it; if it's yellow it's all right. Queer fellow isn't he? We hasten to add that clearance of yellow ones is only on if they are rounded: if they are squared they come under the category of grey and are thus suspect.

Field Timebase

There is not a lot of trouble with the field timebase apart from the need to replace the PCL85 when the symptoms are variation of field hold, lack of height or no field scan at all. When a replacement valve doesn't help matters, bear the following in mind.

Even loss of height top and bottom: Check R232 1.2MΩ, C230 (0.01μF) and if necessary VDR2. The v.d.r. may be an E298CD/A258 or equivalent (MU01).

Bottom compression: Check the value of R206 (330Ω). If it looks nice it probably is nice, if it looks discoloured it may have changed value. Check C207 and if necessary C204. Check the value of P203.

The presence of the interlace filter diode D200 should not be overlooked in the event of unreliable field locking.

Chassis Removal

It is rarely necessary to remove the chassis from the cabinet but when this has to be done the usual GEC/Sobell drill is to be followed: release the system bar from the left side, remove the 4BA head PK screws (one either side) and clear the right side before withdrawing to the extent of the leads and braiding.

Tuner Operation

A lot could be written about the mechanical side of the tuner unit but it is better to observe the operation as the channels are selected. The details then become self evident, albeit a little kinky.

Semiconductor Devices

Diodes: D100 OA91; D101 OA90; D102 BA115; D103 OA91; D104 AA119; D105 AA119; D106 AA119; D107 OA90; D200 OA91; D201/2 FSY41A.
Transistors: TR101 BC187; TR102 BF167 or BF196; TR103 BC148; TR104 BF167 or BF197; TR105 BF173 or BF197; TR106 BC187; TR107 BF194; TR108 BF194.
Rectifiers: D301 and D302 are both type BY127.

Voltages

All measurements made with 245V a.c. mains input.

Transistor voltages measures using a 20,000Ω/V meter with a 10kΩ resistor in series at the point being measured: contrast control at maximum, no signal input. Voltages marked with an asterisk vary appreciably with applied signal. Total 22V line current 87mA.

Transistor	*Collector volts*	*Emitter volts*	*Base volts*
TR101	3*	18*	19*
TR102	19.2*	4.2*	4.8*
TR103	4.8*	4.8	5.5
TR104	14.2	3.5	4.3
TR105	15.8	1	1.6
TR106	7.6*	13.4*	12.5
TR107 (405)	16.4	0.88	1.38
(625)	14.4	1.3	1.92
TR108	9.3	3.6	4.4

The following valve voltages were taken with signal applied, the controls set for a normal picture and the signal then attenuated so as to only just lock the timebases.

405-line operation

Valve	*Anode volts*	*Screen volts*	*Cathode volts*
V1A	164	167	2.8
V1B	174	67	—
V2A	85	—	—
V2B	238	194	4.4
V3A	45	—	—
V3B	209	217	17
V4A	190	—	3.8
V4B	110	70	3.8
V5	240	—	—
V6	—	229	—

625-line operation

Valve	*Anode volts*	*Screen volts*	*Cathode volts*
V1A	154	158	2.9
V1B	156	66	—
V2A	82	—	—
V2B	234	190	4.2
V3A	43	—	—
V3B	207	210	16.5
V4A	185	—	3.8
V4B	115	70	3.8
V5	238	—	—
V6	—	224	—

Approximate c.r.t. voltages: cathode 140V, first anode 490V, e.h.t. 16.8kV (405), 17kV (625).

Boost h.t. 770V on 405 lines, 810V on 625 lines.

Width Adjustment

Correct picture width is determined by the setting of preset "set boost" control P206 on the timebase panel. First adjust this control on 405 lines for minimum voltage (meter on 1,000V or higher range) between the junction of C228/R232 and chassis. Adjust the line linearity sleeve for optimum line linearity then advance P206 to give a reading of 770V. The width should then be correct. If necessary P206 can be slightly readjusted to get the width right but the boost voltage must be kept within the range 750-790V—otherwise the line output transformer can be damaged.

Preset Line Hold

If it is necessary to adjust the core of L200 the correct procedure is as follows. Switch to 625 lines with the u.h.f. tuner on a blank channel. Set the 625 line hold control P204 for 2V between the slider and chassis. Adjust the core of L200 so that when a u.h.f. signal is tuned in the picture locks immediately. Then check that the same results are obtained on 405 lines. This should occur with the 405 line hold control P205 at approximately mid travel. Slight readjustment may be made to L200 if correct locking is not obtained.

Contrast Presets

Switch to 405 and turn P301 to minimum; adjust P101 for a weak picture then advance P301 for a normal picture. Switch to 625 and adjust P100 to match the 405 setting.

YOUR PROBLEMS SOLVED

★ Requests for advice in dealing with servicing problems must be accompanied by an 11p postal order (made out to IPC Magazines Ltd.), the query coupon from page 523 and a stamped, addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets or answer queries over the telephone. We cannot provide modifications to circuits published nor comment on alternative ways of using them.

MARCONIPHONE 4703

There is no field scan on this set, only a horizontal line across the screen. The voltages in the field output stage are incorrect. At the collector of the field output transistor the voltage is only 4V instead of 35V. The components in the collector circuit have been checked but all seem to be in order and a replacement timebase module has been tried in order to prove the scan coils.—L. Drury (Esher).

The field output transistor is taking excess current which since they are d.c. coupled indicates that the driver transistor is taking no current at all. This transistor (VT423) should be checked therefore and the components in its base circuit. (BRC 3000 chassis).

GEC 2028

The picture on this set is mauve where it should be black—especially on black-and-white which is all mauve. On occasions the fault used to right itself but during the last few weeks it hasn't changed.—B. Savil (Loughborough).

What is absent from your picture is green, so the c.r.t. green gun operating conditions need to be checked. Check the voltage at pin 5 of the c.r.t. (green first anode)—it should be the same as the voltage at pin 4 (red first anode). If the voltage at pin 5 is low check the 220kΩ resistor in series with it and the green first anode potentiometer P614—also the plug and socket connections. If the first anode is OK check the voltage at pin 7 (green grid)—this should be about 70V. If this voltage is low check the green colour-difference output valve V8 (PCL84) and its driver Tr22—if the trouble is here it is most likely to be in the clamp section of the PCL84 where the anode resistor R557 (8.2MΩ) connected to pin 2 should be checked.

BUSH CTV184

The trouble with this set is lack of field scan about 10-15 minutes after warm-up. The transistor adjacent to the height control is running rather warm and by clamping a piece of aluminium to it the scan increases to almost full height.—J. Robinson (Morden).

Change the transistor which is overheating. The simplest check is to spray the suspect transistor with a cooling solution such as Freezit. If the transistor is faulty this should result in full scan being obtained. The associated components in the circuit are not usually at fault.

SOBELL 1065

On switching on there is a perfect picture with full raster. After a short warming-up time however the picture shortens with a black band at the top and bottom and there is very fast field roll. If the field hold control is at one end of its range the picture continues to roll fast while at the other end of its range the picture ceases to roll but the picture is short. —G. Case (Brynteg).

A new PCL85 field timebase valve might cure the trouble. If not replace the 1.2MΩ resistor R230 which supplies boost voltage to the height control.

BUSH TV108

There are three pictures side-by-side on the screen and the overall picture size has shrunk by approximately 2in. all round. All valves likely to have a bearing on these faults have been changed without success.—P. Tomlins (Wellington).

The small picture suggests low h.t. If the output from the metal h.t. rectifier is less than 210V it should be changed. For the line hold problem check the 0.005μF capacitor (C72) which feeds the reference signal back to the flywheel sync discriminator circuit. This is mounted on the small panel beside the line output stage screened section and is rated at 1kV.

FERGUSON 705T

New tuner valves have been fitted but the gain is still low—the picture is very grey and weak. The contrast occasionally returns all of a sudden for a few minutes to normal however, then the brilliance increases and the lack of contrast returns. I have checked various capacitors including the h.t. smoothing block.—K. Hackforth (Taunton).

The first component to check should be the 3.9MΩ resistor (R91) from the contrast control slider to the a.g.c. line. Then if necessary check the PCL84 video amplifier, its load resistors R74 and R75 and the picture quality control R77 (100Ω) in its cathode circuit. If the trouble is still present check the supply to the tuner unit, the first i.f. valve EF183, the resistors R57 and R56 in its screen grid potential divider feed and its input coupling capacitor C53.

COLOUR, UHF AND TELEVISION SPARES

"TELEVISION" CONSTRUCTOR'S COLOUR SET. DEMONSTRATION MODEL, WORKING AND ON VIEW AT 172 WEST END LANE, N.W.6. ALREADY SEEN BY HUNDREDS OF CONSTRUCTORS. COMPLETE YOUR SET WITH MANOR SUPPLIES COMPONENTS. CALL, PHONE OR WRITE FOR UP-TO-DATE INFORMATION COLOUR LISTS.
SCAN PACK No. 21. Mullard or Plessey Scan Coils, Convergence Yoke, Blue Lateral, complete set for £10·00 p.p. 40p.
PRINTED CIRCUIT BOARDS. Convergence, 3 for £2·50 p.p. 30p. Decoder, I.F. amp, Time Base £1·25, Power £1·50 p.p. 25p, R.G.B. 70p p.p. 17p, Varicap, C.R.T. Base 66p p.p. 11p. Complete Set £8·25 p.p. 35p. Audio Panel & P.A.263 £1·95 p.p. 15p.
PACKS (incl. p.p.). No. 2 £4·90, No. 5 £1·05, No. 9 45p, No. 12 31p, No. 13 35p, No. 14 £9·90, No. 15 £2·28, No. 16 £10·95, No. 17 £2·72, No. 19 £2·30, No. 21 £10·40, No. 22 £2·20, C.R.T. Base 30p, C.R.T. Shields £2·05 p.p. 55p, Varicap ELC1043 £4·50, TAA550 62p, AE Isolpanel 30p, Pack No. 23 £2·95, Pack No. 24 £1·20.
CABLE 7×0·2 mm. Screened 10 m for 50p. Colours 10 m for 25p p.p. 10p.
MAINS TRANSFORMER for Colour Receiver, guaranteed to give correct outputs under actual load conditions, plus additional 6·3V C.R.T. heater tapping £9·85 p.p. 65p.
C.R.T. HEATER TRANSFORMERS 6·3V 1 amp £1·10 p.p. 25p.
SPECIAL OFFER I.F. Panel, leading British maker, similar design to "Television" panel. Now in use as alternative, incl. circuit, £8·90 p.p. 35p.
G.E.C. Colour decoder panels (for parts) incl. DL20, crystal and approx. 50% of resistors. Conds., diodes, transist., etc. for "Television" decoder £3·50 p.p. 30p.
MULLARD at 1023/05 convergence yoke, New £2·50 p.p. 25p.
PHILIPS G6 single standard convergence panel, incl. 16 controls, switches etc., and circuits £3·75 p.p. 30p, or incl. Yoke £5·00.
PHILIPS G8 decoder panel part complete incl. I/C £2·50. I.F. Panel part/compl incl. modules £2·50 p.p. 30p.
BUSH CTV25 timebase units, line frame, E.H.T. surplus £4·50 p.p. 80p. Mk. III Quadrupler Trays/E.H.T. £8·25 p.p. 25p.
KB CVCI convergence control panels, New, complete £3·75 p.p. 25p.
VARICAP/VARACTOR ELC 1043 UHF tuner (for "Television" colour receiver) £4·50, PHILIPS VHF Varicap tuners for band 1 & 3 £2·85. Varicap tuners salvaged £1·50 p.p. 25p.
UHF 625 kits and tuners. Lists available at reduced prices. UHF tuners, transistd, £3·10, incl. s/m drive, indicator £3·85; 6 position or 4 position pushbutton £4·95. UHF/VHF transistd. tuner, latest type, incl. circuit £3·25. Cyldon valve type £1·50 p.p. 30p.
MURPHY 600/700 series UHF conversion kits in cabinet plinth assembly, can be used as separate UHF receiver £7·50 p.p. 50p.
SOBELL/GEC Dual 405/625 I.F. amp and o/p chassis incl. circuit £1·50 p.p. 30p. PHILIPS 625 I.F. panel incl. cct £1 p.p. 30p.
FIREBALL TUNERS Ferg., HMV, Marconi. New £1·90 p.p. 25p.
TURRET TUNERS. KB "Featherlight" VC11, Philips 170 series, GEC 2010 £2·50. AB Dual Stand, suitable Ferguson, Baird, KB etc. 75p, Cyldon C 75p, Pye 110/510-Pam, Invicta, Miniature, increm. £1·95, Peto Scott 960, Decca 95/606 £1·50 p.p. 30p.
LINE OUTPUT TRANSFORMERS. Popular types available, brand new replacements, fully guar. A selection which can be supplied p.p. 30p. C.O.D. 28p.

MURPHY 849, 939, 153 2417S ... £4·90
PHILIPS 1768/2168, 1796/2196 ... £4·90
PHILIPS 17TG/100 Range
STELLA 1011/1029 ... ... £4·30
PHILIPS 19TG111/12 ... £4·40
PHILIPS 19TG121 to 156 ... £4·90
PHILIPS 19TG170, 210 series £4·90
BUSH TV92, 93, 105 to 186SS £4·90
EKCO 221 to 394, FERRANTI 1001 to 1065 ... ... £4·30
EKCO, FERR. 418, 1093 etc. £4·30
DECCA DR95, 101/606, DR1, 2, 3, 121/123, 20/24, 2000 ... £4·70
FERG, 305 to 436, 606 to 727... £4·30
FERG, HMV, MARCONI ULTRA, PHILCO 3600, 2600, 4600, 6600, 1100 series, Jell pot £4·70
KB VC1 to VC11 ... ... £4·40
GEC 302 to 456, 2000 series ... £4·90
HMV 1865/9, 1870/6, 1910/1924 £4·30
PETO SCOTT 960, COSSOR CT1964 ... ... £4·70
PYE 17/21, 17/S, 110 to 510, 700, 830, 1, 2, 3, 11U to 64 ... £4·30
PYE 169, 569, 769 series £5.25
PAM, INVICTA equiv. LOPTS to above PYE ... ... £4·30
SOBELL 195/282/1000 series... £4·90

SPECIAL OFFERS
BUSH TV53/86 ... £1·75
BUSH TV95/99 ... £2·50
EKCO 380 to 390 ... £2·50
EKCO 407/417 ... £2·50
FERR 1057 to 1068 £2·50
FERR 1084/1092 ... £2·50
FERG. 506 to 546 ... £1·50
HMV 1890 to 1896... £1·50
P/SCOTT 1419 to 1725, 733 to 738 ... £1·75
REG 10-6, 10-17 ... £2·50
REG 191/2, 17-18 ... £2·50
RGD 519, 606, 610, 612, 619, 620, 711 ... £2·50
PHILCO 1010/21 ... £2·25

COLOUR LOPTS
BUSH CTV182 Series £6·60
DECCA (Windings) CTV 19/25 ... ... £6·25
GEC 2028, 2040 ... £7.45
SOBELL 1028, 1040 £7.45

LOPT Inserts p.p. ... 17p
KB/RGD VCH, VC11 Featherlight ... £2·75
KB/RGD VC1-9 ... £1·95
PHILIPS 17TG100... £1·95

Transistorised I.F. panel (salvaged) ... ... £2·50 p.p. 25p
850 field output transformer ... ... £1·80 p.p. 20p
850 scan coils ... ... £4·40 p.p. 30p
THORN 850 Time Base Panel. Dual Standard £1 p.p. 30p.
THORN 850 Mains Droppers 30p p.p. 15p (state approx values)
CALLERS WELCOME AT SHOP PREMISES

MANOR SUPPLIES

172 WEST END LANE, LONDON, N.W.6
(Near W. Hampstead tube stn; 28, 59, 159 Bus Routes) 01-794 8751
Mail Order: 64 GOLDERS MANOR DRIVE, LONDON, N.W.11

GEC 2010

On 625 lines the picture is good but the sound is marred by continuous hum. The EH90 sound detector valve has been changed without improving matters. On 405 lines there is a raster but neither sound nor vision. The v.h.f. tuner valves have been replaced and the contacts in both the tuner and the system switch cleaned.—A. Tideshaw (Bolton).

There could be more than one fault here. The most likely suspect however is the 32μF electrolytic C93 adjacent to the video amplifier—this decouples the video amplifier screen feed and the supply to the EH90 in the sound channel. The sound trouble could point to the EH90 screen grid circuit resistors (18kΩ and 5.6kΩ) having changed value—examine them to see whether they have lost their clear colours (R92 and R93). The loss of 405 line signal could be due to the oscillator in the v.h.f. tuner failing to oscillate—check its 5.6kΩ anode feed resistor which is inside the tuner against the front side wall, also if necessary the associated 6.8kΩ resistor and 0.001μF capacitor.

ULTRA WT917

This old set has given good service and up to now we have only had to replace the h.t. and e.h.t. rectifiers. We are now having trouble with a band of light which flashes up and down the screen however. These flashes are accompanied by loud plops on the sound which increase when the volume control is advanced. The timebase circuits have been checked without revealing anything amiss.—H. Broome (Oxford).

We suggest you check the value of the 4μF electrolytic (C73) which decouples the screen grid of the 10P13 audio output valve, also the 0.04μF grid coupling capacitor (C71) and the valve itself. The 200μF main smoothing capacitor (C56) could be faulty.

FERGUSON 3636

There is sound and a raster but the nearest I can get to obtaining a picture is a white horizontal flare which fades towards the bottom of the screen. There is a faint outline of a picture in the background, jittering up and down. The video and vision i.f. valves have been replaced without improving the situation.—T. Halstead (York).

Check the voltage at the anode (pin 10) of the PFL200 video amplifier. If this is absent check its 3.6kΩ anode load resistor R41. If the voltage at pin 10 is correct check the vision detector diode W2 and if necessary the a.c. coupling network to the c.r.t. cathode. These suggestions assume that the brilliance control is operating normally and that the sound is also normal. (BRC 950 chassis.)

SOBELL 1002

There is severe field buzz on this set. It can only be removed by turning the field hold control clockwise but the picture is then reduced to about 4-5in. and is not very clear. I have changed the PCL85 and nearly every component in the field timebase without success. The height control also affects the buzz but as with the hold control this only stops when the picture is 4-5in.—G. Overton (Derby).

If the overall picture linearity is right there is no point in component checks. Examine the field output transformer for loose laminations, tightening up—with shims if necessary—as much as possible. If the field hold control is at one end change C91 (0.005μF) mounted close to it.

HMV 2714

The problem with this set is S-shaped verticals—with occasional intermittent loss of one colour over the bottom few lines of the picture. Satisfactory line sync can only be obtained with the hold control at one end of its travel. When the hold control is at mid-travel the correct setting up voltage is obtained but the picture virtually disappears—it is impossible therefore to adjust the line oscillator coil. The sync pulses are exactly as the waveform in the manual and the supply lines to the line timebase free of ripple. The line output stage earth however has significant 50Hz superimposed.—D. Tovey (Bath).

The trouble seems to be in the line output stage earthing. The earth connection (point C) from the line output transformer is taken to the "sub-earth" on the line timebase panel. The "sub-earth" is returned via R907 in the beam limiter circuit to the set's true earth. Check the earthing of tag C on the line output transformer, also C514 which smooths the supply to the line output stage, and try taking a separate earth lead from the line output stage "sub-earth" to R907. Check for dry-joints and other poor connections. Poor contact from C on the line output transformer would explain the line hold trouble and the displacement of the line flyback pulses the colour trouble at the bottom of the picture. (BRC 3000 chassis.)

QUERIES COUPON

This coupon is available until October 5, 1973 and must accompany all Queries sent in accordance with the notice on page 521. Don't forget the 11p (inc. VAT) postal order!

TELEVISION SEPTEMBER 1973

TEST CASE

129

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.

? *The main fault symptom on a Bush Model TV183 (single-standard version of the TV161 series) was apparent lack of contrast owing to the brightness control's inability to bias-off the picture tube sufficiently. Even with the brightness control turned right down a fairly bright raster remained. Suspecting a picture tube fault the technician in charge checked the interelectrode insulation when the tube was both hot and cold but perfect insulation was indicated.*

Further tests revealed that while the grid voltage was reasonably normal over the range of the brightness control the cathode voltage remained abnormally low. Thus even with the brightness control in the fully retarded position the grid-cathode voltage was sufficient to maintain conduction in the tube.

Having had trouble with the PFL200 video amplifier in similar models this valve was replaced but the fault persisted.

What was the most likely cause of this trouble and what tests were next indicated to prove the diagnosis? See next month's Television *for the solution and for a further item in the Test Case series.*

SOLUTION TO TEST CASE 128

(Page 475 last month)

Although the technician raised the signal level applied to the receiver by using an aerial preamplifier the signal-to-noise ratio was not improved because significant noise was present on the amplified signal. When an aerial preamplifier is employed it is the signal-to-noise ratio at the output of the preamplifier that is important. If the preamplifier is "noisier" than the receiver front-end then the grain on the picture will be in excess of that present without the preamplifier being used despite the increase in the strength of the signal applied to the receiver.

The gain provided by the preamplifier is of little help therefore unless its noise factor is also low—lower in fact than that of the receiver's tuner unit. Modern transistor tuners have fairly low noise figures, sometimes almost as low as that of a preamplifier. The improvement in effective signal-to-noise ratio produced by adding a preamplifier is thus barely noticeable—as in the Test Case cited.

The preamplifier gain figures in the overall noise formula as follows:

$$Fn(\text{total}) = Fn1 + (Fn2 - 1)/P1$$

where Fn(total) is the total noise factor with the preamplifier connected, $Fn1$ the noise factor of the preamplifier itself and $Fn2$ the noise factor of the television front-end. $P1$ is the power gain of the preamplifier.

For the best signal-to-noise ratio therefore the preamplifier must have the lowest possible noise factor and the highest possible gain. If $Fn2$ is 6dB (about 4:1 power ratio), $Fn1$ 8dB (about 6.3:1 power ratio) and $P1$ 10dB (10:1 power ratio) for example, then Fn(total) works out at about 6.6:1 power ratio which is slightly higher than $Fn1$ (8dB) and over 2dB higher than the noise factor of the front-end without the preamplifier! The preamplifier would thus worsen the signal-to-noise ratio.

On the other hand an improvement of about 6.6dB in Fn(total) would result from using a preamplifier with a noise factor of 4dB and a power gain 10dB when the noise factor of the television front-end is about 10dB, thus showing a substantial improvement in the overall signal-to-noise ratio.

Aerial siting of the preamplifier appears not to help much in practice unless the downlead is extra long and of not too good quality or is passing through a strong interference field.

Published on approximately the 22nd of each month by IPC Magazines Limited, Fleetway House, Farringdon Street, London EC4A 4AD. Printed in England by Fleetway Printers, Crete Hall Road, Gravesend. Sole Agents for Australia and New Zealand—Gordon and Gotch (Asia) Ltd.; South Africa—Central News Agency Ltd.; Rhodesia and Zambia—Kingstons Ltd.; East Africa—Stationery and Office Supplies Ltd. Subscription Rate (including postage): for one year to any part of the world, £2·65. "Television" is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

TELEVISION CLASSIFIED ADVERTISEMENTS

SETS & COMPONENTS

COLOUR TV's
19" Decca £100
25" Decca £115
25" RBM/Phillips £120
25" Thorn £125
Fully Serviced, one months' guarantee. Delivery & Terms can be arranged. Non-Workers available.
S.A.E. details please.
T.E.S.T. P.O. Box 1,
Kirkham, Preston PR4 2RS.
Telephone 077-48 2796.

CHEAPER TV SETS
405 from 50p. D/S 625 from £2.50.
Colour also available.
Mon./Sat.—9.00 a.m. to 5.30 p.m.
PREMIER TV WAREHOUSE,
Bridge Works, East Farleigh,
Maidstone.
Tel: Maidstone 26007

150 NEW Capacitors/Resistors/Silicon Diodes. Electrolytic. Mica, Ceramic. Carbon. Oxide etc. £1 Post Free. Whitsam Electrical, 33 Drayton Green Road, London, W.13.

EHT Rectifier Trays. Direct BRC 950/1400/1500 replacement. 3 Stick £2.90, 5 Stick £3.40. Post Free. State BRC Model. Devi, 44 Sandells Ave., Ashford, Middx. 58335.

For quality Hi-Fi Equipment, records and Colour Television, Visit
HANSPAL'S AUDIONICS
488 Lady Margaret, Southall, 01-578 2258; 54 St. Anns Road, Harrow, 01-863 3400. 24 hours Autophone Service. Marantz, Pioneer, Sansui, Akai, Rotel, Nikko, Lux, Telefunken, Sony, Sanyo, Tandberg, Hitachi, Grundig, Scan-Dyna, KEF, TEAC, National, Quad. Telefunken, Hitachi, Sony and Grundig Colour T.V. Always in stock.
Up to 5 years Colour Tube guaranteed and 1 year Free Servicing and Labour. Late evening: Friday until 7.00 p.m.
EXCELLENT CREDIT FACILITIES

EX-RENTAL, UNTESTED

BBC2 TV's

Thorn 850-900
£7.50

Murphy 159U
Transistor Push Button
£14

U.H.F. Tuners Suitable for Thorn 850-900, adaptable for most makes. **£2.50**

All prices inc. P. & P.

Quantity Discount to Trade

PENCOYS TV CENTRE
"Pencoys", Four Lanes, Redruth, Cornwall.
Tel. Redruth 6579.

Top 20 Plus Tested TV Valves

PL504	18p	PCL84	10p
PC86	15p	PCL82	10p
30L15	15p	PFL200	10p
PL36	15p	ECC82	10p
PCL805/85	15p	EH90	10p
30FL1/2	15p	30PL13	15p

Colour Valves Fully Tested

PL509	30p	PY500/A	30p
PL508	30p	PL802	30p

Many others available including Mazda Types.
P. & P. 4p per valve, over 12 2½p per valve, orders over £3 post free.
Prompt service.
S.A.E. for free list.
L. & D. COMPONENTS LTD.,
71 Westbury Ave., London N22 6SA.
Tel. 01-888 2701.

Component problems?
—write to us for our free catalogue. Send a stamped addressed envelope to Dept. TV1
J. T. Eden Electronics
P.O. Box 5
LANCASTER LA1 3HZ

SLIMLINE TELEVISION
Ex-Rental Television
Dual-Standard with UHF Tuners complete; untested
19" Thorn 850 £4
19" Cossor 1964 £5
19" KB VV £7
19" Bush 125 £7
No scrap sets all as withdrawn from rental
Collect or send £2.00 p.p.

162 Kettering Road,
Northampton
90 Tavistock St., Bedford
Tel: Bedford 51948

TVs TVs TVs ! ! ! 19" TVs
All in Working Order
Bush, Murphy, Ferguson, Pye, • Marconi, Thorn, etc.
£11.50 plus £2.00 Carriage
COLOUR - COLOUR - COLOUR
All Working
19" Various Makes £100.00
22" Various Makes £140.00
26" Various Makes £150.00
11" Colour Portables ... £75.00
Delivery Arranged
S.A.E. LISTS
ENG. 919031
LINAVALE RADIO LTD.,
48 Hoe St., London E17 4PG.
01-520 7546

EX RENTAL TV's BARGAIN
23" & 19" 3 Channel with U.H.F. Tuner £3.50
19" & 25" Colour from £50.00
19" & 23" tubes guaranteed from £2
All sets complete.
EDWARDS & SONS
103 Goldhawk Road, London W.12.

EX-RENTALS
ALL SETS complete with UHF Tuners, many working:—
19" BBC2 Sets at £3
23" BBC2 Sets at £7
Working Sets to Order.
All Sets Re-polished. Calls Only.
TV DISPOSALS
Tel: Bristol 626374

TV'S COLOUR TV'S
Reserviced. Perfect working order. Repolished.
19in DECCA £110
19in. GEC 2028 ...... £115
19in. THORN 2000 £120
25in. DECCA £125
25in. RBM PHILIPS £130
25in. THORN 2000 £135
One month comprehensive written guarantee. These are cash and collect prices. Delivery quotations by phone.
MONO U.H.F.
Fabulous TVs. No rubbish, from good source. Repolished cabinets. Many working. Recent transistorised models, including:
BUSH TV 148 U, TV 166, TV 176
PHILIPS style 70 and 210
PYE & EKCO 868 chassis
THORN 950 1400, GEC Concorde
FROM £12 EACH
Valve u.h.f. models include:
BUSH push-button, THORNE 850, SOBELL 1000, etc. FROM £5
U.H.F. TUNERS
For FERGUSON 850, 900 chassis but adaptable for most D/STD chassis £2.50 each, c.w.o. postage included. Send s.a.e. for lists of Tubes, TVs, Valves, etc. For England:
TRADE DISPOSALS, 1043 Leeds Rd., Bradford. Tel: Bradford 665670
For Scotland:
TRADE DISPOSALS, Unit 5, Peacock Cross INDUSTRIAL ESTATE, 32 Burnbank Road, Hamilton.
Tel: Hamilton 29511/2

WANTED

NEW BVA valves of popular types, PCL805, PY800/1, PL504, etc. Cash waiting. Bearman, 6 Potters Road, New Barnet. 449/1934-5.

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

WANTED. 64/65 Newnes Radio/T.V. Servicing. Ring 021-552-6936 after 6.15 cash paid.

£10 OFFERED by Herts Hobbyist for Cossor 1035 Scope in Working Order. Box 110.

MAINS DROPPERS. 37 Ω-31 Ω-97 Ω-26 Ω-168 50p. 14 Ω-26 Ω-97 Ω-173 Ω 50p. 14-36-97-160 ohm 50p. 25-35-97-59-30-168 ohm 50p. 15-19-20-70-63-28-63 ohm 50p. Post free. C.W.O. Durham Supplies, 367 Kensington Street, Bradford, 8, Yorkshire.

WANTED Line Output Transformer Mk. 513.19 for Philips Television Projection Receiver No. 6027A. Picture 4 x 3. Would purchase one of these sets if complete, working or not, for the parts. A. Rea, 67 Charles Street, Hull.

TOP PRICES PAID for NEW VALVES and TRANSISTORS

popular T.V. and Radio types

KENSINGTON SUPPLIES (A)
367 Kensington Street, Bradford 8, Yorkshire.

SERVICE SHEETS

A.L.S Service Sheet Service
10 Dryden Chambers, 119 Oxford Street
LONDON W1R 1PA

Please always state Make & Model Number, and whether TV, AMP, RADIO, TAPE. etc;

SERVICE SHEET SERVICE ONLY 30p Plus large s.a.e.

Lists covering Mono & Colour TVs, Radio, Tape, Record Players, Books, Manuals, Newsletter, etc Only 5p Plus sae

COMPREHENSIVE COLOUR TELEVISION MANUAL. BY McCOURT
Contains Faults & Causes on most British sets. NOW ONLY £2 post paid

"A GUIDE TO TELEVISION ALIGNMENT USING ONLY TRANSMITTED TEST SIGNALS"
By B.R.Epton. price 30p plus S.A.E.

We can supply Manuals for most makes of TV both Mono and Colour including Bush, Murphy, B.R.C., Ferguson, H.M.V., Decca, Sony, Sanyo, Hitachi, etc; + Most Colour TV require a Manual to cover the large amount of information that is necessary.
S.A.E. for quote price and delivery

Please Note
Mail Order Only return service

One title recommended from our now extensive book list.
"SERVICING WITH THE OSCILLOSCOPE"
(KING) (1969) 176 pages illustrated
PRICE .... £2 POST PAID
A S.A.E. FOR FULL LIST -----

OUR STOCKS NOW EXCEED 20,000 ITEMS covering 1000s of makes and models of TV, Radio, Amps, Recorders, etc;

SERVICE SHEETS, Radio, TV etc. 8,000 models. Catalogue 15p. S.A.E. enquiries. Telray, 11 Maudland Bank, Preston.

LARGE SUPPLIER OF SERVICE SHEETS

(T.V., RADIO, TAPE RECORDERS RECORD PLAYERS, TRANSISTORS, STEREOGRAMS, RADIOGRAMS, CAR RADIOS) Only 40p each

"PLEASE ENCLOSE LARGE S.A.E. WITH ALL ENQUIRIES & ORDERS"
Otherwise cannot be attended to

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

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

C. CARANNA
71 BEAUFORT PARK
LONDON, N.W.11

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

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

Mail order or phone 01-458 4882

SERVICE SHEETS

(1925-1973) for Radios, Televisions, Transistors, Radiograms, Car Radios, Tape Recorders, Record Players, etc. with

FREE FAULT FINDING GUIDE

PRICES FROM 5p

Over 10,000 models available.
Catalogue 15p + SAE

Please send stamped addressed envelope with all orders and enquiries.

Hamilton Radio

47 Bohemia Road, St. Leonards, Sussex. Telephone Hastings 29066.

FOR SALE

COLOUR TUBE R.C.A. 21" Deflection, convergence coils, mask, frame, extras £25. Phone Slough 35764.

SCOPES. Very special offer. All serviced by Telequipment and in perfect condition. S43 single beam 15 Mc. bandwidth £70. D43 double beam 15 Mc. bandwidth £90. Phone 01-886 9666.

AERIALS

U.H.F. Aerials. 18 Element complete with Clamp £1.85 + 35p p. & p. please state Channels or Group. F.M. Radio Aerials, 4 Element complete £3.50. Low Loss Coax 10p yd. S.A.E. for full list.

CAPENER,
177 Dashwood Avenue, High Wycombe

BAINES for High Frequency Aerials. Multibeams by J. Beam for UHF MBM 18 £2.90. MBM 30 £3.90. MBM 46 £6.00. MBM 70 £11.00. LBM 2 £5.25. 75/300 Balun £1.00. Rotators £22 and £28. RZ100 Alignment Bearing £7.20.
Stereobeams by J. Beam for FM SBM 1 £2.10. SBM 2 £2.80. SBM 3 £4.20. SBM 4 £4.60. SBM 6 £6.95. Stacking Kit £2.10. SP 15 Loft Kit 42p. Masthead Amplifiers for FM and TV £5.75 and £7.75, Setback £3.75. Accessories: Large SAE please. Postage paid on all aerials. VAT is 10% on all orders. Co-ax 5p and 9p.
11 Dale Crescent, Tupton, Chesterfield S42 6DR—863755

LADDERS

LADDERS, 24½ft. £9.80, carr. 80p. (Please add 10% V.A.T.). Leaflet. Callers welcome. Home Sales Ladder Centre (PTT2) Haldane, Halesfield (1) North, Telford, Salop. Tel. 0952-586644.

MISCELLANEOUS

Build the Mullard C.C.T.V. Camera
Kits are now available with comprehensive construction manual (also available separately at 76½p) Send 5" x 7" S.A.E. for details to
CROFTON ELECTRONICS
15/17 Cambridge Road, Kingston-on-Thames, Surrey KT1 3NG

ALUMINIUM SHEET to individual sizes or in standard packs, 3p stamp for details. Ramar Constructor Services, 29 Shelbourne Road, Stratford on Avon, Warks.

AUSTRALIAN READERS
Part-used COLOUR TELEVISION sets EXPORTED to Australia. Send 1 Dollar (Money order etc) to Sumiks (Export Dept), 7 High St., Langley, Warley, Worcs., England.

DISCOUNT COLOUR

Perfect working order. Repolished cabinets. 30 DAY COMPREHENSIVE GUARANTEE

19" DECCA £77
19" GEC £88
22" PHILIPS/DECCA £132
25" DECCA/BUSH/GEC/ BRC 2000/PYE £110

CASH AND COLLECT PRICES, V.A.T. included.
3 or over less 10% discount.

BRAND NEW 26" COLOUR TV CABINETS
Slight seconds without backs. All with doors in Dark Teak. Delivered for £10 cwo

MONO UHF TV'S
Sold complete but unserviced with tube tested. Good cabinets. Valve tuner type inc.:—
BUSH 128, SOBELL 1000, GEC 2000, THORN 900. Singles £5 each (add £2 delivery). 6 for £20. Delivery extra.
Transistorised tuner type makes inc.: THORN 950, BUSH 141, GEC 2010 to 2038. Philips style 70. Singles £10 each (add £2 delivery). 6 for £50 delivery extra.

TRANSISTORS FOR BRC 3000
R2008 (Line) R2010 (Chopper) Singles £1 each. Any twelve £10 inclusive. Send c.w.o.
Send SAE for list of UHF tuners, valves, tubes, washing machines etc.
Open 6 days every week.

TRADE DISPOSALS
1043 Leeds Road, Bradford 3.
Tel Bradford (0274) 665670 or
Peacock Cross Industrial Estate, Burnbank Road, Hamilton.
Tel Hamilton (06982) 29511

SITUATIONS VACANT

£3,000 + For good, reliable, honest T/V Field Engineer. Car plus Expenses. O/time available. Must have current Licence. Write to: Box 109.

EDUCATIONAL

COLOUR T.V. SERVICING

Be ready for the coming Colour TV boom. Learn the techniques of servicing colour TV sets through new home-study courses specially prepared for the practical TV technician, and approved by leading manufacturer.

Full details from ICS, (D.750T) Intertext House, London SW8.

ENGINEERS—Get a technical certificate. Postal courses in Engineering, Electronics, Radio, T.V., Computers, Draughtsmanship, Building, etc. Free book from: BIET (Dept. ZC BTV 21), Aldermaston Court, Reading, RG7 4PF. **Accredited by CACC.**

COLOUR TELEVISION TRAINING

LEC

11 WEEKS' practical and theoretical Colour training course commences Sept. 24th for men with Mono experience. Hours 2 to 5 p.m. Mon. to Friday.
13 WEEKS' (full-time) combined Mono and Colour training course commences Sept. 10th for men with a good electronics background.
(The above courses are supplementary to the 16 months' full-time course for beginners.)
Prospectus from: London Electronics College, Dept. T.9, 20 Penywern Road, London SW5 9SU. Tel. 01-373 8721.

PHILIP H. BEARMAN

(VALVE SPECIALISTS) SUPPLIERS TO H.M. GOVT. Etc.

NEW valves by Mullard, Mazda, Telefunken etc.,

IMMEDIATE POSTAL DESPATCH, LISTS S.A.E., DISCOUNT PRICE
PRICES FROM 1.4.1973 (INCL. V.A.T.)

DY86/7	33p	PC88	61p	PCL86	53p	6/30L2	80p	30PL 13	95p.
DY802	37p	PCF80	43p	PL36	70p	6BW7	66p	30PL 15	95p
ECC81	40p	PCF801	53p	PL84	53p	6F23	85p		
ECC82	37p	PCF802	55p	PL500/4	70p	6F28	60p	NOTE:	
ECL80	43p	PCF805	73p	PY81	40p	20L1	88p	PRICES ARE	
EF80	37p	PCF808	70p	PY800	40p	20P4	88p	TO NEAREST	
EF183	49p	PCL82	41p	PY801	40p	30C15	84p	NEW PENNY	
EF184	49p	PCL83	53p	U25	80p	30FL1/2	60p	QUANTITY	
EH90	46p	PCL84	49p	U26	80p	30L15	84p	PRICES ARE	
EY51	60p	PCL85 }	53p	U191	80p	30L17	84p	LOWER.	
EY86/7	33p	PCL805 }							
GZ34	63p	PCL805 (non		U193	40p	30P12	84p	BY100-127 with	
PC86	61p	BVA)	44p	U251	83p	30PL1	66p	10W res.	16p!

POST FREE OVER £3, BELOW THIS add 3p per valve

Large PCF80 30p. Sorry, no X78, X79 but EQUIVS, 12AH8 & 10C1
See separate Component, CRT and Transistor Lists. Many obsolete types available.

(Adjacent to Post Office) 6 POTTERS RD., NEW BARNET
HERTS. Tel: 449/1934-5 any time.
Local Agents: MANOR SUPPLIES, 172 WEST END LANE, LONDON N.W6
Tel: 794/8751. (Near West Hampstead Tube Station)

SOUTHERN VALVE CO. P.O. Box 144 BARNET, HERTS.

All new and boxed, Mazda & Mullard wherever possible. Lists sae. Mail order only

AZ31	62p	EY86/7	35p	PL38	90p	U193	31p	30P19	70p
DY86/7	34p	EZ40/1	40p	PL81	45p	U404	40p	30PL1	60p
DY802	40p	EZ80	35p	PL81A	48p	U801	90p	30PL13	75p
EB91	15p	EZ81	25p	PL82	37p	5Y3	35p	30PL14	80p
ECC81	34p	GY501	75p	PL83	45p	5Z4	35p	30PL15	80p
ECC82	25p	GZ30	40p	PL84	45p	6/30L2	60p	30P4MR	88p
ECC83	25p	PC86	46p	PL500 }	58p	6AT6	30p	35W4	35p
ECC85	36p	PC88	36p	PL504 }		6BW7	60p	50CD6G	
ECC88	45p	PC97	38p	PL508	70p	6CD6G	80p		£1.25
ECH42	70p	PC900	45p	PL509	£1.40	6F24/5	60p		
ECH81	34p	PCC84	33p	PL802	85p	6F28	60p		
ECH84	50p	PCC85	35p	PL805	78p	6K7/8	35p		
ECL80	40p	PCC88	60p	PY32/3	47p	6V6	35p		
ECL82	45p	PCC89	45p	PY81	31p	6X4	30p		
ECL83	57p	PCC189	48p	PY88	33p	6X5	35p		
ECL86	40p	PCF80(L)	28p	PY800	31p	9D7	40p		
EF80	24p	PCF80(Br)	38p	PY801	31p	10C2	75p		
EF85	36p	PCF82	50p	PY500	80p	10F1	45p		
EF86	50p	PCF86	48p	UBF89	35p	10P13	70p		
EF89	30p	PCF200	45p	UCC85	40p	12BA6	40p		
EF183	32p	PCF801	48p	UCH42	50p	20L1	80p		
EF184	32p	PCF802	45p	UCH81	40p	20P3	80p		
EH90	45p	PCF805	55p	UCL82	40p	20P4	80p		
EL34	54p	FCF806	55p	UCL83	55p	20P5	95p		
EL41	50p	PCF808	50p	UF41	50p	30C1	38p		
EL42	47p	PCH200	55p	UF85	35p	30C15	70p		
EL84	30p	PCL82	32p	UF89	35p	30C18	55p		
EL86	38p	PCL83	45p	UL41	55p	30F5	75p		
EL90/1	40p	PCL84	32p	UL84	42p	30FL1	50p		
EL95		PCL85 }	40p	UY41	35p	30FL2	50p		
	40p	PCL805 }		UY85	30p	30L1	33p		
EM80/1	40p	PCL86	32p	U25	62p	30L15	75p		
EM84	40p	PFL200	55p	U26	60p	30L17	70p		
EY51	45p	PL36	52p	U191	60p	30P12	70p		

ETC., ETC.
Service & Civility
The above types, and many others, are in stock at time of going to press.
These are new lower prices, asyuming V.A.T. at 10%.
Transistor lists s.a.e.
All valves new and boxed but we cannot always guarantee any specific make.
Postage: 3p per valve / post free over £3.00.
Tel. (Office): 440 8641
Closed Thursday & Saturday afternoons.

COLOR T.V.

19" £95 25" £125

SUMMER SALE PRICES

Bush CTV25 — CTV167, PYE CT70, THORN 2000, DECCA CTV19—25, PHILIPS G6 etc etc, as available.
ALL with repolished cabinets.

MONO 19" Push-button UHF tuner, Single-standardised. £19.90

BBC 2

TV's WORKING — £10
BBC 2 Non-working — £8
VHF Working — £3
Carr. £2.50 per set. Add VAT to total price.

G.E.C. COLOR DECODER PANELS

NEW appearance, 11" x 5½" approx.
Grade B Complete untested
£4.50 + 25p p & p
Grade C Some physical damage but complete with DL20
£3.00 + 25p p&p (2 for £6 post paid)

XTALS — 4.43MHz

40p carr. paid

DL20 COLOR DELAY LINE

£2.50 carr. paid. (both ex-equip.)

UHF TRANSISTOR Tuners

New, untested £5 + 25p carr.

TV STANDS

TV Stands £3.25 + 50p Carr.
Please state length and depth of set, since each stand is specially made to your order. Supplied "in the white" or stained and polished to your requirements at no extra charge.

SUMIKS 7 High Street, Langley, Warley, Worcs. (Near t/o No. 2, M5 M'way)

Audio

THE HI-FI MAGAZINE FOR LEISURE LISTENING

Britain's exciting new-style magazine in music and hi-fi, AUDIO is about every important aspect of the modern sound scene from the make-up of sound, to the latest means of reproducing it, the equipment, its installation and its operation. AUDIO examines new trends, looks at the latest discs and tapes, shows you how to get the most for your money in clarity, definition and craftsmanship.

SEPTEMBER ISSUE NOW ON SALE
GET IT TODAY - 20p

REBUILT T.V. TUBES FOR MEN OF VISION

Current types

17"	£4.00	21"	£5.00
19"	£4.00	23"	£5.00

Panorama & Rimguard types

19"	£6.00	23"	£8.00

Twin panel

19" £7.50

Cash or P.O. with order, no C.O.D. Carriage 75p in England, Scotland, Wales. Add £1.25 for carriage Northern Ireland. For all enquiries please send S.A.E. Each tube fitted with new electron gun assembly. Fully guaranteed for two years against any fault except breakage.

k.s.t. ltd.

Providence Mills, Viaduct St., Stanningly, Nr. Leeds, Yorks. Tel. Pudsey 78177

AERIAL BOOSTERS—£3.25

We make three types of Aerial Boosters: B45–UHF 625, B12–VHF 405, B11–VHF RADIO

VALVE BARGAINS

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

19" UHF/VHF (BBC2)—£6.00

Thorn-850 or Pye, with set of spare valves. Carriage £2.00 (Untested).

100 MIXED RESISTORS—65p

⅛ to 2 watt—10 ohms to above 1m-ohms (our choice) 100 mixed Capacitors up to 500MFD—£1.10 (our choice).

BARGAIN PARTS

Transistor UHF Tuners—£2.00, 500K-ohms V/C with Switch—20p. 50 mixed Tuner Valves—£2.25. Brand New Transistors BF115, BF173, BC171, BC153, BC135, BC113, BC117, BC115, BA102, BA129. All 10p each.
All prices include V.A.T. p. & p. 10p per order. Money back refund. S.A.E. for leaflets.

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

PLEASE MENTION TELEVISION WHEN REPLYING TO ADVERTISEMENTS

TELEVISION TUBE SHOP

BRAND NEW TUBES AT REDUCED PRICES

A31-18W	£12·50
A47-11W	£9·95
A47-13W	£12·50
A47-14W	£8·25
A47-26W	£10·75
A50-120WR	£12·50
A59-11W	£12·95
A-59-13W	£13·50*
A59-15W	£9·95
A59-23W	£14·75
A61-120WR	£16·50
AW43-80	£6.95
AW43-88, 43-89	£6·75
AW47-90, 47-91	£7·50
AW53-80	£7·50*
AW53-88, 53-89	£8·25
AW59-90, 59-91	£9·00
CME1201	£12·50
CME1601	£10·50
CME1602	£12·00
CME1705	£7·75
CME1713/A44-120	£14·50
CME1901, 1903	£7·50
CME1906	£12·50
CME1908	£7.75
CME2013	£12·50
CME2101, 2104	£8·25
CME2301, 2302, 2303	£9·00
CME2305	£14·75
CME2306	£13·50*
CME2308	£9.95
CME2413R	£16.50
MW43-80	£6·75
MW53-20, 53-80	£7·50
TSD217, TSD282	£14·00†
13BP4 (Crystal 13)	£14·00†
190AB4	£9·25
230DB4	£11·25

* These types are fully rebuilt.
† Rebuilt tubes also, at £7.00 plus carriage and old bulb.

COLOUR TUBES	NEW £	R/B £
19" Unprotected	25	-
A49-120X	45	-
A56-120X	72	48
A61-15X	78	52
A63-11X	-	52
A66-120X	82	55
A67-120X	85	-

SHOP-SOILED COLOUR TUBES

19", 22" & 26" NOW AVAILABLE
Brand new, with slight scratches. Prices from £20. Callers only.
Add Carriage and Insurance: Monochrome 75p, Colour £1.50.

ALL PRICES SUBJECT TO V.A.T.

TELEVISION TUBE SHOP

48 BATTERSEA BRIDGE ROAD
LONDON, S.W.11. BAT 6859

WE GIVE GREEN SHIELD STAMPS

AUSTRALIA

DAVID JONES LIMITED, SYDNEY

Australia's leading Retail Group require urgently Television Service Engineers fully conversant with colour using PAL system Solid State Sets.

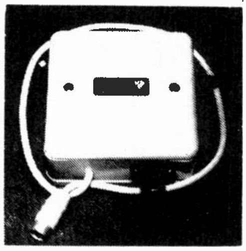
Applicants should preferably be under 40 years of age and married and keen to take up a new life in Australia. They should possess a City of Guilds qualification or similar and have had at least two years experience as Engineers with reputable Retail Organisation. Driving experience essential.

Conditions extremely good. Basic salary approximately £55 per week for 40 hour, 5 day week, overtime work would be available, also an incentive scheme.

Apply in writing in the first instance giving complete career details to the Manager, David Jones Ltd., 315 Regent St, London, W.1.

THE NEW UM4 "COLOURBOOSTER"

UHF/625 LINE



CAN PRODUCE REMARKABLE IMPROVEMENTS IN COLOUR AND PICTURE QUALITY IN FRINGE OR DIFFICULT AREAS WITH SIGNIFICANT REDUCTION IN NOISE (SNOW).

HIGH GAIN—VERY LOW NOISE
FITTED FLY LEAD—INSTALLED IN SECONDS
HIGHEST QUALITY COMPONENTS
IVORY PLASTIC CASE 3¼ x 3¼ x 1½ CORK BASE
CHANNELS: Group A, Red code 21-33
Group B, Yellow code 39-51
Group C-D, Green code 52-68

EQUALLY SUITABLE FOR BLACK AND WHITE

Also the M4 DUAL BAND VHF UNIT
BOOSTS ALL BAND III and ANY SPECIFIED BAND I CHANNEL SIMULTANEOUSLY
NOMINAL GAIN 16-18 DB BOTH BANDS

PRICES BOTH TYPES:

Battery model **£4.17** Mains version **£6.50**
Including VAT. Postage 9p

TRANSISTOR DEVICES LIMITED
6 ORCHARD GARDENS, TEIGNMOUTH, DEVON
Telephone : Teignmouth 4757

REBUILT COLOUR TUBES

19"	£22.50	22"	£25.00
25"	£27.00	26"	£28.00

Exchange prices: Tubes supplied without exchange glass at extra cost, subject to availability.

Colour Tubes demonstrated to callers.

Carriage extra all types.

Full range of rebuilt mono tubes available, Standard, Rimband and Twin Panel

- ★ Complete new gun fitted to every tube.
- ★ 2 years' guarantee monochrome, 1 year colour.
- ★ 16 years' experience in tube rebuilding.
- ★ Trade enquiries welcomed.

N.G.T. ELECTRONICS LTD.
(Nu Gun Teletubes)

22-24, Anerley Station Road, London S.E.20.

Telephone: 01-778 9178.

CUT PRICE T.V. AERIALS

U.H.F. Aerialite supreme (fringe model) £5.50; Set Top 6 ele. £1.60, 10 ele. £1.50, 18 ele. £2.00; J. Beam MBM30 £3.80, MBM46 £5.50.

STEREO RADIO 2 ele. £2.50, 3 ele. £4.00, 4 ele. £4.40, 6 ele. £6.80.

COAX. CABLE Low loss random lengths, 2 yds.—12 yds., 5p yd.; cut lengths 8p yd., standard cable 5p yd.

AMPLIFIERS: Pye/Labgear. Distribution 6+2 outlets £16.20, 1 outlet £10.50; Mast head/power unit £8.50. Set back batt. op. £3.75.

ACCESSORIES: Coax plug 9p, surface socket 30p, flush socket 50p, line connector 14p, Diplexers v.h.f. band 1/3 50p, u.h.f. gp. A/B-CD or A-B/CD 75p, splitters 90p, plastic tape 24 yds. x ¾" 25p, cable clips 7mm 30p 100, 5mm 25p 100.

LASHING EQUIPMENT: Universal clamps 45p, lash kit 1"—1¼" masts £1.00, wall-mounting bracket 75p, loft-mounting kit 55p.
Please add 10% V.A.T. to all items.
Please state ch. gp. clearly.

P.+ P.: Aerials 50p; other items 30p.
C.W.O. to :

H. A. ELECTRIC
Dept. P.T.
2 & 4 BARDEN LANE
BURNLEY, LANCS.

COLOUR TUBES
STANDARD TUBES
METAL BAND TUBES
TWIN PANEL TUBES

Rebuilt with new Electron Guns to British Standard 415/1/1967.

SUFFOLK TUBES
LIMITED

261 CHURCH ROAD
MITCHAM, SURREY CR4 3BH
01-640 3133/4/5

Britain's Largest *Independent* TV Tube Rebuilder

PHILIP H. BEARMAN, 6 POTTERS RD., NEW BARNET, HERTS.

One of the finest range of new and makers rebuilt tubes in the country; every tube is tested before it leaves the premises. Delivery usually ex stock and sent securely packed daily. Commonwealth deliveries arranged.

FOR EXAMPLE: NEW TUBES TWO-YEAR GUARANTEE

			Cge. (including insurance Mono)
CME1702, AW43-80, CRM173, MW43-80, MW43-69, CRM172, AW43-88, AW43-89, CME1705, CME1703 C17AF	17″	£6.46	55p
CME1903, CME1902, CME1901, AW47-90, AW47-91, A47-14W, C19AH	19″	£7.56	60p
CME2101, AW53-88, AW53-89, CRM211, CRM212, MW53-20, MW53-80, CME2104	21″	£8.66	65p
CME2303, CME2301, AW59-90, AW59-91 A59-15W, CME2308	23″	£10.45	65p

ALL CGE. SUBJECT VAT

Makers Rebuilt Tubes:

CME1908, „ 1903	£6.05	CME2308, „ 2303	£8.25
AW47-91, A47-14W	£6.05	AW59/91, A59/15W	£8.25

10% V.A.T. HAS BEEN INCLUDED FROM 1/4/1973!

NEW TUBES (1601 as available)

*TSD282 (TSD217)	£13.75
A28-14W (Mullard)	£12.10
MW31-74	£3.30
TSD290/CME1201	£10.78
A31/120W-CME1220	£10.78
*13BP4	£15.40
MW36/24 & 44	£5.23
CME1602	£11.00
CME1713	£13.20
CME1906, A47-13W	£12.10
A47-11W & 26W	£9.35
A50-120W/CME2013	£11.55
†CME2306, A59-13W	£16.50
A59-11W & 25 or 23W	£12.65
CME2413/A61, 120W	£14.30

carriage up to 17″ 55p.
* Two Year Guarantee Except TSD282 and 13BP4 1 year.
Please enquire regarding availability of rebuilds.
† Rebuilt T/Panel (£13.20 *when available*)
Telephone enquiries welcomed.
MONO QUANTITY DISCOUNTS IN CERTAIN CASES

MAKERS COLOUR TUBES

4 YEAR GUARANTEE All 90°

17″	A44/271X		
19″	A49.11X,	A49.191X	£53.90
20″	A51.110X	(510CKB22)	£55.00
22″	A55.11X,	A56.120X	£58.30
25″	A63.11X, use	A63.200X	£62.70
26″	A67.120X,	A66.120X	£64.90

PLUS £1.50 Cge. + VAT packing and breakage insurance

USUALLY EX STOCK EXCEPT A66.120X (short supply)

NOTE: Above prices from 1st April 1973 include 10% V.A.T.

ALL SEA JOURNEYS 50p EXTRA

EIRE £2.00 EXTRA FOR CUSTOMS CLEARANCE

OPEN SATURDAY MORNINGS
CLOSED THURSDAY AFTERNOONS

TELEPHONE: 01-449 1934/5. ALL ENQUIRIES SAE PLEASE

PADGETTS RADIO STORE

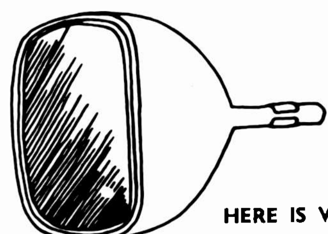
OLD TOWN HALL, LIVERSEDGE, YORKS. WF15 6PQ.

TEL: HECKMONDWIKE 405285

The T.V. Graveyard of the North, as seen on T.V. Close to the Motorway. Plenty of Free Parking Space. Est. 1935.
FAMOUS R & A SPEAKERS. 30HM. **50p** P & P. 12p.
NEW TOP QUALITY MAINS TRANSFORMERS. 250v–250v at 80ma. 6-3v at 4 Amp. Not to be missed at **£1.80**. Post paid. Weight 10 lbs.
COMPLETE UNTESTED T.V. SETS. With back and all valves. BBC1 & ITV. 17″ 90° Tube **£1**. 17″ 110° Tube **£2.20**. 19″ **£3.30**. Carr. and Ins. on any set £1.65.
50 UNTESTED T.V. VALVES **50p**. Post PAID.
¼CWT. OF EX GOVERNMENT ELECTRONIC SCRAP. Resistors, Panels, Gears, etc. **30p**. Carr. 80p
19″ UNTESTED BBC2 SETS. When available **£6**. Carriage and Ins. £1.65.
SPEAKERS. Removed from T.V. sets. all 3 ohm. 7 x 4″, 8 x 2¼″, 6 x 4″ **27p**, post 11p.
TOP QUALITY TAPE. Reel to reel. 5″ ST. **44p**. 5″ LP. **55p**. 5¾″ LP. **60p**. 7″ ST. **66p**. 7″ LP. **80p**. Post on any Tape 11p. Tapes Cassette Type. C60 **35p**. C90 **45p**. C120 **55p**.
JAP EARPIECE. 8 ohm Magnetic 2-5 **12p**. 3-5 **12p**.
EX EQUIPMENT VALVES. All tested on our Mullard Valve Tester before despatch. 3 months guarantee on all Valves. Single Valves Post 3p. Over post paid.

ARP12	6p	PCF80	6p	PY82	10p
EB91	5p	PCC84	6p	PY33	20p
EF80	10p	PCL82	14p	U191	20p
EBF89	15p	PCL83	15p	6BW7	12p
ECC81	12p	PCL84	15p	6U4	12p
ECC82	12p	PL82	10p	6F23	20p
EF91	5p	PL83	10p	20P1	15p
EY86	22p	PL36	17p	20P3	12p
EF183	20p	PY81	10p	30F5	12p
EF184	20p	PY801	17p	30FL1	20p
		PY800	17p		

REBUILT TUBES!



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

HERE IS WHAT YOU PAY:

Mono		Rimband & Twin Panel		Colour	
15-17″	£5.00	19″	£7.00	19″	£25.00
19″	£5.50	23″	£9.00	22″	£25.50
21″	£6.50	24″	£10.00	25″	£30.00
23″	£7.50			26″	£32.50

Exchange Basis

Carriage 75p (carriage-ins. £1·50)

INC V.A.T.

Cash or cheque with order, or cash on delivery

★ Each tube is rebuilt with a completely new gun assembly and the correct voltage heater.

★ Each tube comes to you with a guarantee card covering it for Mono Tubes, two years against all but breakage.

★ Each tube is insured on the journey.

★ Each tube is rebuilt with experience and know-how. We were amongst the very first to pioneer the technique of rebuilding television tubes.

RE-VIEW ELECTRONIC TUBES
237 London Road, West Croydon, Surrey
Tel. 01-689 7735

Which of these 165 career opportunities could earn you £10... £15...even £30 extra a week?

In a job you really enjoy

How to qualify in your spare time for a better job

Make yourself *worth* more and you'll earn more. It's as simple as that. There are always plenty of people to do the routine work – but, right now, key jobs are going begging for lack of suitably qualified men to fill them. *The basic qualification is technical know-how.* When you've got that, you're in demand – out in front.

Are you ambitious – willing to set aside about 60 minutes a day for home study? If you are, B.I.E.T. can give you the technical knowledge you need – change your entire future prospects.

It's easier than you think...

Make no mistake about it – you *could* do it. Most people have unused ability. A low-cost B.I.E.T. course helps you discover this hidden ability – makes learning enjoyable and so much easier than it used to be. The B.I.E.T. simplified study system gets results fast.

We've successfully trained thousands of men at home – equipped them for higher pay and better, more satisfying jobs, steered them safely through City and Guilds examinations – enabled many of them to put letters after their name.

With the help of B.I.E.T., you too could soon be on your way to better things.

OTHERS HAVE DONE IT — SO CAN YOU

Many of the successful B.I.E.T. students who get a recognised qualification never thought they had the brains to do it. But you don't need outstanding brain-power or talent – not even any special education. With enthusiasm, a little determination and a B.I.E.T. home training, ordinary, average ability will see you through. We've proved it over and over – *thousands* of times, in fact!

BEST VALUE FOR MONEY HE EVER OBTAINED.
"Yesterday I received a letter from the Institution informing that my application for Associate Membership had been approved. I can honestly say that this has been the best value for money I have ever obtained – a view echoed by two colleagues who recently commenced the course" – *Student D.I.B., Yorks.*

HE GOT OUT OF A BAD JOB INTO ONE HE LOVED.
"Completing your course, meant going from a job I detested to a job that I love, with unlimited prospects" – *Student J.A.O., Dublin.*

HE MADE FOUR TIMES AS MUCH MONEY.
"My training with B.I.E.T. quickly changed my earning capacity and in the next few years, my earnings increased fourfold" – *Student C.C.P., Bucks.*

FREE 76-PAGE BOOK

can put you on the road to success through a B.I.E.T. Home Study Course. It's yours for the asking, without obligation. Post coupon for your FREE COPY TODAY!

ACT NOW – DISCOVER FOR YOURSELF

It costs no more than a stamp to find out how we can help you. Tick the subject that interests you. Then post the coupon (or write). We'll send you an interesting 76-page book that will open up for you a whole new world of opportunity – and it's FREE.

B.I.E.T, Aldermaston Court, Reading RG7 4PF.

Choose from this list

MECHANICAL
- A.M.S.E. (Mech.) ☐
- C & G Agric. Mechanics ☐
- Diesel Eng. ☐
- Eng. Inspection ☐
- Eng. Metallurgy ☐
- Inst. Eng. & Tech. ☐
- Inst. Motor Ind. ☐
- Mainten. Eng. ☐
- Mechanical Eng. ☐
- Sheet Metal Work ☐
- Welding ☐

ELECTRICAL & ELECTRONIC
- A.M.S.E. (Elec.) ☐
- C & G Agric Mechanics ☐
- C & G Elec. Eng. ☐
- C & G Elec. Inst. ☐
- C & G Elec. Tech. ☐
- Computer Elect. ☐
- Elec. Maths ☐
- Elec. Science ☐
- Electronic Eng. ☐
- Electrical Eng. ☐
- Install & Wiring ☐

MANAGEMENT & PRODUCTION
- Auto. Control ☐
- Computer Prog. ☐
- Electronic Data Processing ☐
- Estimating ☐
- Foremanship ☐
- Inst. Cost & Man Accountants ☐
- Inst. Marketing ☐
- Management ☐
- Metrication ☐
- Motor Trade Man. ☐
- Network Plan. ☐
- Numerical Cont. ☐
- Operational Research ☐
- Personnel Man. ☐
- Planning Eng. ☐
- Production Eng. ☐
- Quality Control ☐
- Salesmanship ☐
- Storekeeping ☐
- Work Study ☐
- Works Management ☐

DRAUGHTSMANSHIP
- A.M.I.E.D. ☐
- Design of Elec. Machines ☐
- Die & Press Tool Design ☐
- Electrical Draughtsmanship ☐
- Gen. Draughtsmanship ☐
- Jig & Tool Des. ☐
- Techn. Drawing ☐

RADIO & TELECOMMUNICATIONS
- Colour TV ☐
- C & G Radio/TV/ Electronics ☐
- C & G Telecomm. Tech. ☐
- Prac. Radio Elec. (with kit) ☐
- Radio Amateurs Exam. ☐
- Radio Servicing & Repairs ☐
- Radio & TV Eng. ☐
- Trans. Course ☐
- TV Main. & Serv. ☐

AUTO & AERO
- Aero Eng. ☐
- A.M.I.M.I. ☐
- A.E.C. Cert. ☐
- Auto Engineer. ☐
- Auto Repair ☐
- C & G Auto. Eng. ☐
- Garage Management ☐
- MAA/IMI Dipl. ☐
- Motor Vehicle Mechanics ☐

CONSTRUCTIONAL
- A.M.S.E. (Civil) ☐
- Architecture ☐
- Building ☐
- Building Drawing ☐
- Build. Foreman ☐
- C & G Agric. Mechanics ☐
- Carpentry & Join. ☐
- Civil & Municipal Engineering ☐
- Constructional Engineering ☐
- Construction Surveyors Institute ☐
- Clerk of Works ☐
- Geology ☐
- Health Eng. ☐
- Hydraulics ☐
- Inst. of Builders ☐
- Inst. Works & Highway Sup. ☐
- Painting & Dec. ☐
- Public Hygiene ☐
- Road Engineer. ☐
- Structural Eng. ☐
- Surveying ☐

GENERAL
- Council of Eng. Inst. ☐
- Farm Science ☐
- General Educat. ☐
- Gen. Plastics ☐
- Pract. Maths ☐
- Pract. Slide Rule ☐
- Pure & Applied Maths ☐
- Refrigeration ☐
- Rubber Tech. ☐
- Sales Engineers ☐
- Tech. Report Writing ☐
- Timber Trade ☐
- University Ent. ☐

PLUS 58 'O' & 'A' LEVEL GCE SUBJECTS
☐ tick here

Coaching for many major exams, including C & G and assistance in ONC/HNC.

IT PAYS TO BE QUALIFIED! POST TODAY FOR A BETTER TOMORROW

To B.I.E.T., Dept BTV08
Aldermaston Court, Reading RG7 4PF CF BTV08
Please send full details and FREE 76-Page Book, without obligation.

NAME
Block Capitals Please
ADDRESS

OTHER SUBJECTS .... AGE ......

Accredited by C.A.C.C.

BIET

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY