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Television

NOVEMBER 1975 40p

servicing
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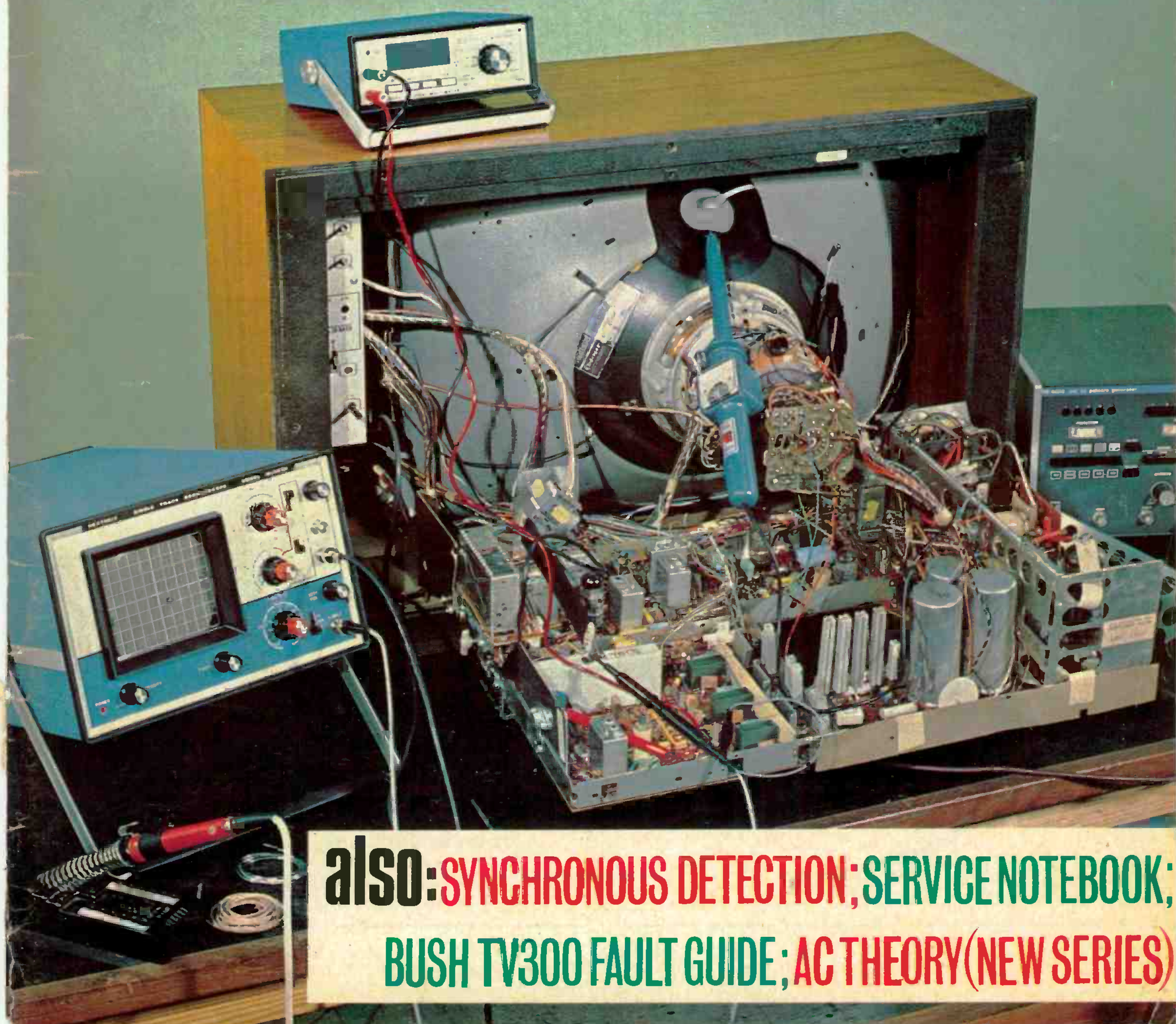

also: SYNCHRONOUS DETECTION; SERVICE NOTEBOOK; BUSH TV300 FAULT GUIDE; AC THEORY (NEW SERIES)

Television

SERVICING
VIDEO
CONSTRUCTION
COLOUR
DEVELOPMENTS

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CORRESPONDENCE

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

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We regret that we are unable to supply back numbers of *Television*. Readers are recommended to enquire at a public library to see copies. Requests for specific back numbers of *Television* can be published in the CQ Column of *Practical Wireless* by writing to the Editor, "Practical Wireless", Fleetway House, Farringdon Street, London EC4A 4AD.

QUERIES

We regret that we cannot answer technical queries over the telephone nor supply service sheets. We will endeavour to assist readers who have queries relating to articles published in *Television*, but we cannot offer advice on modifications to our published designs nor comment on alternative ways of using them. All correspondents expecting a reply should enclose a stamped addressed envelope.

Requests for advice in dealing with servicing problems should be directed to our Queries Service. For details see our regular feature "Your Problems Solved".

this month

CORRECTION

A misleading misprint occurred in the article on switch-mode power supplies in our October issue. In the left-hand column of page 591, line 11 from the top, the final component reference R735 should have been R753, i.e. the line should read "R752 compensating for the lack of current through R753."

OUR NEXT ISSUE DATED DECEMBER WILL BE PUBLISHED ON NOVEMBER 17

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Television

TRAINING THE NEW TV SERVICEMAN

Last month we commented on the problems facing TV service personnel as a result of the rapidly expanding technology now being used in TV receivers. Not only does the serviceman have to store in the back of his mind a vast range of circuit techniques, but it now seems that each time a new chassis comes out he has to sit down with the service manual (if it's available!) in order to fathom out how the thing ticks. With remote control, touch tuning, 110° scanning and some models appearing with built in VCRs, the standard of education required to produce competent technicians is rising year by year. School-leavers contemplating the TV service trade as a future career must be daunted by the amount still to be learnt after eleven years of life at school.

But the task of training new arrivals to the trade is not so great as the problems of re-educating those who have been servicing TV receivers for a good many years. One's ability to take in new knowledge declines as the years go by. And any attempt to teach complex new techniques to those whose basic theory is shaky is almost impossible.

The current City and Guilds Radio and Television Technician and Mechanics' courses replaced the old City and Guilds 48 courses in Radio and Television Servicing and run side by side at two separate levels, the mechanics being below and the technicians above the level of the old 48 course. Why this split in TV service training? Perhaps, with the rapid increase in the use of modular receivers, City and Guilds saw the need for less skilled servicemen whose job would be simply to decide which module was faulty, replace it and take the defective one back to the workshop where it would be dealt with by someone with greater skill. This system works very well for large rental organisations: but for the small business handling a wide range of colour sets it is almost impossible to make the system work or pay.

As if trying to arrange for training at two separate levels did not itself present enough problems to colleges, the educational side is about to change substantially yet again with the introduction of the new course run by the Technician Education Council (TEC). Following the trend in receivers themselves, the course will consist of a number of separate units covering particular topics, each with its own examination. The idea is very similar to the system adopted by the Open University. Two levels can be reached, depending on the number of units a particular student has been able to pass: this will result in either the lower level TEC Certificate or the higher level TEC Diploma being awarded. The new system has yet to be finalised, but at its higher level it will have facilities to cope with new techniques as they appear on the scene: units covering CCTV, VTR, digital techniques and of course colour are all planned. The big advantage is that the system is designed to cope with change, something that has been sadly lacking in the past. As techniques change, so the units can change with them.

Before we all shout out in praise of a course that at long last seems to be geared to the requirements of the trade however, let's stop and think about some of the problems facing the colleges planning to run them. First, the present economic situation has put a stop to expansion. In fact many establishments are having to reduce their facilities and even their staffs. The cost of running courses is extremely high, and where practical work forms part of a course the cost can be almost crippling. People tend to forget that students go to college to learn, and that part of learning consists of making mistakes. Readers will know all too well how much damage can be done to a receiver if a screwdriver slips, or if a meter is used on the wrong range. The cost of running a colour TV servicing course for say twenty students can run into many hundreds of pounds – before you equip the class with receivers, a complete set of service equipment, and spares. How long do you think a colour receiver can last if it is pulled apart and has faults put on and taken off every day? Printed circuits can take only so much!

Even if the money is there, the staff has to be trained and has to have time to sit down and bone up on all the new ideas that keep coming along as the technology develops. So spare them a thought: it's not everyone who can at the same time instruct twenty or more students working on as many colour receivers each with a different fault!

If the TEC scheme is to get off the ground and develop the full potential it has then a very close look is required at the financial situation of the colleges required to run the courses. If this is not done soon, and if the video side of the market opens up, Teletext gets started and developments in receiver design continue at the present rate, the educational establishments are likely to be caught with their trousers down!

COVER PICTURE

In addition to the ITT CVC5 chassis, this month's cover features three items from the Heathkit range – 10MHz Oscilloscope IO-4530, Digital Multimeter IM-2202 and 40kV Probe Meter IM-5210 – plus (right) the Philips PM5509 PAL TV Pattern Generator.

teletopics

THE UP MARKET

Even at the height of a recession there are plenty of wealthy people around. So if sales are low and you want to keep your turnover up, the thing to do is to take a look at the luxury end of the market. This at any rate seems to be the idea that has occurred to several setmakers, including a newcomer to the TV market, Roberts Radio.

Roberts have established a subsidiary company, Roberts Video, and have launched two up-market colour receivers. The RCT221 is a 90° 22in model at £425 and the RCT261 a 110° 26in model at £475. Both prices include VAT. The sets are fitted with Philips chassis – G8 in the case of the 90° model and G9 in the 110° model. There is a tweeter as well as the main loudspeaker, and separate bass and treble controls. Naturally there are luxury cabinets, and the features include remote control and facilities for connecting a VCR.

Meanwhile at the Berlin Radio Show Grundig released a luxury colour model with any number of intriguing features. First, the set incorporates a digital clock: a button on the remote control unit enables the time to be displayed on the screen in large green numerals. The accuracy of the clock is ±1 minute per year. Next, on changing channels the new channel number appears at the bottom right-hand corner of the raster: it fades automatically after seven to eight seconds. To assist engineers when tuning the set, a large tuning scale can be displayed thermometer fashion on the screen. All this is done by incorporating a quantity of digital electronics in the set. The c.r.t. is the new Philips/Mullard 20AX, with in-line guns, slotted shadowmask and vertical striped phosphor screen. The set is due for release in the UK later this year. As an accessory Grundig have introduced an infra-red sound transmitter-receiver system which can be used with any equipment having an audio amplifier. The audio signal is converted into and transmitted as an infra-red signal which the infra-red receiver detects and converts back to an audio signal to drive headphones.

Over to Japan, where Sony are now selling a 27in Trinitron tube colour receiver incorporating four loudspeakers and other luxury features. Price is £1,000 a set – though an economy version is available at £920.

US ASPECTS

Things always seem to be done rather differently in the USA than over here. Take energy conservation for example. While the UK government is accused of doing little or nothing in this field, the Commerce Department of the US government has gone so far as to assign to TV setmakers the target of reducing the power consumption of new TV sets to 40% below the 1972 level by next year. The use of solid-state circuitry has already made a considerable improvement of course: other approaches include reduced e.h.t. – there seems to have been a battle amongst US setmakers to out-bright one another – and the abandonment of 110° scanning for colour sets. Well, we've said some rather rude things in the past about 110° colour, but this is one argument against it that hadn't occurred to us.

On a different tack, we were recently sent by a DXer visiting the states an intriguing little "TV Service Tips" leaflet for the do-it-yourself enthusiast. It seems that valve testers are a common feature in do-it-yourself stores – where replacement valves are also available – and the leaflet tells you which valve type to look for in the case of a series of illustrated fault symptoms. All very well, but fancy changing every valve in an attempt to cure a hum bar! And what happens when the DIY enthusiast removes the back and finds lots of little black things? One nevertheless has to admire the clarity of the instructions given, and the way in which high technology is brought home to the average person. Pity though that there aren't any warnings about looking around for burnt components before fitting a nice new valve, sorry tube.

NEW FROM MULLARD

An interesting new varicap u.h.f. tuner, type ELC3043/01, has been announced by Mullard. It is designed to provide improved performance in the congested u.h.f. bands through its ability to handle signals of widely different strengths. A large-signal r.f. transistor is used, with a Schottky diode mixer, and the a.g.c. is applied via a pin diode attenuator in the input circuit. Typical noise figure is 7dB.

A smaller chrominance delay line, type DL60, has been developed: its maximum external dimensions are just 28·5×37mm. The encapsulation is self-extinguishing and non-dripping.

The new generation of Mullard i.c.s for TV sets was described in the July *Teletopics*. It includes the TDA2640 which acts as the control section of a switch-mode power supply. Mullard are now offering setmakers a complete package of components for a switch-mode power supply, including this i.c., various wound components, the BU126

TRANSISTORS, ETC.

Type	Price (£)
AC107	0.35
AC117	0.24
AC126	0.25
AC127	0.25
AC128	0.25
AC141	0.26
AC141K	0.27
AC142	0.20
AC142K	0.19
AC151	0.24
AC152	0.25
AC153K	0.28
AC154	0.20
AC176	0.25
AC178	0.27
AC187	0.25
AC187K	0.26
AC188	0.25
AC188K	0.26
AC193K	0.30
AC194K	0.32
ACY28	0.25
ACY39	0.68
AD140	0.50
AD142	0.52
AD143	0.51
AD149	0.50
AD161	0.48
AD162	0.48
AF114	0.25
AF115	0.25
AF116	0.25
AF117	0.20
AF118	0.50
AF121	0.32
AF124	0.25
AF125	0.25
AF126	0.25
AF127	0.25
AF139	0.35
AF147	0.35
AF149	0.45
AF178	0.55
AF179	0.60
AF180	0.55
AF181	0.50
AF186	0.40
AF239	0.40
AF279	0.84
AL100	1.10
AL102	1.10
AL103	1.10
AL113	0.95
AU103	2.10
AU110	1.90
AU113	2.40
BC107	0.12
BC107A	0.13
BC107B	0.14
BC108	0.12
BC108B	0.13
BC109	0.13
BC109C	0.14
BC113	0.13
BC114	0.20
BC115	0.20
BC116	0.20
BC117	0.20
BC119	0.29
BC125	0.22
BC126	0.20
BC132	0.15
BC134	0.20
BC135	0.19
BC136	0.20
BC137	0.20
BC138	0.20
BC142	0.30
BC143	0.35
BC147	0.13
BC148	0.12
BC149	0.14
BC152	0.25
BC153	0.20
BC154	0.20
BC157	0.15
BC158	0.13
BC159	0.15
BC161	0.48
BC167B	0.15
BC168B	0.13
BC169C	0.13
BC170	0.15
BC171	0.15
BC172	0.14
BC173	0.20
BC174B	0.26
BC176	0.22

Type	Price (£)
BC177	0.20
BC178	0.22
BC178B	0.22
BC179	0.20
BC179B	0.21
BC182L	0.11
BC183	0.11
BC183K	0.12
BC183L	0.11
BC184L	0.13
BC186	0.25
BC187	0.27
BC208	0.12
BC212L	0.12
BC213L	0.12
BC214L	0.15
BC238	0.12
BC261A	0.28
BC262A	0.18
BC263B	0.25
BC267	0.16
BC268C	0.14
BC294	0.37
BC300	0.60
BC301	0.35
BC303	0.60
BC307B	0.12
BC308A	0.10
BC309	0.15
BC323	0.68
BC377	0.22
BC441	1.10
BC461	1.58
BCY33	0.36
BCY42	0.16
BCY71	0.22
BCY88	2.42
BD115	0.65
BD123	0.98
BD124	0.80
BD130Y	1.42
BD131	0.45
BD132	0.50
BD135	0.40
BD136	0.46
BD137	0.48
BD138	0.50
BD139	0.55
BD140	0.62
BD144	2.19
BD145	0.75
BD163	0.67
BD183	0.56
BD222	0.78
BD234	0.75
BD410	1.65
BD519	0.76
BD520	0.76
BD599	0.75
BDX18	1.45
BDX32	2.55
BDY18	1.78
BDY20	0.99
BF115	0.20
BF117	0.45
BF120	0.55
BF121	0.25
BF123	0.28
BF125	0.25
BF127	0.30
BF158	0.25
BF159	0.27
BF160	0.22
BF161	0.45
BF162	0.45
BF163	0.45
BF167	0.25
BF173	0.25
BF177	0.30
BF178	0.33
BF179	0.33
BF180	0.35
BF181	0.33
BF182	0.44
BF183	0.44
BF184	0.26
BF185	0.26
BF194	0.15
BF195	0.15
BF196	0.15
BF197	0.17
BF198	0.20
BF199	0.25
BF200	0.35
BF218	0.35
BF222	1.08
BF224J	0.15
BF240	0.20

Type	Price (£)
BF241	0.22
BF244	0.18
BF254	0.45
BF255	0.45
BF256	0.45
BF257	0.49
BF258	0.66
BF259	0.93
BF262	0.70
BF263	0.70
BF273	0.16
BF336	0.35
BF337	0.35
BF458	0.60
BF459	0.63
BF596	0.70
BF597	0.15
BFR39	0.24
BFR41	0.30
BFR61	0.30
BFR79	0.24
BFT43	0.55
BFW10	0.55
BFW11	0.55
BFW16A	1.70
BFW30	1.38
BFW59	0.19
BFW60	0.20
BFW90	0.28
BFX16	2.25
BFX29	0.30
BFX30	0.35
BFX84	0.25
BFX85	0.26
BFX86	0.26
BFX87	0.28
BFX88	0.24
BFY18	0.53
BFY40	0.40
BFY41	0.43
BFY50	0.25
BFY51	0.23
BFY52	0.23
BFY57	0.32
BFY64	0.42
BFY72	0.31
BFY90	0.70
BLY15A	0.79
BPX25	1.90
BPX29	1.70
BPX52	1.90
BRC4443	0.68
BRY39	0.47
BRY56	0.40
BR101	0.47
BSX19	0.13
BSX20	0.19
BSX76	0.15
BSX82	0.52
BSY19	0.52
BSY41	0.22
BSY54	0.50
BSY56	0.80
BSY65	0.15
BSY78	0.40
BSY91	0.28
BSY95A	0.27
BT106	1.24
BT116	1.20
BU105/02	1.95
BU108	3.25
BU126	2.99
BU204	1.98
BU205	1.98
BU207	3.00
BU208	3.15
BU209	2.55
BUY77	2.50
BUY78	2.55
BUY79	2.85
D40NI	0.45
E1222	0.55
E5024	0.20
ME6001	0.16
ME6002	0.17
ME8001	0.18
MJE340	0.68
MJE341	0.72
MJE370	0.65
MJE520	0.85
MJE521	0.95
MJE2955	1.20
MJE3000	1.85
MJE3055	0.74
MPF102	0.40
MPS6566	0.21
MPSA05	0.47
MPSA55	0.50
MPSU05	0.66
MPSU06	0.76

Type	Price (£)
MPSU56	1.26
MPSU55	1.26
OC26	0.38
OC28	0.65
OC35	0.59
OC36	0.64
OC42	0.55
OC44	0.25
OC45	0.32
OC70	0.32
OC71	0.32
OC72	0.32
OC73	0.51
OC75	0.25
OC76	0.35
OC81	0.53
OC81D	0.57
OC139	0.76
OC140	0.80
OC170	0.25
OC171	0.30
OC200	1.30
OCP71	0.92
ON236A	0.65
ORP12	0.55
R2008B	2.05
R2010B	2.95
TIC44	0.29
TIC46	0.44
TIC47	0.58
TIP29A	0.49
TIP30A	0.58
TIP31A	0.65
TIP32A	0.67
TIP33A	0.99
TIP34A	1.73
TIP41A	0.80
TIP42A	0.91
TIS43	0.30
TIS73	1.36
TIS90	0.23
TIS91	0.23
ZTX109	0.12
ZTX300	0.16
ZTX304	0.22
ZTX310	0.10
ZTX313	0.12
ZTX500	0.17
ZTX502	0.17
ZTX504	0.42
ZTX602	0.24
2N525	0.86
2N696	0.23
2N697	0.15
2N706	0.12
2N706A	0.15
2N708	0.35
2N744	0.30
2N914	0.19
2N916	0.20
2N918	0.42
2N930	0.35
2N1164	3.60
2N1304	0.21
2N1305	0.21
2N1306	0.31
2N1307	0.22
2N1308	0.26
2N1309	0.36
2N1613	0.34
2N1711	0.45
2N1890	0.45
2N1893	0.48
2N2102	0.51
2N2217	0.36
2N2218	0.60
2N2219	0.50
2N2221A	0.41
2N2222A	0.50
2N2270	0.41
2N2369A	0.42
2N2401	0.60
2N2484	0.41
2N2570	0.18
2N2646	0.53
2N2712	0.12
2N2894	0.77
2N2904	0.22
2N2904A	0.26
2N2905	0.26
2N2905A	0.28
2N2926G	0.13
2N2926Y	0.12
2N2926O	0.12
2N2955	1.12
2N3012	0.91
2N3019	0.75
2N3053	0.21
2N3054	0.55
2N3055	0.60

Type	Price (£)
2N3133	0.54
2N3134	0.60
2N3232	1.32
2N3235	1.10
2N3250	1.02
2N3254	0.28
2N3323	0.48
2N3391A	0.23
2N3501	6.99
2N3702	0.13
2N3703	0.15
2N3704	0.15
2N3705	0.11
2N3706	0.10
2N3707	0.13
2N3715	2.30
2N3724	0.72
2N3739	1.18
2N3766	0.99
2N3771	1.70
2N3772	1.90
2N3773	2.90
2N3790	4.15
2N3794	0.20
2N3819	0.35
2N3820	0.49
2N3823	1.45
2N3866	1.70
2N3877	0.25
2N3904	0.16
2N3905	0.18
2N3906	0.15
2N4032	0.43
2N4033	0.54
2N4036	0.52
2N4046	0.35
2N4058	0.17
2N4123	0.13
2N4124	0.15
2N4126	0.20
2N4236	1.90
2N4248	0.12
2N4284	0.19
2N4286	0.19
2N4288	0.13
2N4289	0.20
2N4290	0.14
2N4291	0.18
2N4292	0.20
2N4392	2.84
2N4871	0.24
2N4902	1.30
2N5042	1.05
2N5060	0.32
2N5061	0.35
2N5064	0.45
2N5087	0.32
2N5294	0.35
2N5296	0.57
2N5298	0.58
2N5322	0.85
2N5449	1.90
2N5457	0.30
2N5458	0.35
2N5494	0.85
2N5496	1.05
2N6027	0.65
2N6178	0.71
2N6180	0.92
2SC643A	1.36
2SC1172Y	2.80
3N140	1.21
40250	0.60
40327	0.67
40361	0.48
40362	0.50
40429	0.80
40439	2.67

MATCHED PAIRS

Type	Price (£)
AC128/AC176	0.52
AC141K/AC142K	0.56
AC187/AC188	0.60
AC187K/AC188K	0.61
AC193K/AC194K	0.71
AD161/AD162	0.95
BC142/BC143	0.70
TIS90M/TIS91M	0.50

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

DIODES

Type	Price (£)
AA113	0.15
AA119	0.09
AA129	0.20
AA143	0.10
AAZ13	0.30
AAZ17	0.12
BA100	0.15
BA102	0.25
BA110U	0.30
BA115	0.12
BA141	0.17
BA145	0.17
BA148	0.17
BA154	0.13
BA155	0.16
BA156	0.15
BA157	0.25
BAX13	0.06
BAX16	0.07
BAY72	0.11
BB104	0.52
BB105B	0.52
BB105G	0.45
BB110B	0.45
BR100	0.50
BY100	0.22
BY103	0.22
BY126	0.16
BY127	0.17
BY133	0.23
BY140	1.40
BY164	0.55
BY176	1.68
BY179	0.70
BY206	0.31
BYX10	0.15
BYZ12	0.30
FSY11A	0.45
FSY41A	0.40
OA10	0.20
OA47	0.07
OA81	0.12
OA90	0.08
OA91	0.07
OA95	0.07
OA200	0.10
OA202	0.10
OA210	0.29
OAZ237	0.78
S2M1	0.22
TV20	1.85
IN914	0.07
IN914E	0.06
IN916	0.10
IN1184	0.92
IN1185	1.10
IN4001	0.05
IN4002	0.06
IN4003	0.07
IN4004	0.08
IN4005	0.09
IN4006	0.11
IN4007	0.14
IN4148	0.05
IN4448	0.10
IN5400	0.15
IN5401	0.17
IN5402	0.20
IN5403	0.22
IN5404	0.25
IN5405	0.27
IN5406	0.30
IN5407	0.34
IS44	0.07
IS310	0.45
IS920	0.07

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

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

LINEAR INTEGRATED CIRCUITS

Type	Price (£)
CA3045	1.35
CA3046	0.70
CA3065	1.90
MC1307P	1.19
MC1310P	2.94
MC1327PQ	1.01
MC1330P	0.76
MC1351P	0.75
MC1352P	0.82
MC1358PQ	1.85
MC1496L	0.87
MC3051P	0.58
MFC4000B	0.43
MFC4060A	0.70
MFC6040	0.91
NE555	0.72
NE556	1.34
SL414A	1.91
SL901B	3.84
SL917B	5.12
SN76001N	1.45
SN76003N	2.92
SN76013N	1.95
SN76013ND	1.72
SN76023N	1.95
SN76023ND	1.72
SN76033N	2.92
SN76227N	1.46
SN76530P	1.05
SN76533N	1.20
SN76666N	0.90
TAA300	1.76
TAA320	0.94
TAA350A	2.02
TAA435	0.85
TAA450	2.70
TAA550	0.55
TAA570	2.02
TAA611A	1.70
TAA611B	1.85
TAA630Q	4.18
TAA630S	4.18
TAA661B	1.32
TAA700	4.18
TAA840	2.02
TAA861A	0.49
TAD100	2.66
TBA120S	0.99
TBA240A	2.97
TBA281	2.28
TBA480Q	1.90
TBA500	1.99
TBA500Q	2.00
TBA510	1.99
TBA520Q	3.34
TBA530	2.71
TBA530Q	2.71
TBA540	3.21
TBA540Q	3.21
TBA550Q	4.10
TBA560C	4.09
TBA560CQ	4.10
TBA570	1.17
TBA641	2.30
TBA673	2.28
TBA700	2.59
TBA720Q	2.45
TBA750Q	2.33
TBA800	1.75
TBA810AS	1.75
TBA920Q	4.23
TBA990	4.10
TBA990Q	4.10
TCA270Q	4.18
ZN414	1.25

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

DIGITAL INTEGRATED CIRCUITS

Type	Price (£)
7400	0.20
7401	0.20
7402	0.20
7404	0.24
7406	0.45
7408	0.25
7410	0.20
7411	0.25
7412	0.28
7413	0.50
7416	0.45
7417	0.30
7420	0.20
7425	0.37
7430	0.20
7440	0.20
7441	0.85
7445	1.95
7447	1.30
7450	0.20
7451	0.20
7454	0.20
7460	0.20
7470	0.33
7472	0.38
7473	0.44
7474	0.48
7475	0.59
7489	4.32
7490	0.65
7491	1.10
7492	0.75
7493	0.65
7494	0.85
7495	0.85
7496	1.00
74100	2.16
74121	0.60
74122	0.80
74150	1.44
74151	1.15
74154	1.66
74164	2.01
74192	2.05
74193	2.30

HARDWARE BASES

Type	Price (£)
DIL8	0.16
DIL14	0.16
DIL16	0.18

MOUNTING KITS

Type	Price (£)
TO-3	0.06
TO-66	0.06

VALVES

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

ZENER DIODES

400mW 3.0-33V **12p** each
1.3W 3.3-100V **18p** each

VDR'S, PTC & NTC RESISTORS

Type	Price (£)	Type	Price (£)
E295ZZ/01	14	E299DD/P116-P354	all 8
E295ZZ/02	14	VA1015	50
E298CD/A258	7	VA1026	41
E298ED/A258	6	VA1033	8
/A260	6	VA1034	8
/A262	6	VA1040	8
/A265	6	VA1053	8
/P268	6	VA1055S	10
E298ZZ/05	7	VA1077	12
/06	6	VA1104	35
		VAB650	110

RESISTORS

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

WIREWOUND (5%)
2½W 0.22 Ω-270 Ω **15p ea**
5W 10 Ω-8.2k Ω **13p ea**
10W 10 Ω-25k Ω **18p ea**

CAPACITORS

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

MASTHEAD AMPLIFIERS

Labgear uhf group amplifier complete with mains power unit CM6001/PU. Groups A, B, or C/D please specify **£12.65**

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

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

PATTERN GENERATORS

Labgear CM6004/PG giving crosshatch dots, greyscale and blank raster on 625-lines. Tuning can be preset for anywhere in Bands IV and V as well as Band III (for relays) **£58.80**

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

COLOUR/BAR GENERATORS

Labgear CM6037/DB: Dual standard band generator gives standard 8 band colour bars + greyscale step wedge + red raster + centre cross + centre dot + crosshatch + dot pattern + blank raster. Sync output also provided **£125.15**

VHF/UHF CONVERTERS

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

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

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MAINS DROPPERS	each	TAA 630	**£3.82**	TBA 750	**£1.24**	SN 76013N	**£1.93**	LOPT'S COLOUR	each
BRC 1400	**48p**	TAA 700	**£3.80**	TBA 750Q	**£1.34**	TBA 120A	**65p**	BUSH	
BRC 1500	**48p**	TAA 840	**£1.84**	TBA 920	**£3.88**			CTV 25 Mk. 3	**£6.28**
BRC 3500	**32p**	TAD 100	**£1.85**	TBA 920Q	**£3.90**	LOPT'S MONO	each	CTV 162	**£6.28**
BRC 8000	**44p**	TBA 480Q	**£1.84**	TBA 990	**£3.89**	PHILIPS		CTV 167 (not Mk 1	
BRC 8500	**48p**	TBA 500Q	**£2.42**	TBA 990Q	**£3.89**	170 Series	**£5.52**	or 2)	**£6.28**
PHILIPS 210	(pr) **68p**	TBA 510Q	**£2.42**	TCA 270Q	**£4.26**	210 Series	**£5.37**	CTV 174	**£6.26**
BUSH colour S/S		TBA 520Q	**£3.07**	TCA 160B	**£2.07**	BUSH		CTV 182S	**£7.73**
56ohm 68ohm	**40p**	TBA 530	**£2.60**	TCA 160C	**£2.23**	141 to 178	**£5.91**	CTV 184S	**£7.73**
PHILIPS G8	**31p**	TBA 530Q	**£2.62**	SAA 570	**£1.27**	KB Chassis No.		CTV 187CS	**£7.73**
GEC 2000	**36p**	TBA 540	**£2.99**	TAA 611	**£1.93**	VC2/VC3	**£5.52**	DECCA	
GEC 2028	**36p**	TBA 540Q	**£3.00**	TBA 800	**£1.75**	VC4/VC51	**£5.52**	CS 2220	**£7.74**
BUSH 161 ser	**34p**	TBA 550	**£4.14**	SN 76013ND	**£1.75**	VC52/VC53	**£5.52**	CS 2225	**£7.74**
		TBA 550Q	**£4.24**	SN 76666	**£2.25**	VC100	**£5.52**	CS 2227	**£7.74**
I.C.'S.	each	TBA 560C	**£4.14**	RCA 3065	**£1.55**	VC1	**£5.52**	CS 2520	**£7.74**
TAA 350	**£1.85**	TBA 560CQ	**£4.24**	BRC 1330	**55p**	VC11 featherlight	**£5.69**		
TAA 300	**£1.61**	TBA 570	**£1.41**	MC 1327Q	**£2.35**	GEC 2000/2064	**£5.58**		
TAA 310A	**£1.38**	TBA 570Q	**£1.48**	76530P	**£2.45**	BUSH S/S			
TAA 320	**£1.25**	TBA 673	**£2.07**	SN 76227N	**£1.30**	Printed Cir.	**£6.44**		
TAA 350A	**£1.20**	TBA 690Q	**£2.23**	SN 76013N	**£2.45**	PYE P/C			
TAA 550	**60p**	TBA 700Q	**£2.23**	SN 76544N	**£2.29**	160 161 150	**£5.69**		
TAA 570	**£2.20**	TBA 720AQ	**£2.38**	SN 76003N	**£2.56**	151 155 156	**£5.69**		

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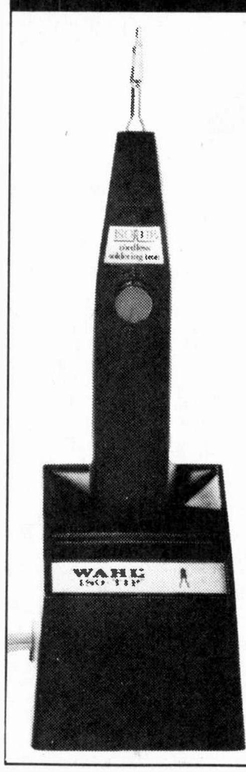
A NEW DIMENSION IN SOLDERING



Iso-Tip Cordless Soldering Iron

Ideal for factory, field servicing, laboratory or home, the Iso-Tip Cordless offers a great advance in soldering. It is completely portable, heats in 5 seconds and recharges automatically in its own stand.

The Iso-Tip is powered by long-life nickel cadmium batteries giving tip performance up to 50 watts with a temperature of 370°C. Tips are available in five different sizes ranging from Micro to Heavy Duty to meet all soldering requirements.

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Portman Rd, Reading RG3 1NE, England.
Telephone: Reading (0734) 595844.
Telex: 848659.

high-voltage switching power transistor, and rectifiers with characteristics matched to the requirements this application imposes, i.e. fast soft-recovery types.

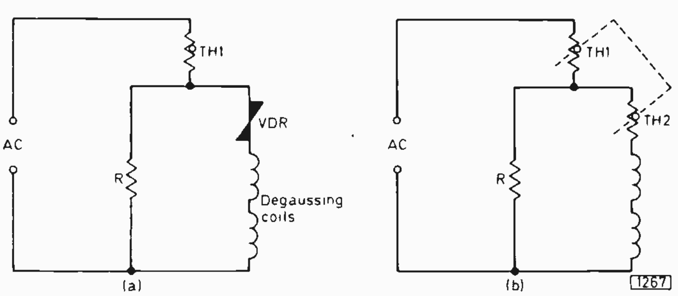
Mullard have also introduced a new dual positive temperature-coefficient thermistor (or posistor as these are sometimes called) to simplify colour set degaussing circuitry. This is the latest step in a process of circuit evolution – shown in Fig. 1 – that has been going on for the last two or three years. The traditional arrangement is shown in Fig. 1(a), using a single posistor (TH1), a v.d.r. and resistor (R) in addition to the degaussing coils themselves. At switch on the resistance of the posistor and the v.d.r. is low, so a substantial current flows through the coils. As the posistor heats up, its resistance increases: the reduced voltage across the v.d.r. means that its resistance also increases. As a result there is little current in the circuit after a few seconds, most of the residual current flowing through TH1 and resistor R. Most recent chassis use the arrangement shown in Fig. 1(b). Here a dual posistor, thermally coupled in a common encapsulation, replaces the separate single posistor and v.d.r.: the circuit operation is the same. The latest arrangement is shown in Fig 1(c). In this, only the dual-posistor is required in addition to the coils. TH1 is present simply to apply heat to TH2. The initial peak current through the degaussing coils is greater than 5A but falls to less than 70mA within five seconds and less than 2mA after 180 seconds. Advantages of the new arrangement are the reduced number of components, the fact that it can be used equally with continental (220V) and UK (240V) mains supplies, and that there is no overheating if the degaussing coils are accidentally disconnected – this can result in resistor R in the previous arrangement going up in a puff of smoke. The type number of the new dual posistor is 2322 662 98009 – Mullard's dual posistor for use in the arrangement shown in Fig 1(b) is type number 2322 662 98003. Both dual posistors are encapsulated in the same housing, but whereas the new type has a white outer finish the previous type is coded blue. They are not interchangeable for service purposes.

TRANSMITTER NEWS

The following relay stations are now in operation:

Calver Peak (Derbyshire) BBC-1 (North) channel 39, BBC-2 channel 45, ITV (Yorkshire Television programmes) channel 49. Receiving aerial group B.

Catton Beacon (Northumberland) BBC-1 channel 40, ITV (Tyne Tees Television programmes) channel 43, BBC-2 channel 46. Receiving aerial group B.



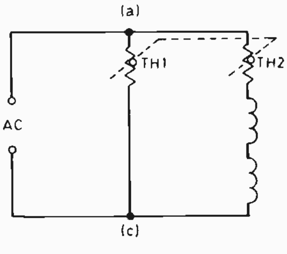


Fig. 1: Evolution of colour receiver degaussing circuits. The first change (b) came with the introduction of double posistors in a common housing. The latest circuit suggested by Mullard, using a new dual posistor, is shown at (c).

Deri (Mid Glamorgan) BBC-Wales channel 22, ITV (HTV Wales programmes) channel 25, BBC-2 channel 28. Receiving aerial group A.

Pontardawe (Glamorgan) BBC-Wales channel 58, ITV (HTV Wales programmes) channel 61, BBC-2 channel 64. Receiving aerial group C/D.

All these transmissions are vertically polarised.

The IBA has issued the following typical ranges for low-power relays, assuming no hills or other obstructions:

1,000W e.r.p.	14 miles
100W e.r.p.	4·4 miles
10W e.r.p.	1·4 miles

Some relay stations use directional aerials so that the e.r.p. in directions other than the intended service area will be a lot less. For a given e.r.p., ranges for the higher channels (Band V) will be a little less than for the lower channels (Band IV).

MAINS FILTER CAPACITORS

Mains filter capacitors seem to short rather often, blowing the mains fuse. Many service engineers simply remove them altogether. This is not to be recommended: the capacitor(s) are there to prevent the set causing interference via the mains leads and to protect the set against transient spikes on the mains input waveform.

Grundig have announced recently that the mains filter capacitors in some of their sets should be replaced, whether faulty or not. The sets concerned are colour Models 5010, 5011, 6010 and 6011 (capacitors C604 and C605) and monochrome Models R810 and R2010 (capacitor C601). The yellow-coded $1\mu F$ capacitors originally fitted are rated at 220V a.c.: they should be replaced with grey-coded types rated at 250V a.c. These are available from the Grundig spares department free of charge.

UK ELECTRONICS INDUSTRY IN THE BLACK

Exports of electronic equipment and components from the UK during the second quarter of this year exceeded imports for the first time since 1972 – prior to then there had always been a favourable trade balance. The overall figures for the first half of the year were also favourable despite a small deficit during the first quarter. Imports during the second quarter were over 22% down, the main factor contributing to the results being the collapse in domestic electronic equipment imports.

MISCELLANY

A midland dealer has suggested that in many parts of the country the minimum charge for a service call will be £10 within twelve months . . . Colour television has been an instant success in Australia, with sales of colour sets running at the rate of over 700,000 sets a year against forecasts of 200,000-350,000 . . . Siemens have announced that their Interplex single-tube colour camera – mentioned in our report from Montreux in the September issue – is now in production. The price is around £2,800. A new type of dichroic strip filter on the pick-up tube screen is used to obtain the luminance and two colour signals . . . The Radio, Television and Electronics Examination Board has held the first two sittings for the new Certificate of Competence in Colour TV Servicing. Out of 23 candidates, only eleven were successful. The tests involved diagnosing faults on five separate sets of two different types, adjustment of the controls, and a written paper on installation and safety aspects.

Synchronous Detection

by Phosphor

THE synchronous detector, which is used for chrominance signal demodulation and is being increasingly used to demodulate the vision i.f. signal, has a lot in common with the coincidence detector which is used as an f.m. discriminator in intercarrier sound i.c.s – a typical example of the latter was described in the April 1975 issue, in the article on the TBA120 and TBA120S. In this article we will be examining mainly synchronous detection of the vision i.f. signal.

Amplitude Modulation

Amplitude modulation of a carrier wave produces sidebands above and below the carrier frequency, the sidebands being displaced relative to the carrier by the modulation frequency: thus for every frequency component of the modulation there are two sidebands, an upper and a lower one. Oddly as it may seem, the carrier itself remains unchanged in amplitude: but the envelope of the r.f. signal produced is that of the modulating waveform.

In the 1920s, when frequency was confused with the number of zero crossings of a wave, there was bitter argument about the reality of sidebands, and a Royal Commission was appointed to sort the matter out. Much to their credit, they came out heavily in favour of the existence of sidebands, which was as well since Carson had all the time been running a transatlantic telephone service in which only one sideband was radiated.

The anti-sideband argument was that as the amplitude only of the carrier was being altered, how could new frequencies be created? – the zero crossing rate was not being altered by the modulation. But only a pure sinewave has a frequency: anything else can have a repetition rate, which is a different quantity. Each cycle of a modulated wave is slightly different from its predecessor, and the number of these different cycles per second is not the same as the mathematical definition of frequency. A modulated wave can however be resolved mathematically into pure sinewaves added together – the carrier and its sidebands.

Even more odd is the fact that if the same mathematical analysis is applied to a frequency-modulated wave, several pairs of sidebands are revealed and the amplitude of the carrier frequency component *is* altered: in fact under certain combinations of frequency and amplitude of the modulating wave the carrier component can be zero!

So much for the theoretical warfare of the twenties. Now, fifty years later, our television transmitters partially remove one sideband in order to conserve space in the television spectrum – and this plays havoc with the simple diode envelope detector since the r.f. signal envelope is no longer an exact copy of the modulating wave. In particular, the diode will produce unwanted beats between the sound carrier and the chrominance signal, as well as a phenomenon known as quadrature distortion which is a subject all of its own and is rather mathematical in concept.

The Homodyne Principle

If the local oscillator of a superhet receiver is at exactly the same frequency as the carrier it is receiving, i.e. the two are synchronous, the intermediate frequency will be zero, in other words d.c. The value of this d.c. can be shown mathematically to depend on the phase of the local oscillator relative to the carrier, and non-mathematically by the account given in the previously mentioned article on the TBA120/TBA120S. Demodulation is thus achieved. It would be a formidable task however to ensure that a free-running oscillator had exactly the same frequency as the carrier, let alone phase (frequency is the rate of change of phase, and any frequency error, however small, would result in a continuous phase change – or slow beats if you would rather express it that way).

A sort of "flywheel sync" – called a phase-locked loop, described later – can be used to ensure that the phase and hence the frequency of the local oscillator are kept correct, but for economic reasons this technique is at present more suited to space-probe reception than to domestic TV.

Fortunately however we can produce a local oscillation of the correct phase and frequency from the signal itself. This is particularly relevant to television since the u.h.f. wave is never allowed to fall to zero as a result of its being modulated.

Deriving the Local Carrier

If the signal is amplified and limited in exactly the same way as in an intercarrier sound channel, the amplitude modulation will be stripped off. A tuned circuit of no very great selectivity can then be used to remove the harmonics produced by the limiting process, leaving a pure sinewave of correct frequency whose phase can be corrected by adjusting the tuned circuit. Unfortunately however the television signal's sidebands are not symmetrical since one set of sidebands is partially removed at the transmitter. As a result the limited signal will in effect be "biased" towards the sound carrier. To remove this "bias" we can either use a tuned circuit with a very high *Q*, thus eliminating the sound carrier but making tuning very critical, or incorporate a notch filter – the preferred arrangement. Even without a notch filter acceptable results are achieved using a simple tuned circuit. The process is being carried out at i.f., not u.h.f., so what we have is a "homodyne superhet".

The arrangement is shown in block diagram form in Fig. 1. Using i.c. techniques, the actual circuitry within the blocks is very similar to the arrangement used in the TBA120/TBA120S and other intercarrier sound i.c.s. The tuned circuit filter does not generate a quadrature carrier signal however since it is fed directly from the limiter amplifier instead of via a small capacitor.

The filter circuit is shown in Fig. 2. L1 and C1 resonate

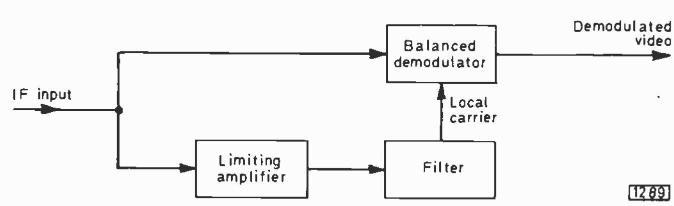


Fig. 1: Synchronous detection of the video signal, using a local carrier obtained from the transmitted carrier by limiting and filtering.

at the vision i.f., providing a high impedance at this frequency so that a large voltage is passed to the balanced demodulator. At some point between the vision and sound i.f.s, C2 forms a series resonant circuit with L1, C1, bypassing the unwanted sideband components. Best freedom from sound/chroma beats is when the series resonant frequency lies somewhere between the sound

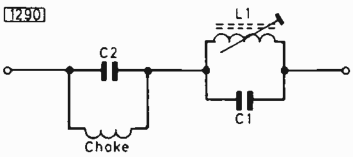


Fig. 2: Series/parallel filter used to obtain the local carrier required for synchronous video detection.

(33·5MHz) and the chroma (35·07MHz) i.f.s. The choke is there solely to pass d.c., which is required by the differential amplifiers and demodulators in the i.c. C2 must be able to absorb the effects of the choke's self-capacitance. There are variants of this three-pole filter allowing the damping of the series and parallel resonances to be controlled separately.

Demodulation

The local carrier produced by the filter, free of modulation, of correct phase but slightly noisy due to the filter's finite bandwidth, is fed to the balanced demodulator circuit where it converts the i.f. carrier to d.c. and the vestigial sidebands to base band, i.e. the same frequencies as those of the original modulation.

There is one unattractive feature – other than its complexity – which a synchronous detector has when used to demodulate a TV video signal: this is its ability to produce from noise an output which is whiter than white. This comes about due to the similarity of the circuit to a phase discriminator. The output will be a maximum for one signal polarity – black with the negative modulation used at u.h.f. – because the tuned circuit is adjusted to give zero phase shift at vision i.f. between the i.f. carrier and the local carrier. Should a signal in quadrature with the local carrier be fed in, zero output will be produced. This is just whiter than white. Should an anti-phase (180° phase difference) signal, i.e. of opposite i.f. polarity, be applied a much whiter than white output will be produced. Neither of these conditions could be continuous, since the local carrier would quickly adjust in phase to the incoming signal. Noise has no phase allegiance to the local carrier or to the signal however, and is just as likely to produce a burst 180° out of phase as it is in any other phase. The filter will not have time to rephase the local carrier, which is just as well.

The TCA270 and SL437 i.c.s incorporate a circuit to detect whiter than white and force the output to grey level for the duration of the noise pulse. The earlier MC1330 synchronous detector i.c. has no such protection however, and moreover if overdriven at its input it will latch to white level. If the a.g.c. voltage is derived from its output the latching will be aggravated since even more drive will be turned on in a vain effort to get a sync tip (blacker than black) level at the output. An external unbiased silicon diode is necessary to prevent this. The condition shows up as a negative, weak picture.

Developments

There are on the market phase-locked loop i.c.s which provide synchronous detection using a very pure local carrier produced by an oscillator whose phase is locked to that of the incoming i.f. by feedback (see Fig. 3). This avoids the selectivity/noise compromise that has to be made with the simple limiter plus filter method. The phase-locked loop always locks the oscillator in quadrature with the i.f. carrier however, and a further balanced demodulator is required for the actual detector plus a 90° phase shift either in the oscillator or the signal path. This is what prices it out of the TV market at present – together with a frequency limit below 39MHz. None of these difficulties is insuperable however. The same chip can demodulate f.m. since f.m. causes a carrier phase shift. One can use either a filter with a short time-constant so that the oscillator tracks the phase of the signal, taking the control voltage as the output, or keep the local oscillator at the carrier frequency by means of a long time-constant filter, taking the output from the balanced demodulator before the filter. These methods both give very good linearity.

With both a.m. and f.m. synchronous demodulation by means of a phase-locked loop, the selectivity is obtained by filtering after the detector. This is because the signal components do not beat together as they do in an unbalanced diode detector but instead beat only with a clean, locally-generated oscillation. When used for TV demodulation however some pre-detector bandwidth shaping filters are required because of the vestigial-sideband signal with its f.m. sound. A medium wave a.m. receiver has been made whose only tuning variable is the control voltage applied to the voltage-controlled oscillator, all pre-detector circuits being of bandwidth sufficient to cover the entire medium waveband. It remains a laboratory curiosity however because of intermodulation in the signal frequency amplifier.

Phase-Locked Loop Demodulation

The phase-locked loop is well known in TV as the basis of the flywheel sync technique. Generally it consists of a voltage-controlled oscillator, a phase detector and a filter, with enough amplification built into the loop to make it work. The technique dates back to telegraph practice before the first world war, but was rather clumsy without even the benefit of the thermionic valve! It has been frequently rediscovered ever since. The basic arrangement is shown in Fig. 3.

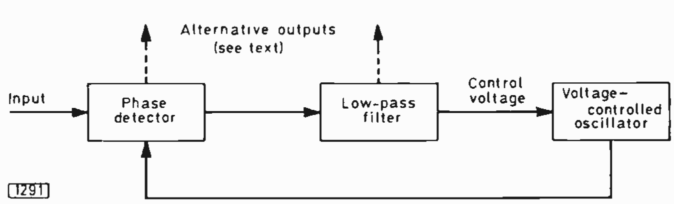


Fig. 3: Detection by means of a phase-locked loop.

The phase detector can be a balanced demodulator of the type used in the TBA120/TBA120S and other i.c.s. This produces the same output (zero) for quadrature relationship between the input and the local oscillation as it does for no signal input, a property not possessed by all phase detectors, particularly the simple digital ones which are available in i.c. form. An output signal appears when the phase conditions depart from quadrature. The output is filtered and applied to the voltage-controlled oscillator in polarity such as to bring the phase conditions back to quadrature.

There are two quadrature states, lagging or leading, and only one is stable – a flywheel sync circuit for example could settle in the condition where the sync pulse occurs

– continued on page 15.

BUSH

MODEL TV300: FAULT GUIDE

John Coombes

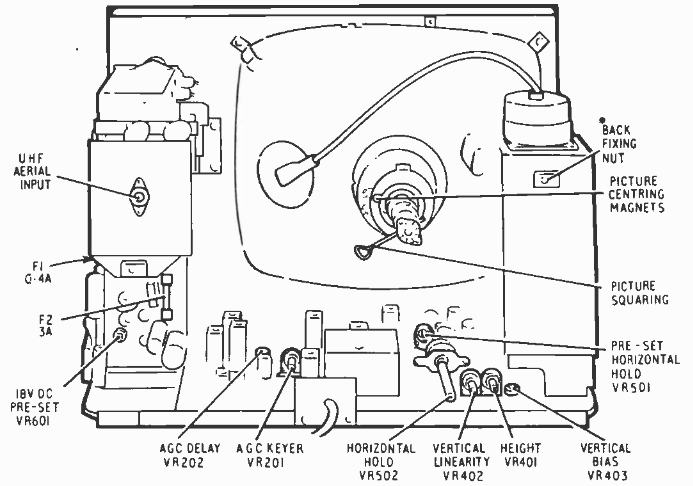


Fig. 1: Rear chassis view of the Bush Model TV300. The length of the top right back fixing screw must not exceed 14mm.

THE Bush Model TV300 is a 12in mains-only portable set fitted with an imported chassis. It is all solid-state except for the e.h.t. rectifier (type 1X2B) and of course the c.r.t. (type 310EYB4). The intercarrier sound channel consists of an integrated circuit (type UPC16C). The e.h.t. is 11·5kV and the consumption 43W. The chassis is isolated by means of a double-wound mains transformer.

The most common trouble is dry-joints – faults are more frequently caused by these than by component failures. Particularly common is a dry-joint at pin 4 on the line output transformer. The symptom is excessive brightness which will not cut off with adjustment of the brightness control. Pin 4 of the line output transformer feeds rectifier D506 (type HFSD-1A) which provides the supply for the c.r.t. first anode and focus electrodes and also the brightness control. The video signal is a.c. coupled to the c.r.t. cathode, the brightness control setting the d.c. level at the c.r.t. cathode – hence the excessive brightness when the supply to the control is removed.

Uncontrollable brightness can be caused by a faulty line output transformer. Other faults which can be caused by a defective line output transformer are line pulling (flywheel sync affected), faulty a.g.c. (the a.g.c. circuit is gated by pulses from the line output transformer), poor sync or a thin black vertical line on the left-hand side of the screen. Line output transformer replacement has not been necessary very often however.

The link from pin 4 on the line output transformer connects to tag J11 on the printed panel, this tag feeding D506. The link can short to chassis, resulting in blown fuses.

Lack of width, possibly with slight hum on vision, is not due to a line timebase fault but to the preset control VR601 in the power supply regulator circuit being incorrectly set. Adjust for 18V at J6.

If the line frequency is too high the e.h.t. will be low and there will be no sound. The usual cause of this trouble is either the line blocking oscillator transistor TR21 (type 2SC182), or the zener diode D503 (type ZB1-10) which stabilises the supply to this stage, being defective. As a result, the l.t. voltage falls.

No raster has been traced to a dry-joint on the line driver transistor TR22 (type 2SD205), also to this transistor going short-circuit.

The series regulator transistor TR204 (type 2SD154) is

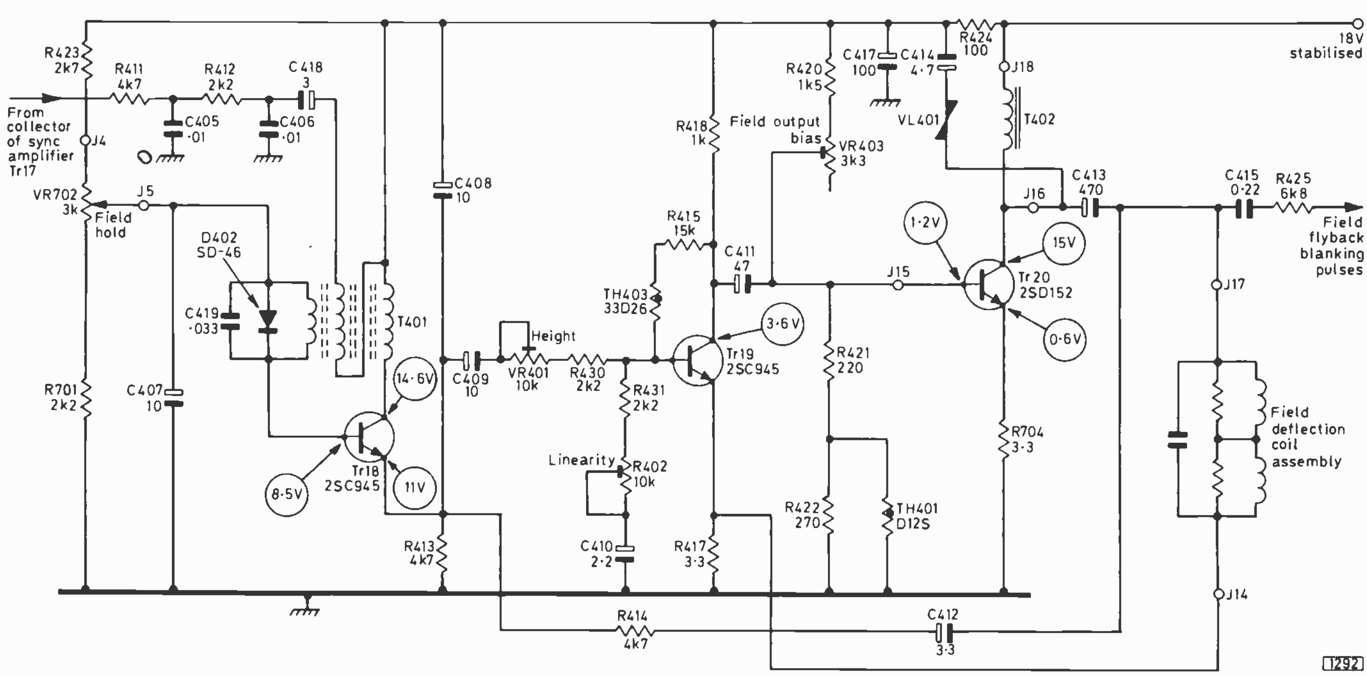


Fig. 2: Bush Model TV300 field timebase circuit. Field and line flyback blanking are carried out in the emitter circuit of the 2SC1103 video output transistor (TR10).

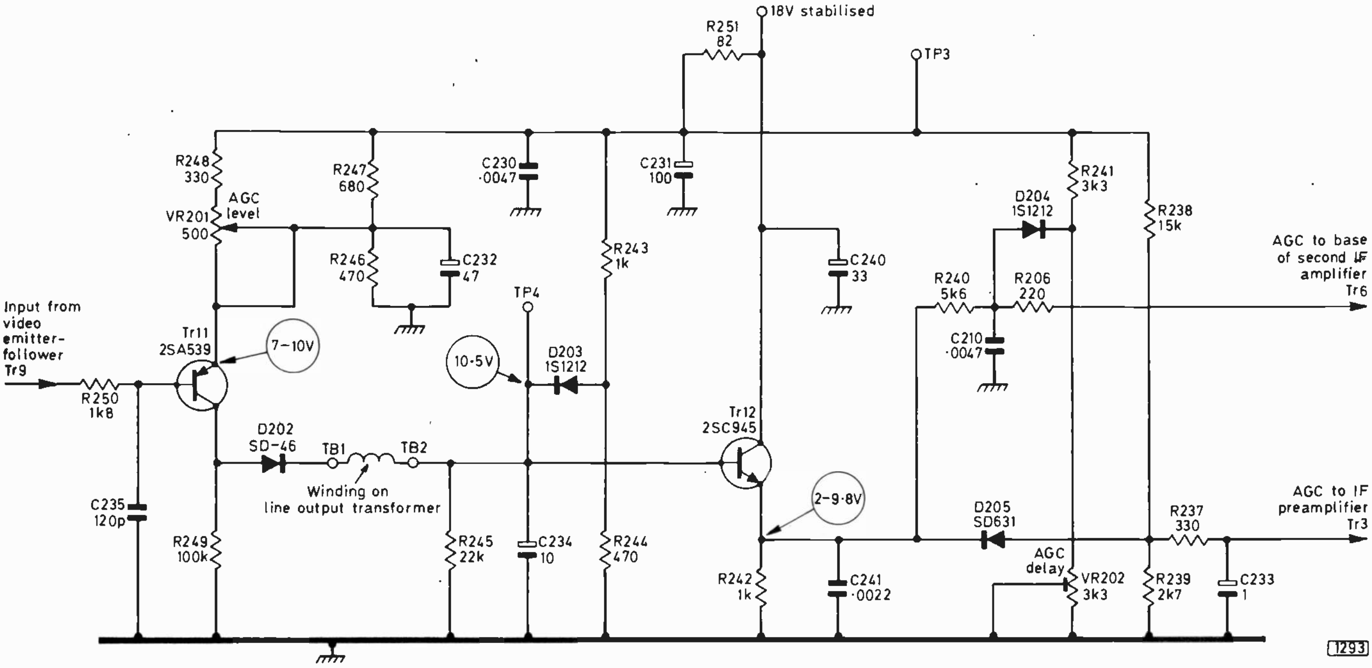


Fig. 3: A.G.C. circuit used in the Bush Model TV300. The i.f. strip comprises a preamplifier (TR3) which is mounted on a subpanel close to the u.h.f. tuner, followed by three stages (TR5, TR6 and TR8) on the main panel. TR8 is in the large centre rear screening can along with the video emitter-follower (TR9). A.G.C. is applied to the base of TR5 from the emitter of TR6 which thus acts as an a.g.c. amplifier as well as an i.f. amplifier.

mounted on the chassis behind the power supply panel at the rear left-hand side. In cases of no sound or raster check the link from its emitter to tag J6 on the printed board.

A common fault is no sound or vision, with hum on sound when the contrast control is at minimum. The cause is a faulty a.g.c. clamp diode (D203, type 1S1212). Check that there is about 10·5V at TP4 (base of a.g.c. amplifier TR12, type 2SC945).

Field collapse can be due to several things. The most common causes are the field output transistor TR20 (type 2SD152) going short-circuit or the field output coupling capacitor C413 (470μF) going open-circuit.

Another field timebase fault sometimes encountered is jitter. This is due to the feedback capacitor C412 (3·3μF) going open-circuit – tapping another across it results in a perfect picture.

I have come across several causes of no sound. First is a short-circuit audio driver transistor TR14 (type 2SC945). The second is when C304 (0·039μF) which is connected to pin 1 of the intercarrier sound i.c. goes short-circuit – there may be very weak sound when this capacitor is defective. If the sound returns when C304 is disconnected the discriminator transformer T302 is faulty. In cases of intermittent sound, check for dry-joints around the i.c. – you may find that by tapping the board around the i.c. the sound comes and goes.

If the gain is low check for dry-joints on the i.f. transformers.

If the gated a.g.c. transistor TR11 (type 2SA539) is faulty the sync pulses will be crushed resulting in poor sync.

Intermittent contrast can be due to a broken track on the line output transformer panel.

The supply for the video output transistor TR10 (type 2SC1103) is derived from pin 3 on the line output transformer. There is a link from this pin to tag J10 on the main panel, the path then being via the surge limiting resistor R514 (10Ω) to rectifier D505 (type HFSD-1A). This rectifier's reservoir capacitor C519 (1μF) can go open-circuit resulting in a negative picture. There should be 68V at the collector of the video output transistor. ■

SYNCHRONOUS DETECTION

– continued from page 13.

half way through the forward scan instead of at the centre of the flyback, but the slightest deviation from this state would make the feedback positive until the correct condition was achieved. In the same way the general phase-locked loop is stable in only one quadrature condition: reversing the polarity of the control voltage will drive it to the other position. For those who think in terms of colour, the decoder reference oscillator is controlled in the same way: the bursts are transmitted with average – (B – Y) phase, the oscillator locking along the R – Y phase axis.

We assumed rather glibly that altering the control voltage applied to the voltage-controlled oscillator alters the oscillator's phase. Actually the voltage change alters the frequency, which is rate of change of phase. This fact places a stability constraint on the filter, a problem for the designer.

If the filter has a very narrow bandwidth – long time-constant – the voltage-controlled oscillator cannot follow rapid phase changes. Thus the phase of the oscillator's output will be the mean of the input phase, clean and free from jitter. This approach is essential with a PAL colour decoder since the bursts are transmitted with a ±45° phase change on alternate lines.

If the filter is given a short time-constant, the control voltage will vary rapidly so that the oscillator can track the phase of the input. This makes f.m. detection possible, but is rarely done.

To sum up, the phase-locked loop is a means of converting phase to voltage, applying what smoothing is required to this voltage, then reconverting the voltage back to phase again. ■

LARGE-SCREEN TV OSCILLOSCOPE

PROJECT PART 4 D.HALEY C.Eng MIEE

THE most complex part of this equipment is the special sampling system which is designed to enable a strobed image of a television line waveform to be displayed on a timebase running at field frequency. A narrow sampling pulse is produced once during each line period, and is used to switch on a field effect transistor for a fraction of a microsecond. The vision waveform is connected to the drain of the f.e.t. and the source has a capacitor to earth. During the "On" period this storage capacitor is charged to the instantaneous signal level. After the f.e.t. is switched off, the signal level during the sample is held on the storage capacitor until the next sampling interval one line later. By this means the signal level at one instant during the line is held for the full 64μs line period and during this time is applied as Y deflection.

Each successive line is sampled slightly later in the line period than the previous one, so that a sequence of signal levels is obtained. The result, when displayed on a 50Hz timebase, is a series of dots at line frequency, each representing an instantaneous line signal level. The display will be a simulated line waveform with those parts of a line which are repetitive, such as synchronising pulse and colour burst, shown in their normal contours.

The sampling pulse is produced by a monostable integrated circuit multivibrator, which is fired by a line ramp waveform on its level triggering input. Since the monostable will be fired each time the triggering signal passes through a given voltage level, adjusting the d.c. level of the line ramp will vary the point on the line at which the sample pulse occurs. By adding to the line ramp a negative going field ramp, the pulses are made to occur in sequence throughout the line period as the field scan progresses (See Fig. 11). By varying the amplitude of the field component the proportion of line period sampled is varied, producing an expansion effect on the display (See Fig. 12). A second monostable integrated circuit produces a 30μs delay pulse which allows the complete line synchronising pulse to be sampled and displayed. A shift control is included to set the point in a line period at which the sampling begins.

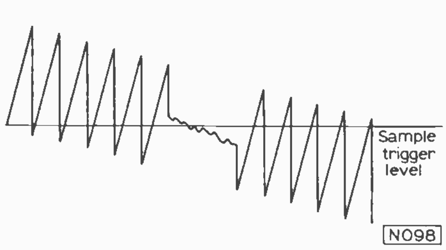


Fig. 11: Mixed line and field ramps for progressive triggering of line sample pulses.

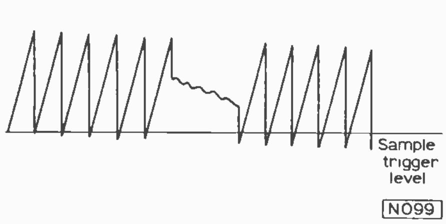


Fig. 12: Mixed ramp waveform with reduced field ramp to produce expanded display, i.e. only part of the line period is sampled.

Pulse generator circuit

The circuit diagram of the sample pulse generator board is shown in Fig. 13. The piece of stripboard which was fitted inside the line scan unit will pick up line pulses by being in the strong electric field surrounding the line scan components. These pulse waveforms are connected to the base of the emitter follower Tr1. There should be approximately 10V of positive-going pulse at the emitter of Tr1. If necessary, the piece of printed board in the line scan unit should be repositioned to obtain this. These pulses trigger the monostable circuit of Tr2 and Tr3 to produce narrow positive-going pulses for the discharge transistor Tr4 in the line ramp generator. A positive-going line frequency ramp is produced across C4. The resistor R10 in series with C4 adds a small pedestal to the bottom of the ramp. This is necessary to overcome the hysteresis effect in the triggering of the monostable integrated circuit. The line ramp waveform is connected to one input of mixer circuit Tr8, Tr9.

Field rate pulses from the c.r.t. flyback blanking are clipped and inverted by Tr5 and applied to a similar ramp generator to produce a field ramp waveform which is fed to the other input of the mixer. The amplitude is made variable by means of the Expansion control VR1 in the charging circuit. The circuit used is for negative flyback blanking pulses. If a receiver is chosen which has flyback blanking applied to the cathode of the c.r.t. instead of the grid, then the pulses will be positive-going, and the inverter Tr5 must be replaced by an emitter follower.

The mixer Tr8, Tr9 inverts the field ramp but passes the line ramp without inversion, to produce the mixed waveform shown in Fig. 11. Tr10 and Tr11 provide a small degree of gain but the principal function of this circuit is to provide a shift control for the start of the sampling sequence, by varying the d.c. level.

The two integrated circuits IC1 and IC2 are monostable multivibrators. IC2 is triggered by the mixed ramps, and provides a pulse of approximately 30μs duration. The second monostable IC1 can be triggered from the trailing edge of this 30μs pulse, or from the ramp waveform direct, thus giving a switchable half line delay facility. The pulse from IC1 should be about 0·5μs wide, positive-going, which is amplified by Tr13 and Tr14 before connection to the gate of the sampling transistor Tr6 of Fig. 9, the preamplifier board described last month.

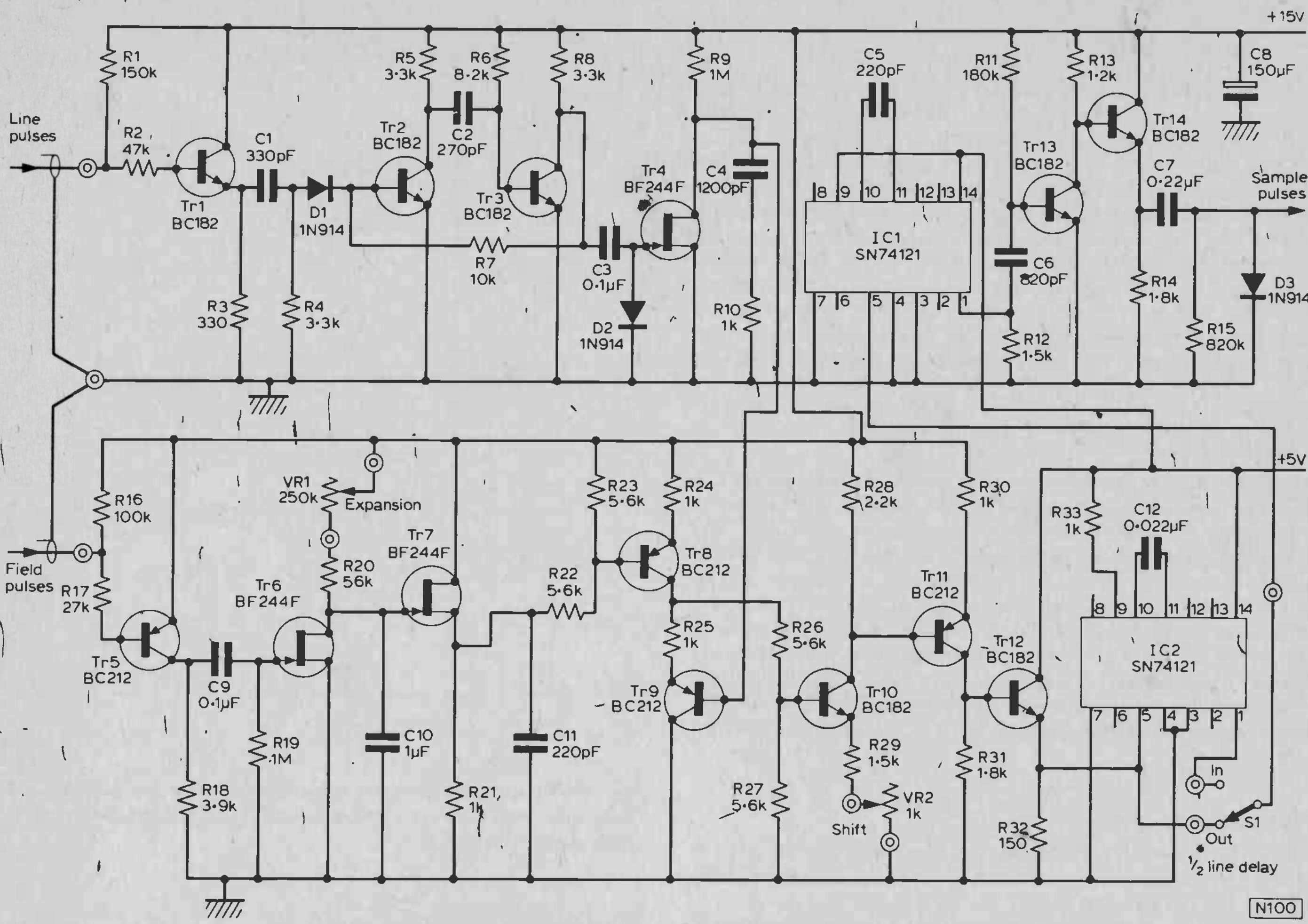


Fig. 13: Circuit diagram of the Sample Pulse Generator. The sampling pulses go directly to the gate of Tr6 on the Preamplifier (Fig. 9 last month).

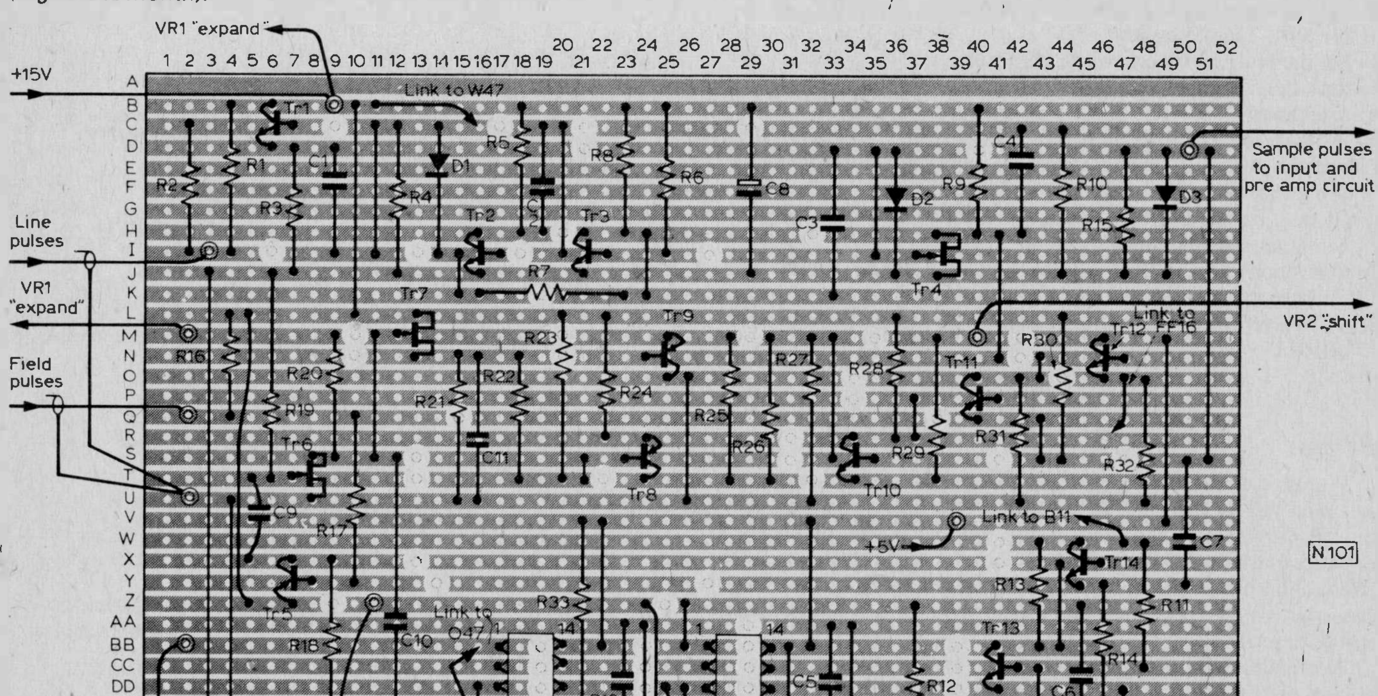


Fig. 14: Layout of the Sample Pulse Generator board, viewed from the component side. Track breaks occur at locations:– C9, 17, 21, 29; D21, 40; H20, 32; I6, 13, 18, 27; K19; M10, 20, 29, 35, 42; N10, 20, 42; O34, 44; P34; Q15, 38; R31; S13, 31, 41, 47; T13, 22, 32; W41; X13, 41; Y14, 27; Z9, 25; AA29; BB19, 24, 29, 39; CC19, 24, 29, 39; DD19, 24, 29, 39; EE19, 25, 29, 36, 47; FF19, 24, 29, 36, GG19, 24, 29, 36; HH19, 24, 29, 36.

Construction

Details of the stripboard and component layout for the sample pulse generator are shown in Fig. 14. The two integrated circuits may be soldered directly onto the board, or if preferred 14-pin i.c. sockets may be used. Sockets are better as they will eliminate any danger to the i.c.s from overheating when soldering. The two 6BA holes near the bottom of the board are for two small brackets to fix the board to the front panel. After assembling and mounting the board, connections are made to the ½-Line Delay switch, Expansion and Shift controls, and to the +5V and +15V supplies, earth and sample pulse input on the preamplifier board. The line and field pulse coaxial cables from the receiver are connected to their respective input tags and clamped to the panel with P clips.

Testing

If a cathode ray oscilloscope is available, the waveforms and voltages throughout the circuit may be checked in accordance with Fig. 15. An oscilloscope suitable for television will adequately display most of the waveforms, but the 0·5μs sample pulse will be distorted unless a wideband oscilloscope is used. If no oscilloscope is available, some indication of the line and field waveforms can be obtained on the receiver using a X1 probe in the a.f. (field) mode, although the line frequency waveforms will be very much reduced in amplitude due to the limited bandwidth. D.C. levels can be checked with a multimeter. Fig. 16 shows how the principal waveforms will look when displayed on the receiver.

Operational check

The final test of the whole circuit is whether it does the job it is designed to do. To make an overall check of the sample and hold system proceed as follows:

1. Tune the receiver to a signal and set the scan changeover switch to Oscilloscope.
2. Set the operating mode switch to Internal.
3. Switch ½-Line Delay out.
4. Set the Normal/Invert switch to Normal.
5. Set the Expansion control counter-clockwise (minimum resistance).
6. Adjust the Shift control. A recognisable television line waveform should be displayed. The shift control is adjusted to bring the start of the line to the left-hand end of the time-base. (It may be necessary to adjust the receiver Line Hold slightly to obtain a steady display).
7. Operating the ½-Line Delay switch should bring line synchronising and blanking to the centre of the scan.
8. The waveform amplitude is adjustable by means of the Y Gain control.

Probes

We have already referred to the two probes which it has been assumed will be used with the oscilloscope. These are similar to the standard probes used with a conventional 'scope, one being a direct connection 1:1 probe, and the other a high impedance 10:1 attenuating probe. Suitable probe kits are available, but for those constructors who prefer to build their own, a form of construction will be described.

A suitable spring-loaded test prod for use as a probe is manufactured by Bulgin. It is obtainable in either red or black, and it is convenient to use one colour for the X1 probe and the other for the X10. The body of these prods contains a standard fuse which can be removed and replaced by the one or two components required in the probes. The X1 probe requires a 47Ω resistor in series to isolate the cable capacity from the external circuits. In the X10 probe, a 9MΩ resistor shunted by a small capacitor is used, thus providing attenuation of 10:1 with the 1MΩ input impedance of the input attenuator. The capacitor must be selected experimentally to give a good pulse response. A suggested initial value is 10 or 15pF. The components may conveniently be mounted on small pieces of stripboard, with a few

Voltages and waveforms
Sample pulse generator

Test point	D.C.	Waveform	
Tr1 e	4·3V	10V	Line pulses
Tr3 c	—	10V	Line pulses
Tr4 d	3·6V	3V	Line ramp
Tr5 b	14·5V	5V	Field pulses
Tr7 s	3·2V	0·5V / 3·0V	Field ramp varies with expansion
Tr8 c	7·5V	2·5V	Mixed line & field ramps
Tr12 e	1·9V	2·5V	Mixed line & field ramps varies with shift & expansion
IC2 p1	1·9V	4V	Line frequency
IC1 p1	4·2V	4V	Line frequency
Tr14e	0·15V	15V (0·3μS wide)	Line sample

N102

Fig. 15: Typical voltages and waveforms for the Sample Pulse Generator. Instruments used were a 20 000Ω/V meter and a wideband oscilloscope.

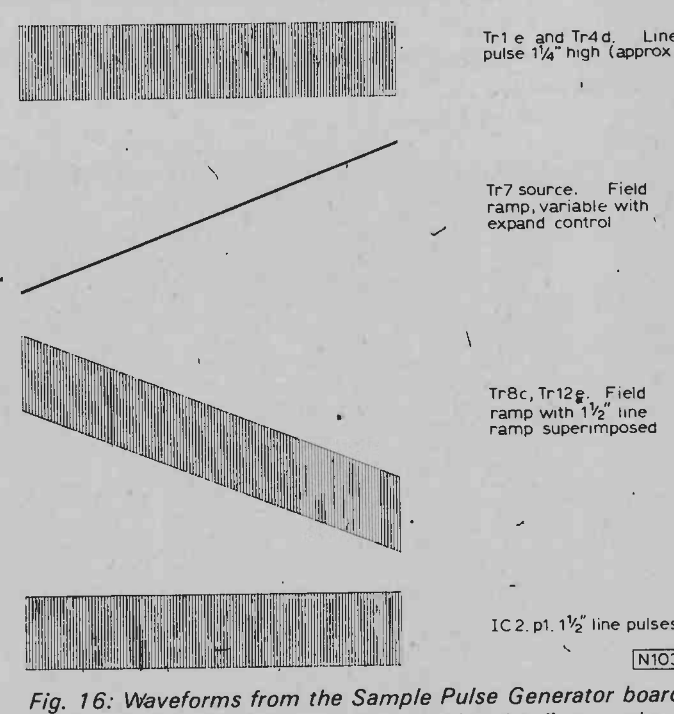


Fig. 16: Waveforms from the Sample Pulse Generator board displayed on the Large Screen 'scope, using the direct probe.

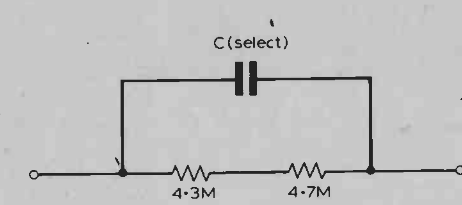


Fig. 17: Attenuator for the X10 probe. The components may be mounted on a small piece of perforated board to fit the probe fuse holder.

★ Components list

SAMPLE PULSE GENERATOR

Capacitors:

C1	330pF	C6	820pF
C2	270pF	C7	0·22μF
C3, C9	0·1μF	C8	150μF 25V
C4	1200pF	C10	1μF (not electrolytic)
C5, C11	220pF	C12	0·022μF

Resistors: (all ±5%, ¼W)

R1	150kΩ	R13	1·2kΩ
R2	47kΩ	R14, R31	1·8kΩ
R3	330Ω	R15	820kΩ
R4, R5,		R16	100kΩ
R8	3·3kΩ	R17	27kΩ
R6	8·2kΩ	R18	3·9kΩ
R7	10kΩ	R20	56kΩ
R9, R19	1MΩ	R22, R23,	
R10, R21, R24, R25,		R26, R27	5·6kΩ
R30, R33	1kΩ	R28	2·2kΩ
R11	180kΩ	R32	150Ω
R12, R29	1·5kΩ		

Variable resistors:

VR1 250kΩ lin. potentiometer
VR2 1kΩ lin. potentiometer

Semiconductors:

Tr1 – Tr3, Tr10, Tr12 – Tr14 BC182
Tr4, Tr6, Tr7 BF244B
Tr5, Tr8, Tr9, Tr11 BC212
D1 – D3 1N914
IC1, IC2 SN74121

Miscellaneous:

S1 s.p.d.t. min. toggle; 2 i.c. holders, 14-pin d.i.l.; Stripboard 135 x 95 mm (5·3 x 3·75 in), 2·54 mm (0·1 in) matrix; 13 wiring pins.

TEST PROBES

(see text)

1 Bulgin TP12 (Black); 1 Bulgin TP14 (Red); Resistors ±5% ¼W, 1 47Ω, 1 4·3MΩ, 1 4·7MΩ; Capacitor, polystyrene (see text); Coaxial cable; B.N.C. plugs; crocodile clips.

turns of tinned copper wire wound over each end to make connection to the spring contacts inside the probe.

The probe leads are made from about 1m of coaxial cable. The inner conductor is connected to the end terminal of the probe, and the screen to a crocodile clip via an earth tail. For connection to the oscilloscope, a standard B.N.C. plug is attached to the other end of the lead.

It may also be found useful to make up a coaxial lead to connect the output of the oscilloscope tuner to the i.f. input of a receiver under test. A receiver in which the tuner is suspect can then be tested from the i.f. section onwards.

Operation

For the display of low frequency waveforms, up to about 4kHz, either probe may be used in the AF/VF Probe input socket. About 1 volt peak to peak signal at this socket will give full deflection with the step attenuator on 0dB and Y Gain near maximum. The operating mode selector switch should be on AF/VF and the Line/Field switch on Field for direct display of l.f. waveforms. With the three levels of attenuation, plus the 10:1 probe, continuous coverage of signals up to 1000V is obtained. When displaying signals of up to a few hundred Hertz, the timebase will lock to the waveform at multiples of 50Hz, since the incoming signal is fed via RLB1 to the oscilloscope video amplifier and thence to the sync separator and timebase circuits.

Line frequency and vision signals from a receiver under test can be displayed using the line sampling facility, by setting the Line/Field switch to Line. In the initial setting up and investigation of a faulty receiver, it will usually be best to turn the scan switch back to normal picture for vision signals. The polarity switch should be set to give a positive image on the screen, and the line and field hold controls adjusted to lock the picture. The attenuation and Y Gain controls should be adjusted to give reasonable contrast, since the incoming signal level may be anything from 1 to 100 volts, depending on the source from which the signal is taken.

Line display

When the scan switch is turned back to the oscilloscope condition, a sampled display of a line waveform should be available. The two controls which will need to be adjusted to obtain a balanced display are Sample Shift and Expansion. With Expansion turned fully counter-clockwise (minimum resistance) adjusting the Sample Shift should enable a full line display to be centralised on the timebase, with the line sync pulse at the left-hand end. Operate the ½-Line Delay switch to bring the line sync and blanking interval to the centre of the display. Using a combination of Expansion and Sample Shift controls, any part of the waveform can be brought to the start of the scan and expanded to give an extended display of, for example, the sync pulse and colour burst signal.

When the operating mode switch is set to Internal or IF, RLB/1 is de-energised, the vision signal from the internal detector of the oscilloscope is fed to the line sampling circuit and displayed on the c.r.t. Apart from providing a useful check on the quality of local signals, this condition is required when i.f. signals from the tuner of another receiver are fed into the IF Probe input socket. It will usually be necessary to use the high-impedance probe for this purpose as it is less likely than the direct one to cause detuning of the tuner output. When using the IF probe input, relay RLA/1 is energised to connect the incoming signal to the i.f. circuits.

Applications

While it is not intended that this oscilloscope will equal a good quality conventional oscilloscope in servicing receivers, it should prove useful in applications where a large screen display is an advantage, such as for instruction and demonstration, and for use in conjunction with swept oscillators for alignment purposes. ■

Service Notebook 1

G.R.WILDING

Unusual Line Timebase Fault

A colour set fitted with the Pye 691 chassis had a rather unusual fault, lack of width accompanied by a thin vertical line at about the centre of the raster. This line suggested that the transition between the boost diode ending its energy recovery action and the line output valve starting to conduct was incorrect, so our first move was to replace the two valves. We also fitted a new PCF802 oscillator valve, but there was no improvement.

In sets where the width is stabilised by a v.d.r. arrangement in the line output valve's grid circuit, increase in the value of the associated resistors is very often the cause of insufficient width, though not of a "kink" in the scan. Nevertheless we decided to check here, but all components turned out to be in order. Adjusting the set-e.h.t. control increased the width and reduced the kink, but the basic fault clearly lay elsewhere.

After returning the set-e.h.t. control to its original position we checked the line linearity and width controls and their damping resistors. Again everything was in order. It seemed likely that the fault was due to a defective capacitor somewhere, so we started to make checks of all likely ones, commencing with the h.t. supply decoupler (C215) and cathode coupling capacitor (C213) in the line oscillator stage since these are common causes of odd faults in this chassis. Eventually the fault cleared when C214 (820pF) in the line drive waveform shaping network between the line oscillator and the line output valve was replaced. On checking this capacitor no detectable leak was found, though it had clearly lost capacitance resulting in a mis-shaped drive waveform.

Weak Colour

A Decca Model CTV25 fitted with a new tube gave an excellent monochrome picture with ample contrast. The colour however was weak, varied somewhat and occasionally dropped out altogether on BBC-1, the weakest local channel. The excellent contrast level clearly indicated that the fault was in the decoder, and our first move was to check the colour-killer action. In this model the chrominance channel turn-on bias is obtained by rectifying the output from the ident amplifier. The rectifier's 7μF reservoir capacitor produces about 10·5V which biases the second chrominance amplifier transistor on. With the ident coil adjusted for peak output there should be 12V across the reservoir capacitor: the correct procedure is to reduce this voltage to 10·5V by rotating the coil's core in an anticlockwise direction. In the set in question however the turn-on potential was barely 7V: ident coil adjustment increased this marginally, but there was obviously a defect somewhere in this part of the circuit.

The first suspects were the diodes in the circuit (see Fig. 1), D602 which provides base bias for the emitter-follower Tr603 and the colour-killer rectifier D603. The latter in particular had a high forward resistance. On changing both these diodes almost 11V was obtained across the 7μF colour-killer reservoir capacitor C609. There are two electrolytics in the ident circuit, C611 which decouples the emitter of the ident amplifier Tr602 and C614 which provides coupling to the emitter-follower. Both looked somewhat dried up, so we replaced them. Peaking the ident coil L602 then gave more than 12V across C609. After detuning to give the correct 10·5V, ample and constant colour was obtained.

Component Storage

We all accumulate a large variety of carbon resistors after a few years and, like service sheets, they tend to get put into one or two containers so that it is necessary to forage through the lot to find the one required. A better arrangement I've found is to sort resistors into boxes according to the third band – irrespective of wattage rating. This saves time whenever a resistor is required for a job. Metal cigarette tins with firm lids are particularly suitable, and when clearly marked with the particular third band colour are just the thing. To save space and stop them shaking about too much I've found that cylindrical 35mm film aluminium containers are the ideal way of storing diodes of all types. I keep a large collection of capacitors in a separate box but always have a couple of high working voltage types separately in a valve box since these are the most widely needed types for replacement purposes – especially as boost capacitors.

Lack of Red

Monochrome reception on a set fitted with the Pye 691 chassis was tolerable, but on colour the picture consisted mainly of various shades of blue with a little green and hardly any red, what red there was appearing only in highly saturated areas of the picture. This chassis uses colour-difference drive, with a PL802 driving the c.r.t. cathodes and three PCL84 valves driving its grids. Clearly there was either almost total lack of output from the R–Y synchronous detector, or loss of signal in the R–Y channel which consists of the appropriate PCL84 plus a transistor preamplifier. The clamp triode section of the PCL84 could be assumed to be working correctly since otherwise the monochrome picture would have been affected.

We first tried a new PCL84 in case the original one had an

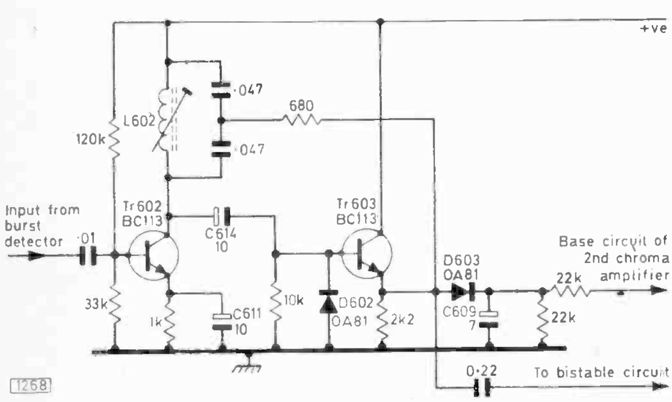
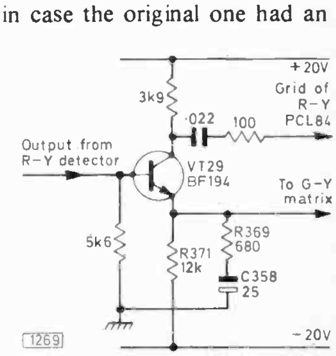


Fig. 1 (left): Ident amplifier and colour-killer circuit used in the Decca Model CTV25.

Fig. 2 (right): R – Y preamplifier stage, Pye 691 chassis.



internal fault, but this made no difference. The anode and screen grid voltages were correct, so the pentode was passing normal current. When we checked the collector voltage of the transistor preamplifier however we found that this was approaching the l.t. rail voltage (20V) instead of 13·4V, so there was obviously very little collector current. Now the preamplifier's bias consists of a negative voltage which is applied to its emitter rather than a positive voltage at its base – see Fig. 2. The negative voltage comes from a –20V rail and is fed via a resistor (R371, 12kΩ) whose high value has the advantage of stabilising the d.c. conditions of the stage. The resultant voltage at the emitter should be –0·65V. The reading we obtained here was only about –0·1V however, so the transistor would not start to conduct until its base signal was about 0·55V– hence the lack of red signal content and green too since one of the feeds to the G–Y signal matrix is from the emitter of the R–Y preamplifier. The cause of the reduced emitter voltage was a severe leak in the electrolytic decoupling capacitor C358 which along with its series resistor R369 sets the a.c. gain of the stage – a different value resistor is used in the emitter circuit of the B–Y preamplifier, thus compensating for the different weightings given to the two signals at the transmitter to prevent overloading. On replacing C358 the emitter voltage returned to normal and after adjusting the various drive controls a good picture was obtained on both colour and monochrome.

No Raster

The raster had suddenly disappeared on an old KB dual-standard model fitted with the STC/ITT VC1 chassis, leaving good sound. Only the slightest suggestion of a spark could be drawn from the anode of the PL36 line output valve, but as the valve was not running unduly hot we assumed it was receiving normal grid drive from the oscillator. Our first move naturally was to replace the PL36, but results were exactly the same. The most likely cause of the trouble therefore was an open-circuit screen grid feed resistor or a short-circuit boost capacitor. The simplest move was to check the latter possibility by removing the boost rectifier top cap – if h.t. was then still present at the PL36 anode this would prove that the capacitor was short-circuit, and would probably also result in a bigger spark at the anode. This turned out to be the case, so we removed the base inspection panel to look for the particular component. Since we didn't have the manual with us we looked for a large-sized capacitor of at least 750V working voltage and a value of around 0·1μF. Having spotted such a capacitor we found that it had a dead short and on replacing it normal results were restored.

Where, as with this chassis, the base panel has to be removed to gain access to the underside of the line output valveholder to check the screen grid feed resistor, connect the meter from the appropriate pin to a primary tag on the sound output transformer or to the h.t. tag of the main reservoir or smoothing capacitor. Alternatively, remove the boost rectifier and line output valve and with the set switched on measure the voltage at the line output valveholder screen grid pin: if h.t. is present you have a sure indication that the resistor and the attendant wiring are intact.

No Field or Sound

No sound and no field scan on a Pye Model CT200 (713 chassis) was found to be due to a blown 315mA fuse (F678). In this chassis the supply for these two sections of the receiver is obtained from the same winding on the line output transformer, via a rectifier and filter, with the fuse providing protection. The cause of the blown fuse turned out to be breakdown of the BD233 field output transistor – this is the "upper" transistor of the complementary pair used in the field output stage.

Delayed Hum Bar

A set fitted with the hybrid, dual-standard Pye 368 chassis would work perfectly for a few minutes after switching on. The picture would then start to waver about, and after a few more minutes a strong hum bar would gradually intensify. The delay in the development of these symptoms naturally aroused suspicions that there was a valve with poor heater-cathode insulation. Since the i.f. strip is transistorised however the only real suspect was the PFL200 video/sync valve. Replacing this failed to improve matters, and it was then found that on removing the aerial plug a perfect raster was obtained. This clearly indicated that the l.t. supply to the transistors was the cause of the fault, suspicion centring on the dual 1,000μF reservoir/smoothing electrolytics.

On shunting a 500μF electrolytic across the reservoir capacitor the hum bar was removed – and stayed off even when the test capacitor was disconnected! The slight spark produced by connecting the test capacitor evidently cured the fault in the reservoir capacitor, but since it couldn't be trusted a replacement was fitted. This is the first time that we have come across an electrolytic that seemed to be OK at switch on, gradually loosing or seeming to loose its capacitance within a few minutes.

Brightness Circuit Fault

No raster but good sound was the fault on a portable KB set fitted with the VC11 chassis. On rotating the channel selector it was noticed that brief flashes of light appeared on the screen, so clearly there was ample e.h.t. and the trouble was due to an overbiased c.r.t. – i.e. either the cathode voltage was excessive or the grid voltage insufficient. Absence of, or very low, first anode voltage will also black out the screen of course, but the flashes suggested that this vital voltage was present.

On removing the set's plastic casing and momentarily shorting the grid and cathode pins (2 and 7) of the c.r.t. a peak white raster was obtained, thus confirming our suspicion. In this as in so many older STC-ITT chassis the video signal is a.c. coupled to the c.r.t. cathode. Thus if the PCL84 video output valve had lost emission so that its anode voltage was above normal, the effect on the c.r.t.'s cathode voltage would not be large. Apart from the boost rail voltage (750V) no other voltages are given in the manual, so whether the c.r.t. cathode voltage was too high or the grid voltage too low had to be resolved by other means.

The cathode voltage is set by a potential divider connected from an h.t. point to chassis. Since the values of the two resistors are 470kΩ (top) and 390kΩ (bottom) the voltage at the junction should be rather less than half the h.t. voltage, which one could take to be about 220V. This proved to be the case. The grid voltage is set by the 500kΩ brilliance control which is fed from the boost rail via a 4·7MΩ resistor and returned to the neutral side of the mains on-off switch via a 47kΩ resistor. By resistance ratios therefore since the combined value of the brilliance control and the 47kΩ resistor is roughly a ninth that of the feed resistor, something like a ninth of the boost voltage should be developed across them, i.e. about 80V. There was only 30V at the brilliance control feed tag however, so the feed resistor had clearly gone high-resistance. This was confirmed by switching the Avo meter to the 250V range – its internal resistance is 5MΩ on this range – and connecting it across the feed resistor. This action immediately restored a normal picture, with normal brilliance control action.

AC THEORY
A step by step approach

Ian SINCLAIR

Part 1

Batteries generate steady voltages. Electrons are moved by the ENERGY of the battery to the negative electrode. When a circuit is connected, electrons flow round the wires to the positive electrode and we call this a flow of electric current. In the days before electrons were known about, electric current was said by convention to flow from POSITIVE to NEGATIVE.

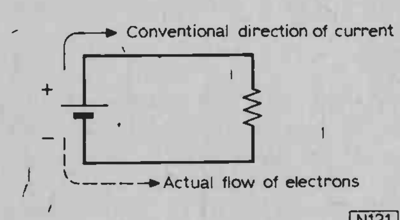


Fig. 1: Directions of conventional current and electron flow.

When there is any doubt as to which direction we mean we talk of ELECTRON CURRENT (– to +) or CONVENTIONAL CURRENT (+ to –). (See Fig. 1). The energy needed to keep the electrons moving comes from the change of energy in the chemicals in the battery.

Does the battery use any energy when the electrons are not moving?

It should not. In practice some chemical change continues and the energy then appears as HEAT.

Voltages can be generated in other ways. One is electro-magnetic INDUCTION in which a voltage is generated when an object moves past a magnet. Near the poles of a magnet, any object which can be magnetised is

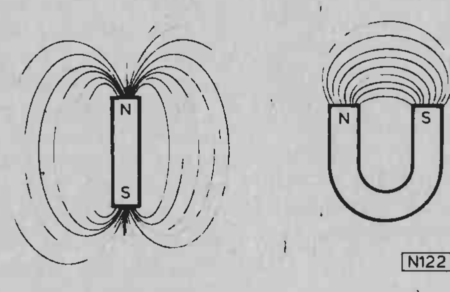


Fig. 2: Field patterns of bar and horseshoe magnets.

acted on by a force. We call the region where magnets exert this force the magnetic FIELD. The shape of the magnetic field can be demonstrated by sprinkling iron filings on a sheet of paper held just above a magnet. Some of the patterns obtained are shown in Fig. 2.

Where is the greatest concentration of the magnetic field?

At the ends of the magnet: these parts are called POLES.

The DIRECTION of a magnetic field is taken as the direction of the lines of these patterns running from the N pole of the magnet to the S pole. The lines are called LINES OF FORCE, and the N pole (or, more correctly, North-seeking pole) of the magnet is the end which points to the Earth's North when it is allowed to swing freely. Lines of force never cross, but they concentrate together when they meet such substances as soft iron and nickel.

What effects do substances such as aluminium, plastics, glass or copper have on the lines of force?

None measurable.

When a conducting straight wire is held at right angles to the lines of force of a magnet, and is moved in a direction which is at right angles to both wire and lines of force, a voltage can be measured between the ends of the wire (Fig. 3). The angles can be imagined as those at the corner of a room. Stand in the corner with your

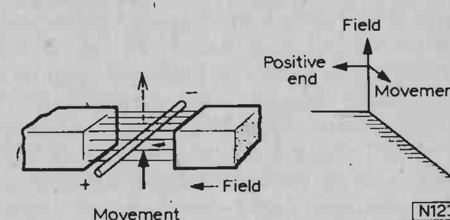


Fig. 3: Direction of voltage induced in a moving wire.

right arm along one wall and your left arm along the other wall. Your head is then pointing in the direction of the magnetic field (lines of force), your left arm in the direction of movement of the wire, and your right arm in the direction of the POSITIVE end of the wire. For the same set-up of magnet and wire, any other set of angles gives a smaller voltage. If the direction of movement is reversed, the polarity of the wire is reversed. If the magnetic field is reversed, the polarity of the wire is reversed.

What happens if we reverse both the direction of movement AND the direction of the magnetic field?

The polarity remains unchanged.

Faraday, in 1831, found that the voltage generated when all the angles are 90° depended on the strength of the magnetic field and on the speed at which the wire was moved through it. If any one of the angles is made 0°,

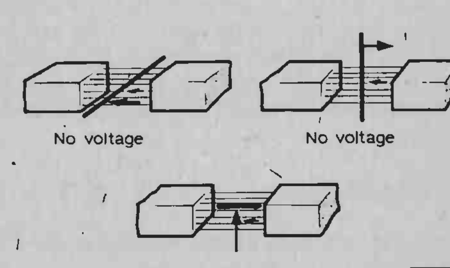


Fig. 4: A moving conductor must cut the lines of force to induce a voltage.

there is no voltage generated (Fig. 4). At angles between 0° and 90°, the voltage is some value between zero and the value obtained at 90°. If the magnetic field is UNIFORM, meaning that the lines of force are parallel to each other and not converging nor diverging, and if the wire is moved at a steady speed with no changes of direction, the voltage produced is STEADY.

What sort of voltage is produced if the wire is moved to-and-fro in the field?

An alternating voltage, perhaps a square wave.

Working at the same time, Lenz found another Law of Induction. If the wire moving in the magnetic field is part of a complete circuit, current flows. If we placed a battery in the circuit so as to move the current in the

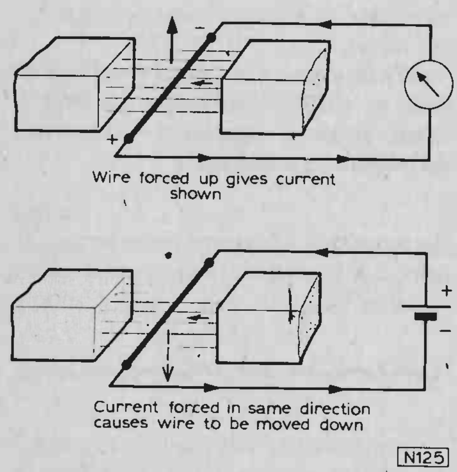


Fig. 5: Relationship between generator and motor effects.

SAME direction, we find that the wire is being forced to move in the OPPOSITE direction (Fig. 5). When we move a wire in a magnetic field and current flows, we have to use more force to keep the wire moving. The work which we do is providing the energy to move the electrons.

If this were not true, and if the current moved in the other direction, what might happen?

The wire would become easier to move, then would start to move by itself.

Summing up so far, we have that a voltage is generated when a wire moves in a magnetic field. The voltage is greatest when the wire, its direction of movement and the direction of the magnetic field are all at right angles. The voltage depends on the strength of the magnetic field (which we can measure by the number of lines of

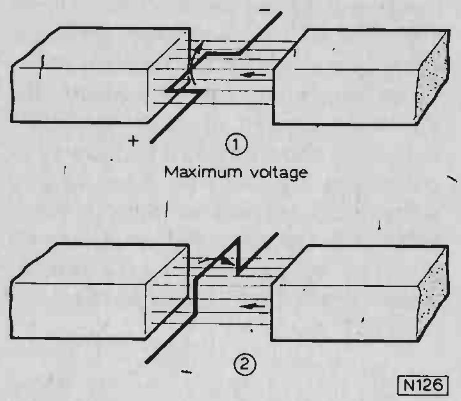


Fig. 6: What voltage is induced in the wire in the position shown in (2)?

force) and the speed of the wire. This can be combined by saying that the voltage depends on the RATE of cutting lines of force. When a circuit is connected to the wire, the current which flows always sets up forces which oppose the movement of the wire.

If we are to generate electricity continuously, we must have some method of moving the wire continuously in the magnetic field. One way of doing this is to ROTATE a loop of wire in the field (Fig. 6). In the first drawing the wire is moving in a direction at right angles to the lines of force, and will be generating the maximum voltage possible with that magnet and at that speed of rotation.

What voltage is being generated in the second drawing?

NONE, since the wire is moving ALONG the lines of force.

As the loop of wire continues to rotate, the wire reaches the position

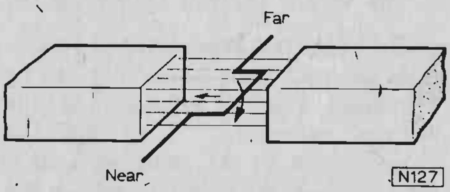


Fig. 7: How does the induced voltage compare with that in Fig. 6(2)?

shown in Fig. 7. It is now moving downwards through the lines of force.

What is the polarity of each end of the wire now?

REVERSED; near side –, far side +.

As the wire moves round, it is moving ALTERNATELY upwards and downwards in the magnetic field. Each end of the wire is alternately + and –. We say that the wire is generating an alternating voltage. As the wire turns, the voltage at one end goes from positive to zero to negative to zero and back to positive again in one complete revolution or cycle.

What will be the effect of turning the wire at a higher rate?

More cycles in each second AND a higher voltage, since the rate of cutting lines of force is greater.

If we draw a triangle, Fig. 8, with one right angle, and we label the corners a, b, and c and the angle cab as θ, we can obtain a different description of the output of our

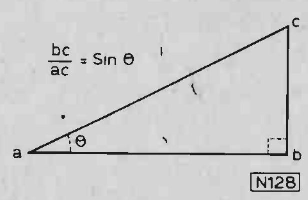


Fig. 8: Defining the sin of angle θ.

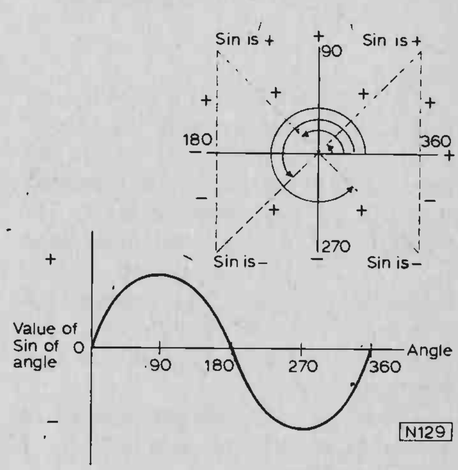


Fig. 9: Plotting the value of sin θ for angles up to 360°.

generator. The ratio of lengths $\frac{bc}{ac}$ is called SINθ, and we can measure the value of this quantity for any size of the angle θ.

We can do this even for values of θ greater than 90° if we agree to call certain directions positive and others negative as shown in Fig. 9. The graph of sinθ against θ is as shown. It is called a SINEWAVE.

Does this wave bear any similarity to the conditions in our simple generator?

Yes; the voltage changes from zero to maximum, or *vice versa*, every 90°.

We can now write the voltage output of our generator as $V = V_O \sin\theta$ where V_O is the peak amplitude. When a generator gives an output of this type, we refer to it as a sinusoidal generator. This waveform is the simplest to deal with mathematically and is generated naturally by rotary generators of the type which we have discussed.

The PEAK AMPLITUDE of a sinewave is the voltage indicated by A in Fig. 10. It is the maximum voltage (current if we are looking at a current wave) measured from the zero line to the peak of the wave. Sometimes the peak-to-peak amplitude is used; this is the voltage measured from a positive peak to a negative one.

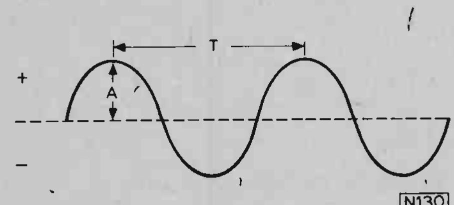


Fig. 10: Defining Peak Amplitude and Periodic Time or Period of a sinewave.

The PERIODIC TIME, or PERIOD of one cycle is the time T from some definite point (which we have taken in the diagram as a positive peak) to the next identical point. The FREQUENCY of a continuous wave is $1/T$, so that a period of 20 milliseconds (0·020s) means a frequency of 50 oscillations per second; or 50 HERTZ (Hz), as it is now known.

What is the frequency of a waveform whose period is 1 millisecond (ms)?

1 kHz, or 1000 Hz.

It is very often useful to compare the effect of an alternating current (a.c.) waveform with that of a direct current. We can calculate the peak amplitude of a generated a.c. waveform, or we can measure it on an oscilloscope, but we find that it does not have the same effect as a direct (steady) current of the same amplitude. This is because the a.c. wave attains its peak amplitude only for a short time. To find a way of comparing the two, we have to find some effect of electric current which behaves in the same way on a.c. as on d.c. The heat generated in a resistor when current flows is such an effect.

Why?

Because heat is still generated no matter in what direction the current flows.

If we take two identical resistors, one connected to a steady voltage, $V_{D.C.}$, and the other connected to an alternating voltage $V_{A.C.}$, Fig. 11, we can adjust the values of voltage until the heat generated by each resistor is equal. When this is the case, the a.c. is doing the same work, putting out the same power as the d.c.

We can easily find the power in the d.c. circuit; we measure the voltage and the current and multiply them together:

$V_{D.C.} \times I_{D.C.} = \text{POWER (in WATTS)}$

If we now multiply the PEAK a.c. voltage (V_O) by the PEAK a.c. current (I_O), we get a figure which is exactly twice as much as the d.c. power. To put it another way, the measured peak a.c. power is exactly twice the true power, as shown by the resistors.

$$\text{True Power} = \frac{V_O \times I_O}{2}$$

We do not always want to use volts multiplied by amps, so that we can split this up to read:

$$\text{True Power} = \frac{V_O}{\sqrt{2}} \times \frac{I_O}{\sqrt{2}}$$

(Remember that $\sqrt{2} \times \sqrt{2} = 2$, and that $\sqrt{2} = 1{\cdot}414$ approximately.)

The values $\frac{V_O}{\sqrt{2}}$ and $\frac{I_O}{\sqrt{2}}$ are known as R.M.S. (Root Mean Square) values, from the method by which they can be calculated without reference to the resistor experiment. They are the values which do the same work as a direct voltage or current, and are the values we often quote when referring to the mains voltage.

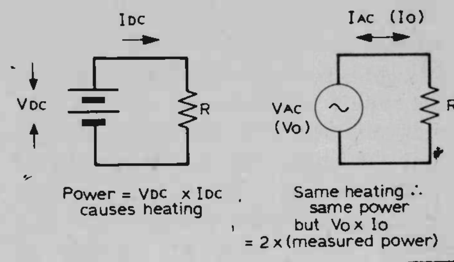


Fig. 11: Comparing power dissipated due to d.c. and a.c. supply sources.

What is the r.m.s. value of a voltage waveform whose peak voltage is 28V?

20V, as near as we need calculate.

Most of the meters used for a.c. are calibrated to read r.m.s. values of sine waves. They will not read correctly if the waveform is not a sinewave, and they will operate correctly only if the frequency of the waveform being measured is within the range stated on the meter.

When a meter indicates a voltage of 250, as it will on the mains live lead in many districts, what peak voltage will an oscilloscope indicate?

About 354V – this must be remembered when some readings in a circuit are taken by oscilloscope and some by meter.

Some meters will read "true r.m.s." no matter what sort of waveform is being used. At low frequencies, a MOVING IRON meter will do this if the waveform is not too unlike a sinewave; for high frequencies and odd waveforms, HOT-WIRE meters have to be used. Neither type is good for accurate measurements, but sometimes nothing else is suitable. For example, a hot-wire ammeter is often used for measuring the current in the aerial of a transmitter.

Why does a hot-wire ammeter measure true r.m.s.?

The heating of a wire depends on power, as we saw from our resistor experiment. The hot-wire ammeter uses the current to heat a wire whose expansion moves the needle. Because power is being used, the reading is true r.m.s.

Still on the subject of values, we often put a sinewave into a half-wave rectifier, as shown in Fig. 12, so that the output consists of pulses, each of them half of a sinewave, separated by gaps of the same time (half of the period). This waveform will deflect a d.c. meter because the current is always in the same direction and is always trying to move the needle in the same direction.

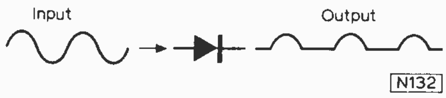


Fig. 12: A half-wave rectifier passes only half of an applied a.c. signal.

Why does a d.c. moving coil meter not respond to a.c.?

The needle is being forced alternately in opposite directions, and cannot move quickly enough to vibrate, so it remains still.

We can find the AVERAGE VALUE of the output of a half-wave rectifier by trial or by calculation. If we draw half of a sinewave and then make a rectangle of the same width (time) and having the same area as the half sinewave, Fig. 13, this rectangle should represent a wave which can do the same work as our half sinewave. The rectangle's height will represent the average value of voltage of the half sinewave, and it works out as

$\frac{2V_O}{\pi}$ or $0{\cdot}65V_O$ approximately.

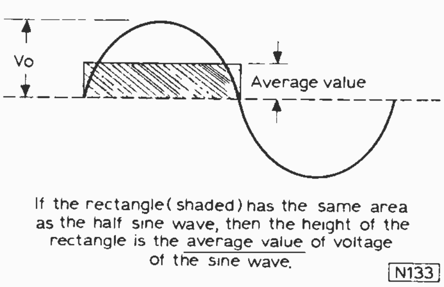


Fig. 13: Graphical representation of the average value of a sinewave.

Why could we not have used this method of averaging for a complete sinewave?

Half of a sinewave is positive, the other half negative. When we add the average value for the negative half to the average value for the positive half we get zero.

For a rectifier output, then, we take the average output as $0{\cdot}65V_O$ when the half sinewave appears, and zero when there is no output during the time of the other half wave. For this case, the average value of output voltage over a long time is the average of $0{\cdot}65V_O$ and zero, which is $0{\cdot}325V_O$ (Fig. 14).

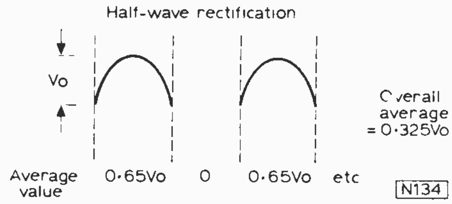


Fig 14: Average value of a half-wave rectified sinewave.

This is NOT the value which most multimeters will read, because their scales are marked to agree with the readings of complete sinewaves, whereas we are trying to measure the output of an unsmoothed half-wave rectifier, or of a smoothed circuit under heavy load.

What average value would you expect for a full-wave rectifier?

$0{\cdot}65V_O$, because one half sinewave comes directly after the previous one with no gap.

If we add to our rectifier circuit a smoothing capacitor (Fig 15), the effect is that the capacitor charges up to the PEAK value of voltage during the time when the rectifier conducts, and some of the current passing through the rectifier flows into the capacitor instead of into the rest of the circuit.

If there is no load to take current, the voltage remains at this value during the other half cycle when a half-wave rectifier is not conducting. When some current is being drawn, the capacitor supplies this during the non-conducting periods. If the current required by the load is large and the capacitor cannot cope with it, the voltage drops almost to the level provided by an unsmoothed rectifier circuit.

If 240V r.m.s. is fed into a smoothed half-wave circuit, what is the true voltage out (a) with no load, as when a TV set is first switched on, (b) when there is excessive load, or when a fault develops in the smoothing capacitor?

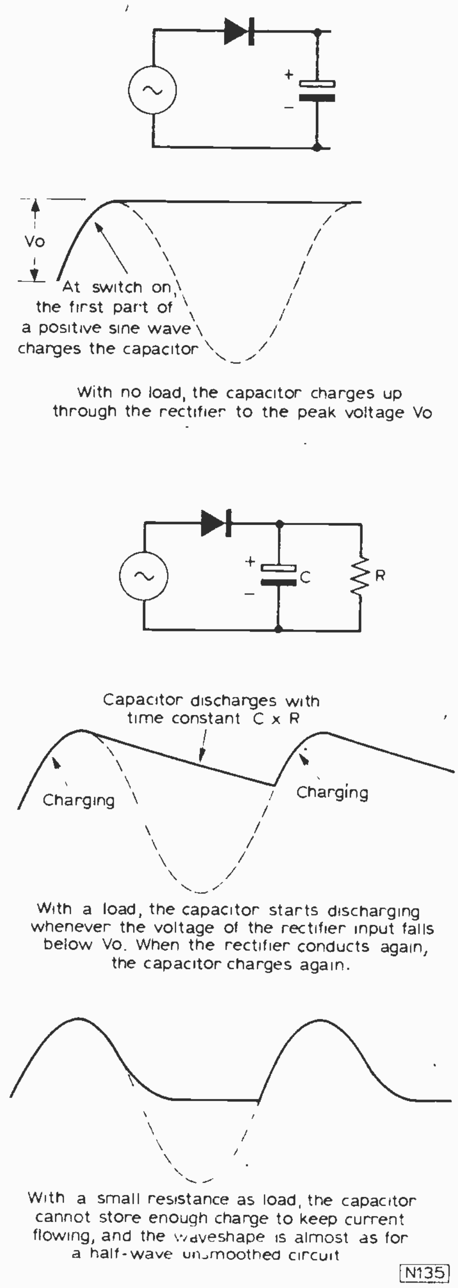


Fig. 15: The effect of various loads on the output waveform of a half-wave rectified, capacitor-smoothed supply.

(a) 240 × 1·4 = 336V
(b) 240 × 0·325 = 78V

A voltmeter would read the first voltage correctly, but not the second, where the reading would be higher, almost double.

The same effects occur with full-wave rectification, though in this case there is not such a big difference between the no-load and the overload conditions. It is possible to calculate the voltage for any condition of load, but this requires a lot of information about the rectifier, the capacitor, the resistance of any transformer used etc., in most cases the idealised approximations which we have given are adequate.

Servicing the ITT CVC5 CVC5/8 CVC7 CVC8 CVC9 Chassis

PART 1

E. TRUNDLE

IN preparing an article of this sort it is very easy to give the impression that the chassis described is unreliable or troublesome. It should be made clear at the outset however that the ITT CVC5-CVC9 series chassis compare favourably with similar UK and European designs on the score of reliability, and it is the opinion of the author that the basic chassis is the best design yet to appear from a British manufacturer. The performance leaves little to be desired, and a well set up 20in specimen is capable of producing a picture as good as many higher-priced receivers. After several years of servicing these chassis however I have come across certain stock faults: these will be described together with one or two unusual failures.

With the odd notable exception, the majority of common failings have been eliminated by the makers in later production. One example of this is the problems experienced in the early days with polystyrene capacitors. These did not like the solder-bath operation and often became open-circuit, with harassing results for the service engineer. Later versions use different types of capacitor which have eliminated the problem.

Construction

The receiver is built on four main printed-circuit boards, which are not intended to be "swappable". The boards are mounted vertically on a steel framework which can be swung downwards to a horizontal or intermediate position for servicing. The design is hybrid, employing five valves in the timebases and sound stages. The varicap tuner is controlled from a bank of seven push-buttons – six touch-buttons in the case of the CVC7 chassis (Model FT100).

Tuning

The varactor tuner is mounted on its own printed-circuit panel, bolted to the main chassis. In early CVC5 chassis a large zener diode, type LZ36B (D11), is mounted near the tuner to stabilise the tuning voltage. Any tuning drift beyond the range of the a.f.c. action should direct attention to this component. The later TAA550 i.c. stabiliser is less prone to thermal drift but can also be responsible for wandering tuning. Note that the same replacements must be used, i.e. you can't replace an LZ36B with a TAA550 (equivalents ZTK33 or SN76550-2) or vice versa. Transistor T6 can also cause tuning drift.

The switch/potentiometer bank used mainly in the CVC5 chassis – recognizable by a separate tuning dial for each button – seems to have a limited life. Many have had to be replaced in sets between two and four years old. The symptoms here can be misleading as, due to the high circuit impedance, one faulty track can upset the operation of the other buttons. Symptoms are sudden and large changes in tuning, and possibly intermittent flashing on the picture. Cleaning rarely works, but the manufacturers operate an exchange scheme on these units.

Sudden tuning changes can also be due to a faulty tuner, along with the more common tuner disorders such as noise. Repair of these units is not recommended, and an exchange scheme is again available. In the case of intermittent tuner problems it is worth checking socket A via which the tuner is connected to the main panel. Sometimes the socket pins are crimped over the wire's insulation. The cure is obvious.

Touch Tuning (CVC7 Chassis)

It is in the tuner area that the "Feathertouch 100" (CVC7 chassis) differs from the standard chassis. A fairly complex touch-switching circuit is incorporated. Random tuning drift without the illuminated station indicator changing state has been traced on several occasions to a leak in one of the hold-off diodes D1111-D1116. Inability to select one or more channels results from poor contact of the "fingers" which carry the trigger signal from the touch-button: the printed-circuit board should be pushed hard up to the touch-button panel before tightening the retaining screws. If the selector doggedly remains on channel 1, check that the 22MΩ resistor R177, on the print side of the board, is not adrift.

On one memorable occasion an FT100/CVC7 came in for repair with the complaint that it favoured button 2. Regardless of the programme selected, sooner or later the set would switch itself over to channel 2, and no amount of button-touching would make it budge. This is commonly due to surface leakage on the button-panel. The usual resort of cleaning the panel face thoroughly with methylated spirit had no effect on the fault however. After much fruitless investigation and soul-searching, the touch-panel was removed from the assembly and checked with a Megger. This revealed the mind-boggling fact that the plastic was conducting! A new touch-panel put matters to rights, but a permanent scar was left on this engineer's credibility.

Note that both the neutral and live sides of the mains are present on the top and back edge of this board – so care is required.

The IF Strip

The i.f. strip is a compact printed-circuit unit mounted vertically on the main board. Many inductors are printed

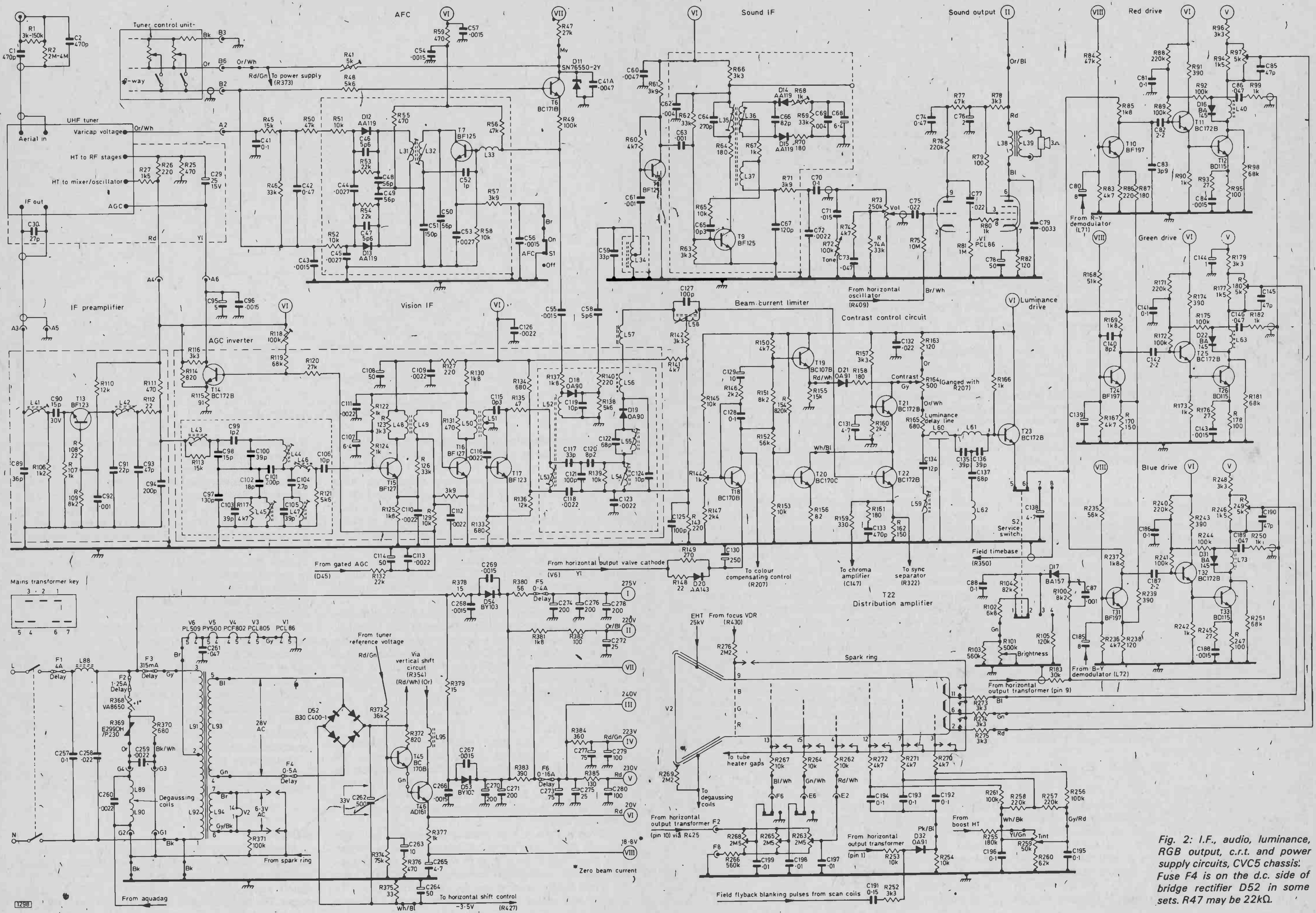


Fig. 2: I.F., audio, luminance, RGB output, c.r.t. and power supply circuits, CVC5 chassis. Fuse F4 is on the d.c. side of bridge rectifier D52 in some sets. R47 may be 22kΩ.

"He's come to deal with sets fitted with Thorn's Syclops circuit."

upset the a.g.c. operation. The only sure check is substitution. Another possibility to bear in mind is C235 going open-circuit. One or two cases where the signals have disappeared after the set has warmed up have been traced to T41 being leaky. C114 being leaky when hot can cause darkening on the left-hand side of the screen.

Contrast/Brightness Variations

Variation in the contrast level can be due to D45 having a high forward resistance. A common complaint, varying contrast/brightness level, is generally due to a dry-joint at R423 in the line output valve cathode circuit. This is easily missed as the stand-off sleeves are well soldered but the resistor legs may not be making contact. Careful probing will often prove the point.

Loss of Luminance Signal

Complete or intermittent loss of luminance signal, with sound and chrominance intact, is commonly due to poor soldering on the luminance delay line where the fine coil wire is terminated. Like most of the coils in this receiver, the line is wound with "solder-through" enamelled wire which is recognizable by its bright red colour. Plenty of heat and solder is required to tin the lead.

Excess Contrast plus Psychedelic Colour

Faults in C131 (4·7μF tantalum) lead to over-contrasted pictures with bizarre psychedelic colour effects. This symptom often occurs when the set has warmed up, and can culminate in complete loss of luminance and chrominance. A squirt of freezer on C131 will confirm the diagnosis. This fault can occur only in the CVC5 and CVC7: the CVC8 and CVC9 chassis have a different circuit altogether at this point.

Chrominance Channel

T27 and T28 are the chrominance amplifiers, the a.c.c. voltage being applied to T27 base. C151 smooths this feed, being one of several small tantalum capacitors dotted around the chrominance amplifier area: all of these are prone to trouble which is often temperature-dependent. This leads to intermittent colour drop-out or desaturation. In the case of decouplers such as C153 and C155 or the smoothing capacitor C162 the quickest check is with an oscilloscope: an open-circuit capacitor will be found to have a chrominance signal across it. Intermittent colour drop-out can also be due to C156 or C158 where these are polystyrene capacitors. Low saturation can be due to a leak in C265 in the power supply circuit (CVC5, CVC7 chassis), see later.

Saturation control is effected by a novel bridge arrangement around L67, the centre-tap of which is earthed, the inductor thus forming two arms of a bridge. When the capacitances of D23/D24 and C160 are equal the bridge is balanced and C161 receives no chrominance signal. As the saturation control is advanced, the varicap diodes D23 and D24 become progressively less back-biased: the resulting increase in their capacitance unbalances the bridge thus passing a controlled amount of chrominance signal to C161. The trimmer C160 is normally set for zero colour at minimum setting of the saturation control. Sudden lapses of the picture into reversed (complimentary) colours is often traceable to a faulty or mis-set trimmer. The delay-line driver stage around T29 gives little trouble apart from the tantalum capacitors C162 and C165. In early versions C161 was a polystyrene type, and suffered from intermittent open-circuit.

Reference Chain

Turning now to the reference chain, the burst gate stage (T34) is quite reliable apart from C200 (0·001μF) which is rather fragile and can go open-circuit for mechanical reasons, thus removing the colour. If the burst filter can assembly has to be replaced be sure to specify the chassis type when ordering since the polarity of D34 and D35 is reversed between the CVC5/7 and CVC8/9 chassis. The wrong can causes the reference oscillator to lock 180° out of phase, resulting in complementary colours and demented service engineers!

T38 has two functions, that of d.c. amplifier of the control voltage applied to the varicap diodes D42 and D43 and also subcarrier oscillator. It must be replaced by the specified type, i.e. BC172C or BC109. The error potential source in the burst filter circuit is of high impedance, and the smallest amount of leakage in the associated components can play havoc. It is our practice to replace C208 (6·8μF) and the 1·5V zener D36 in cases of wandering oscillator frequency. The crystal itself can also cause this, often obligingly drifting about under the influence of gentle heat or freezer. The oscillator capacitors C228 and C231 and amplifier tuning capacitor C232 were of the notorious polystyrene (see-through) type on early versions, resulting in intermittent shutdown of the oscillator and thus no colour. Another cause of reference oscillator shut-down or incorrect frequency is imbalance between the phase detector diodes D34 and D35. Replacement of any components in the burst filter or crystal oscillator circuits should be followed by realignment of the a.p.c. loop as detailed in the manual.

Ident and Bistable Circuits

In the absence of colour, the killer may be over-ridden by linking the 20V rail to the top of C162 via a 12kΩ resistor. If this results in locked but not necessarily correct colours the chances are that the ident stage (T35) output is low. The ident tuning is critical for correct killer operation, a peak-to-peak voltage of at least 12V being necessary at T35 collector. If retuning L75 for maximum voltage at D37

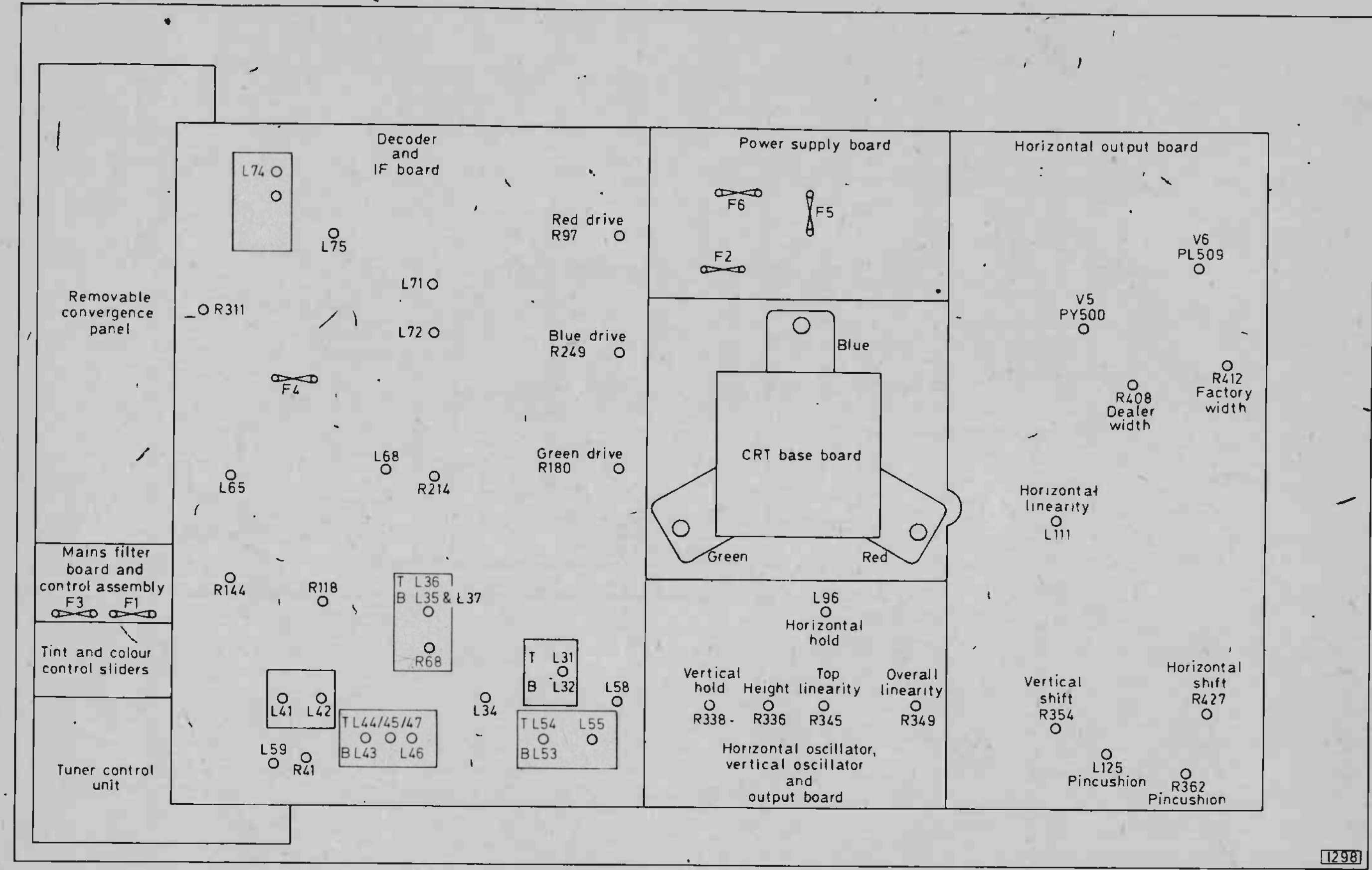


Fig. 1: Rear view of the CVC5 chassis.

and not adjustable. The flatpack transistors used for T13-T17 can give rise to many strange symptoms. Intermittent faults in these can usually be located with the aid of a freezer aerosol and gentle heat from a hair-dryer. More reliable substitutes are BF197 for T13 and T17 and BF196 for T15 and T16. Poor print joints in this area usually occur at the junction points of the conductors on the i.f. board with those on the main panel. The printed conductor from R118 to T14 base seems prone to hair-line cracks, causing grainy pictures unaffected by the setting of the tuner a.g.c. control R118. We have found that a piece of 5A fuse wire bypassing the board joint and printed track in this area is the best solution.

Access to the print side of the i.f. panel is poor, but the entire i.f. unit can be replaced at reasonable cost. (Eliminate the a.g.c. department first however – details later.) When replacing this board, RS Components' desoldering braid has been found more effective than the use of the solder-pump type of tool. T13 is more often the cause of low i.f. gain than the other transistors.

Sound Faults

The sound i.f. amplifiers are T8 and T9. Sound i.f. troubles are occasionally due to T8 failing, but in the majority of cases the problem lies in the sound detector can – D14/15, T9 and the 6·8μF capacitor C68 being the most common causes of faults here. Later models use an i.c. in the sound can: this has proved most reliable provided L35 is correctly tuned.

The early discrete type detector assembly is no longer available. If this type has to be replaced by the i.c. version (part No. 32-517) the drill is to remove T8 and resistors R60 (4·7kΩ), R61 (39kΩ), capacitor C61 (0·001μF) and the sound discriminator assembly. Fit a wire link from T8 collector hole on the board to the centre tap on L34 which is the coil end of the capacitor C61 previously removed. The new assembly can then be fitted in place of the old can.

The audio output stage is conventional and reliable. If the cathode resistor R82 is burnt, replace the PCL86 which will usually have developed internal leakage. Where R82 is provided with brass stand-off sleeves, dry-joints to the printed board can occur. The sleeve is invariably soldered but often the resistor leg is not, leading to intermittent crackles and distortion. Replacement of C78 (50μF) is wise in these circumstances. Mysterious absence of sound can be due to a faulty "silent warm-up" circuit. The voltage which brings the audio channel into operation once the line output stage has warmed up comes via R413 and R409 from the boost rail.

Mains hum on sound, most noticeable at low to medium volume levels, is due to a hum loop being set up in the screened lead to the audio amplifier. Ensure that the earthy end of the volume control is connected only to the leads' braiding and not to the metalwork of the control panel. It sometimes happens on CVC8 series chassis that the braid is badly crimped at pin 6 on socket P on the main printed-circuit board. The effect is sudden bursts of full volume, regardless of the control setting. A blob of solder on the braid/socket connection will prevent this.

Occasionally the symptom of distorted sound at low volume crops up. As with most equipment, an off-centre speech-coil in the loudspeaker is the usual cause of this.

AGC Faults

Absence of signals should – assuming the power supplies are correct – lead to a check of the voltage across C114. A negative voltage here greater than about –1·1V (with signal) indicates a.g.c. problems, T41 often being the culprit. The slightest leak in the gating pulse diode D45 will cathode restores normal operation, C215 (0·015μF) should be suspected. Again, a high-gain transistor is called for in this (T35) position, a BC172C or BC109 being the only suitable replacements.

The bistable circuit operates only when a colour signal is present. D37 then rectifies the ident signal, producing a positive voltage across C218 to prevent the negative-going pulses fed into the circuit via R310 and C223 passing through D38 to the base of T36 – the line-by-line triggering pulses are positive-going and are fed to the bases of T36 and T37 via C222 and C226 respectively. On monochrome the negative-going pulses switch T36 off and its high collector voltage is applied via R301 to T37 base so that it is held conducting. The purpose of this arrangement is to provide the colour-killer action. On colour, when the bistable is active, the square waveform at T37 collector is smoothed by R205/C162 and used to bias T29 on. Thus failure of the bistable to switch, due say to one of the transistors, or if C162 is defective there will be no colour.

Under certain circumstances, the bistable can operate erratically, showing on a 'scope as "hiccups" during the line period. The effect on the display is dotted red and green vertical lines about half-way across the picture, showing up best at low settings of the brightness and contrast controls. This baffling symptom can be eliminated by replacing C220 and C225 with 68pF ceramic capacitors.

A fault that has cropped up on some receivers of recent vintage is leakage in D40 which couples the ident signal to T37. This upsets the mark-space ratio of the bistable, the effect on the display being a transition from correct to complementary colour of any chroma signal with a V component. The switching characteristic depends on the severity of the leak, so that the "green/red bar" may occur on either side of the screen. Fortunately the diagnosis is simple. The effect can be moved across the screen at will by manipulation of the ident coil L75. The leakage in D40 is not always discernible on an Avo check and substitution is thus recommended.

Colour Confetti on Monochrome

A problem which often crops up in readers queries is colour confetti sometimes seen on monochrome transmissions. The killer circuit can be simply desensitised by interchanging R196 and R197 in the decoder. In persistent cases, reduce R309 (47kΩ) to 22kΩ.

Faint Green and Magenta Striations

Before leaving the decoder, mention should be made of a fault which is present in a few chassis produced around 1972 and seems to defy diagnosis. It takes the form of faint green and magenta vertical bars extending across the full width of the screen and mainly visible on low-key scenes. This is a manifestation of the harmonic ringing of the line output transformer and is due to stray pulse pick-up in the decoder. If you meet this problem, check the phasing of the subcarrier traps L71 and L72 towards the top of the decoder board. The direction of winding should be clockwise when viewed from above. Other contributory causes of this symptom are faults in the 20V line decouplers in the decoder. These are C219 and C152, both 8μF. Finally, ensure that the leads to the convergence box are dressed tight against the degaussing shield, and that the green lead to the base of T46 (AD161) is dressed well away from the r.f. filter choke L95.

CONTINUED NEXT MONTH

THE PHILIPS VIDEO CASSETTE RECORDER

M. P. RILEY

PART 2

THIS is the fourth and final article in this series on videotape recorders, in which the playback path and the servo system of the Philips VCR will be explained. In last month's issue the tape path of the machine and the functions of the E to E and Record electronics were outlined.

As with the record mode, the playback path can be logically subdivided into three sections, these being for the audio, luminance and chrominance signals. As the first of these is the easiest to understand and contains the least amount of electronics, it will be dealt with first.

The audio signal

The block diagram shown in Fig. 12 covers the complete playback system of the VCR together with the modulator section which was described in last month's issue. The signal from the audio record/playback head K3 is fed directly to a series of transistor amplifiers TS451 to TS453, where it is amplified and l.f. equalised to produce a reasonably flat audio response. From here it is fed to the output sockets provided for CCTV use, and also to a final single-stage amplifier TS450 which drives the 6 MHz f.m. modulator in module U505.

The luminance signal

The path of the luminance signal in the VCR is very similar to systems already described in this series, but there are a few major differences in the operation of the head amplifier and the dropout compensator. The two video heads mounted on the circumference of the drum are wired in series, and therefore only one head amplifier is required in the playback path between the heads and the limiter. Coupling between the heads and the amplifier is through a rotary transformer.

The head amplifier does not use the cascode circuit described earlier but utilises an n-channel field effect transistor (BFW11) in the common-source mode of operation. This is followed by a common-emitter amplifier with negative feedback and then an emitter-follower. Further amplification and equalisation of the f.m. signal is provided by transistors TS423 to TS425. The amplified and corrected f.m. signal is now fed to three separate sections of the machine, these being the luminance limiter, dropout compensator and chrominance processor.

The luminance section contains a high-pass filter which removes the 562·5kHz chrominance information before feeding the signal to the limiter. If this were not done then the a.m. chrominance signal would still remain, and the clipping action of the limiter on the chrominance would produce a large number of harmonics falling inside the luminance passband. These harmonics would beat with the luminance f.m. signal resulting in herring-bone patterning.

The limiter in the VCR is contained in a TAA350 integrated circuit which is in common use in many TV receivers; the i.c. contains four single-stage amplifiers connected in cascade. The output of the i.c. is fed to a pulse-counting f.m. detector. This type of detector is seldom used in TV receivers and so may be new to many readers; a brief explanation of this simplest of f.m. detectors will therefore be given.

Pulse-counting detector

An f.m. detector is required to give a change in output voltage when fed with a signal of constant amplitude and varying frequency. If the f.m. signal is fed across a capacitor (see Fig. 9) whose value is fixed, the reactance of the capacitor will change with the frequency of the applied signal. If the capacitor acts as a load to an amplifier being fed with the f.m. signal, then as the load impedance changes with changing frequency so will the output of the amplifier. Fig. 10 shows a simple pulse-counting detector. If

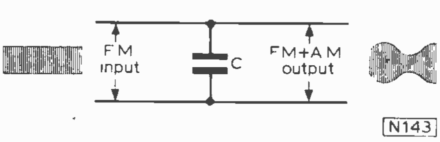


Fig. 9: Principle of the pulse-counting detector.

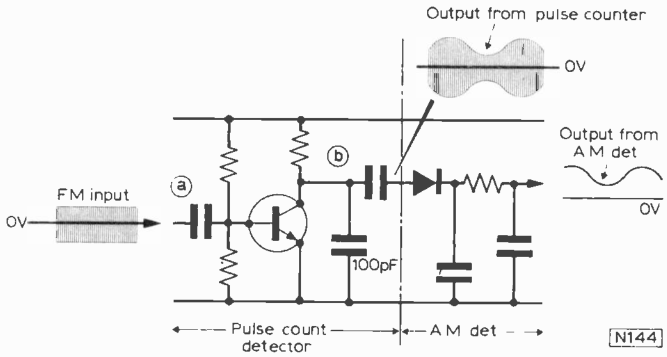


Fig. 10: A simple pulse-counting detector circuit.

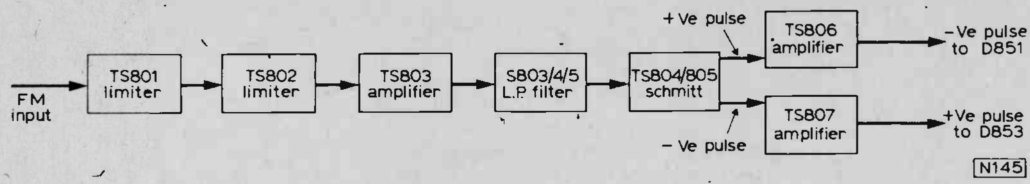


Fig. 11: Block diagram of the dropout detector circuit.

the f.m. input at point (a) is varying in frequency from 3 to 4·4MHz then the output at point (b) will be developed across a load whose impedance will change from 530Ω at 3MHz to 361Ω at 4·4MHz.

As the load impedance of the amplifier goes down with an increase in the frequency of the input signal, the output of the detector will always be negative-going. The output signal of the detector will still be an f.m. signal, but the amplitude of the signal will also be changing as shown in Fig. 10. If the signal is then fed to a conventional a.m. detector and filter, the f.m. content will be removed leaving only the amplitude variations. One major advantage with this type of detector is that, providing it is working over the straight part of the capacitor's reactance range, the output is very linear. Returning to Fig. 12, the pulse-counting detector is represented by TS427 and the following low-pass filter by L416/417 and TS853. The demodulated luminance signal is now fed to the electronic switch in the dropout compensator.

Dropout compensator

The delayed signal path to the dropout compensator differs from the system described in the September issue in that it is the f.m. signal that is delayed and then fed to a second limiter and demodulator. TS808 is a single-stage common-emitter amplifier which feeds the f.m. signal to a conventional 64μs glass delay line and also to the dropout detector. The output from the delay line TD801 is fed to a limiter, demodulator and low-pass filter, all of which are virtually identical to the modules used in the luminance signal path. The delayed luminance signal is then fed to the second input of the electronic switch. You will note that dropout compensation is applied to the luminance signal only and not to the chrominance signal.

Transistors TS801 to TS807 form the dropout detector which has been further subdivided for our purposes in Fig. 11. The amplified signal from TS808 is fed directly to two limiter stages TS801 and TS802 to remove any small amplitude variations that may be present. The limited signal is then coupled to a low-pass filter, which removes the f.m. content of the signal, leaving a smooth d.c. voltage.

When a dropout occurs, the f.m. signal will disappear causing a change in d.c. level at the output of the low-pass filter. This voltage change is coupled to the Schmitt trigger TS804 and TS805. Two push-pull switching pulses are produced and these are fed to the amplifiers TS806 and TS807. The inverted outputs of these amplifiers are then used to switch diodes D851 and D853 in the video switch.

The dropout-compensated signal from the video switch is de-emphasised and then delayed to compensate for the inherent delay of the chrominance processor. Signal processing from this point onwards is identical in all respects to the record mode of the machine.

The chrominance signal

Chrominance processing of the signal from the video head is the most complex of the three signal paths because it entails the conversion of the chrominance from 562·5kHz up to 4·433MHz. Not only does this up-conversion of frequency have to take place, but correction of the final chrominance frequency against head and tape speed variations has also to be effected if they are not to cause changes in picture hue or saturation. Both of these requirements are in fact built into the chrominance processor and are effected simultaneously.

Modules U66 and U67 operate together with U61 in exactly the same way as in the record mode, only the signal feeds are changed. Off-tape luminance is fed to the sync separator in U67 and the resulting line sync is used to lock the 562·5kHz oscillator. The oscillator output is divided by 36 and used as the feedback signal to the discriminator. The output of the oscillator is now locked to the off-tape video signal, and should the speed of the tape vary over the period of several lines the output frequency of the 562·5kHz oscillator will also vary with the change in timing of the line sync.

This oscillator frequency is mixed with a 4·433MHz subcarrier signal produced by the now free-running subcarrier oscillator in the decoder. A 4·99MHz sinewave is obtained from the additive products of these two signals whose frequency is again directly locked to the off-tape line sync pulses. The 562·5kHz off-tape chrominance signal is mixed with the 4·99MHz sinewave in module U64, the subtractive products of the mixing being filtered to produce the regenerated 4·433MHz chroma signal.

Phase-shift correction

Correction of the chrominance phase-shift caused by changes in tape speed can only be explained if a small amount of mathematics is applied. Let us examine a case where the tape speed increases by 1%. The off-tape chrominance, if not corrected for this increase in tape speed, would rise in frequency by 1%, i.e. 4·43361875MHz plus 0·0443361MHz = 4·4779548MHz. This new chrominance frequency would of course throw the subcarrier oscillator in the receiver completely out of sync and cause the operation of the colour killer in the decoder.

A 1% rise in tape speed would produce a new line frequency of 15·78125kHz. This signal when used to lock the 36 times line frequency oscillator in U66 would in turn produce a frequency of 568·125kHz at the output of U66 (i.e. 562·5kHz +1%). This new frequency is now added to the 4·43361875MHz signal from the subcarrier oscillator in the decoder of the VCR to produce a frequency of 5·0017437MHz at the output of U61. The off-tape chrominance frequency will also rise by a factor of 1% from 562·5kHz to 568·125kHz. The mixer in U64 takes the new off-tape chroma frequency of 0·568125MHz and the regenerated 5·0017437MHz sinewave from U61 and mixes the two signals. The subtractive products are selected by the band-pass filter (i.e. 5·0017437 –0·568125MHz) producing 4·43361875MHz, the required chrominance frequency.

The reader will realise that this correction will only be effective over a period of several lines, and any speed

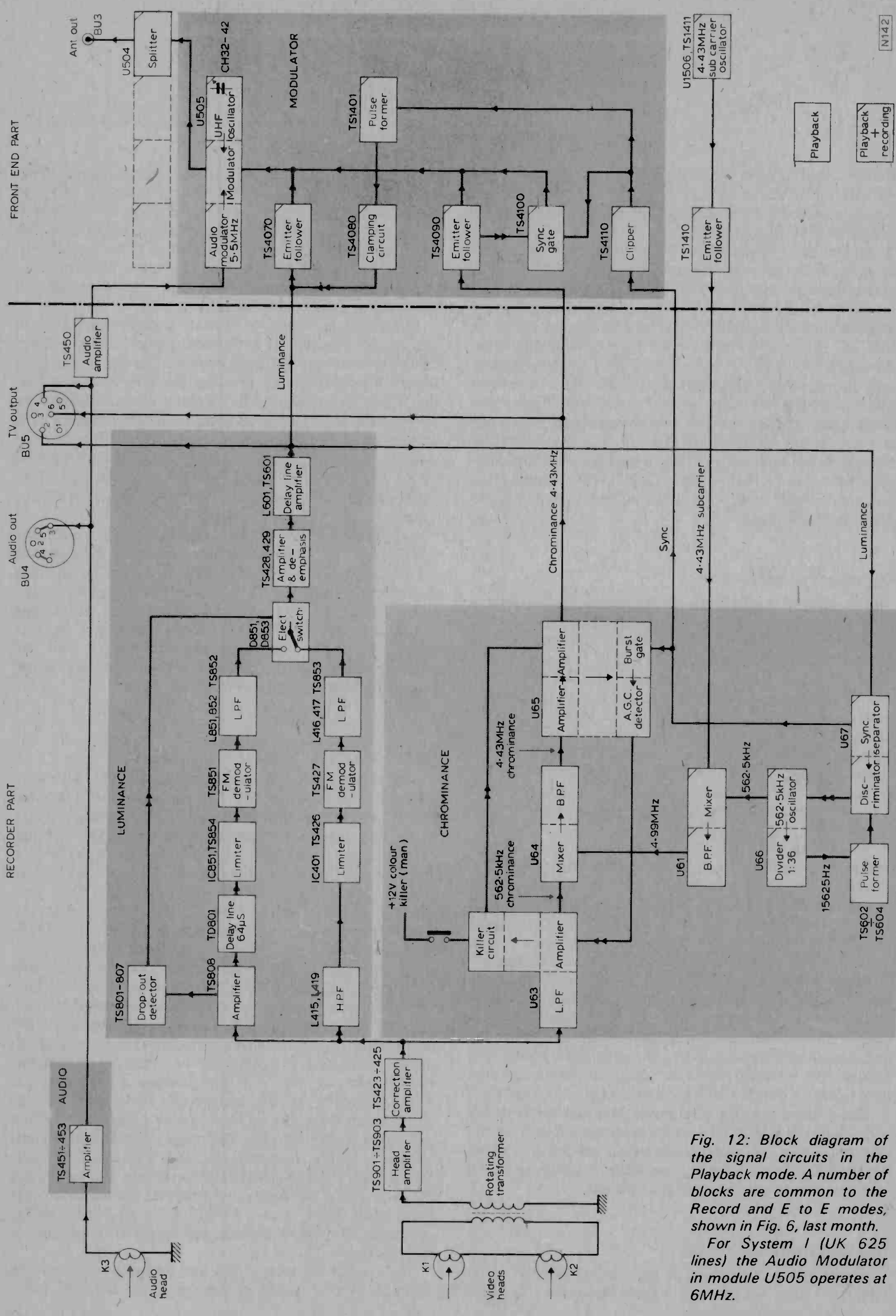


Fig. 12: Block diagram of the signal circuits in the Playback mode. A number of blocks are common to the Record and E to E modes, shown in Fig. 6, last month.

For System I (UK 625 lines) the Audio Modulator in module U505 operates at 6MHz.

variations that take place during a single line will not be compensated. It should also be noted that as the drum revolves at 25 r.p.s. (picture frequency) any speed change of the drum will take place over several fields. The error used in this example is quite realistic as it represents an increase of head drum speed of a quarter of a revolution per second.

The circuitry between the chrominance processor and the head amplifier follows standard colour receiver techniques and is quite simple. Module U63 contains a low-pass filter which separates the off-tape chrominance signal from the luminance f.m. signal and passes it to a variable gain amplifier. The automatic chrominance control voltage fed to this amplifier is produced in module U65 by gating out the colour burst and passing it through a gated half-wave rectifier and smoothing circuit.

A colour killer is incorporated in U63 which produces a second d.c. control voltage biasing the chroma amplifier in U65 into conduction during the presence of a colour signal. A manual colour killer facility is provided which removes the supply voltage to all the chrominance circuits in modules U63, 64 and 65. The fully processed chrominance signal at the output of U65 is fed to the TV output socket for CCTV applications, and also to the emitter-follower TS4090 which in turn drives the u.h.f. modulator described last month.

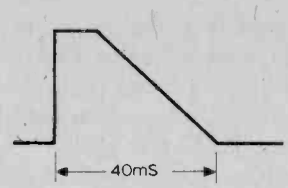
I hope that this description of the video processing sections of the VCR has given the reader an insight to the principles involved in the field of video tape recording. In the following section the servo system of the machine is described in a little more detail because very few people who have been involved with television servicing will have come across this particular type of electronics. Being in my middle twenties, I have only vague memories of the last time electric motors were commonly used in connection with the television trade. I am, of course, referring to the original type of electronic tuning where motors were employed to turn the biscuits in a mechanical tuner, and from what I can remember the inside of the receiver resembled the gearbox of an Austin Twelve rather than the publicised 'modern TV receiver'. Things have certainly changed!

The servo

The principles of the servo were explained earlier in the series to give the reader a foundation on which we are about to build. Before any explanation of the VCR servo can be given, a closer examination of some of its functions must be made.

Two types of correction to the speed of either the tape capstan or head drum can take place. The first of these will correct for long-term fluctuations in the speed of rotation, such as may be caused by the changing amounts of tape on the two spools in the cassette producing a slow but gradual fluctuation in the tape tension around the head drum. The second type of correction will take place during a short period of time, for example to correct sync disturbances of the programme material, or very large servo errors which develop when either the record or playback modes are entered. Splices, creases and dropouts can also cause the servo to compensate for an error very quickly.

Long-term errors are normally caused by changes in the mechanical conditions of the transport system itself, while short-term disturbances are nearly always caused by electronic fluctuations of either the material being recorded or replayed, or the electronics of the machine. One must always bear in mind that the prime function of the VCR servo is to reproduce during the playback mode the exact conditions that were present in the record mode.



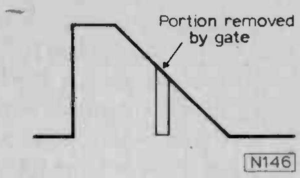


Fig. 13(left): The servo reference ramp.

Fig. 14 (right): Application of the feedback signal.

Error voltage generation

The method used in the VCR (and in many other VTRs) to produce the error voltage, which is fed via a power amplifier to the eddy current brake, is rather unusual and warrants a closer look. To generate the error voltage two signals are required. One is a reference which is known to be correct, and the second is the feedback voltage which is to be compared with the reference. The reference voltage takes the form of a sawtooth ramp falling in a linear manner from a high potential to a low potential, see Fig. 13. This ramp is of course generated at the reference frequency, 25Hz. The feedback signal which is to be compared with the reference consists of a pulse of constant amplitude and width, but whose frequency will change with a change in speed of the head drum or capstan motors. The feedback pulse is used to gate out part of the reference ramp as shown in Fig. 14.

When the servo has locked, the gate position will appear in the centre of the ramp, but should the phase of the motor change then the gate position will travel either up or down the slope depending whether the speed of the motor has decreased or increased. The sampling gate conducts during the period occupied by the feedback pulse, and the coincident portion of the ramp is removed. This is amplified and then fed to a smoothing or storage stage. A basic block diagram is shown in Fig. 15. As the phase of the feedback pulse changes then so does the gating position on the reference ramp causing the gated signal to rise or fall in potential. See Fig. 16.

Servo record mode

The block diagram of the VCR servo in the record mode is shown in Fig. 17. As we have seen, during the record mode the servo reference is the field sync information

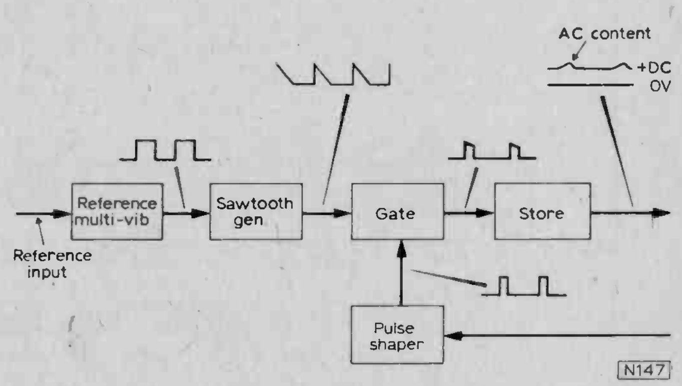


Fig. 15: Block diagram of the error-voltage generator.

contained in the video signal to be recorded. The separated mixed sync pulses are fed to a field pulse separator TS461 and then clipped by TS462 to produce a clean positive-going field sync pulse. These field sync pulses are then used to lock the master reference oscillator TS228 and TS229.

It can be seen from the block diagram that the method of controlling the frequency of this oscillator is very similar to the correction system just explained. The squarewave output from the oscillator TS228, TS229 is fed to a sawtooth generator TS230. The output of this stage is a waveform similar to that shown in Fig. 13 and this is gated by the shaped field pulse which is applied to the sampling gate TS231. The output of the sampling gate consists of the gated portion of the ramp applied to its input, the amplitude of this gated signal being dependent on the phase of the master oscillator when compared with the reference field pulses. This error voltage is then applied across a capacitor to store the signal and convert it to the d.c. control voltage. From here the signal is d.c. coupled to an impedance matching emitter-follower and then applied to the master oscillator.

The squarewave output of the master oscillator is fed to a binary divider TS226, 227 and from here the true reference signal is fed to three separate sections of the servo. The first of these feeds is to a pulse amplifier which drives the control track record head. It will be noted that the signal recorded does not have h.f. bias as one might expect but is simply recorded directly onto the tape. All that is required of the control track signal is that it gives an accurate reference of the moment that a new picture is recorded. The shape, or any distortion is not important. Even broadcast machines costing many tens of thousands of pounds do not go to the expense of biasing the control track signal.

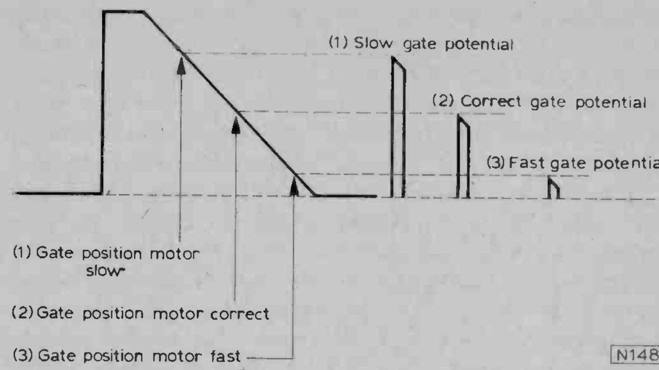


Fig. 16: Variation of gate position with changes in motor speed.

The second output of the binary divider is applied to the head drum servo as the reference signal and the third output is fed to the capstan servo, again as a reference.

Head drum servo

Comparison between the reference and the feedback signal needs no detailed explanation, apart from mentioning that the feedback signal is produced by passing a magnet that is attached to the head drum over a pick-up coil once every revolution of the head drum. The resulting pulse from the pick-up coil is shaped by TS201 before being used to gate the ramp. The error voltage from the storage circuit is applied to one input of a differential amplifier, the second input to this amplifier is produced by half-wave rectifying and smoothing the error voltage (D205 and C209).

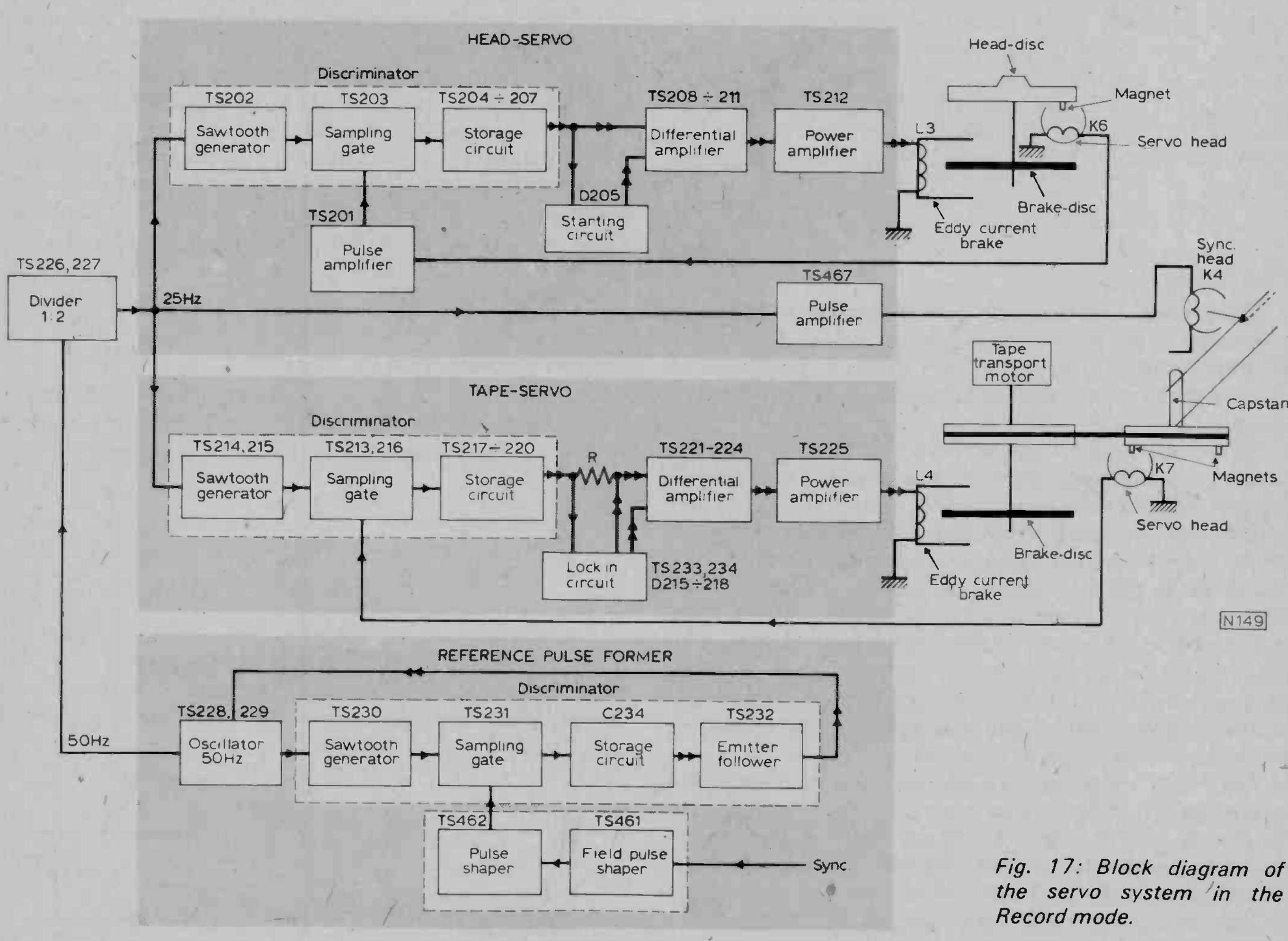


Fig. 17: Block diagram of the servo system in the Record mode.

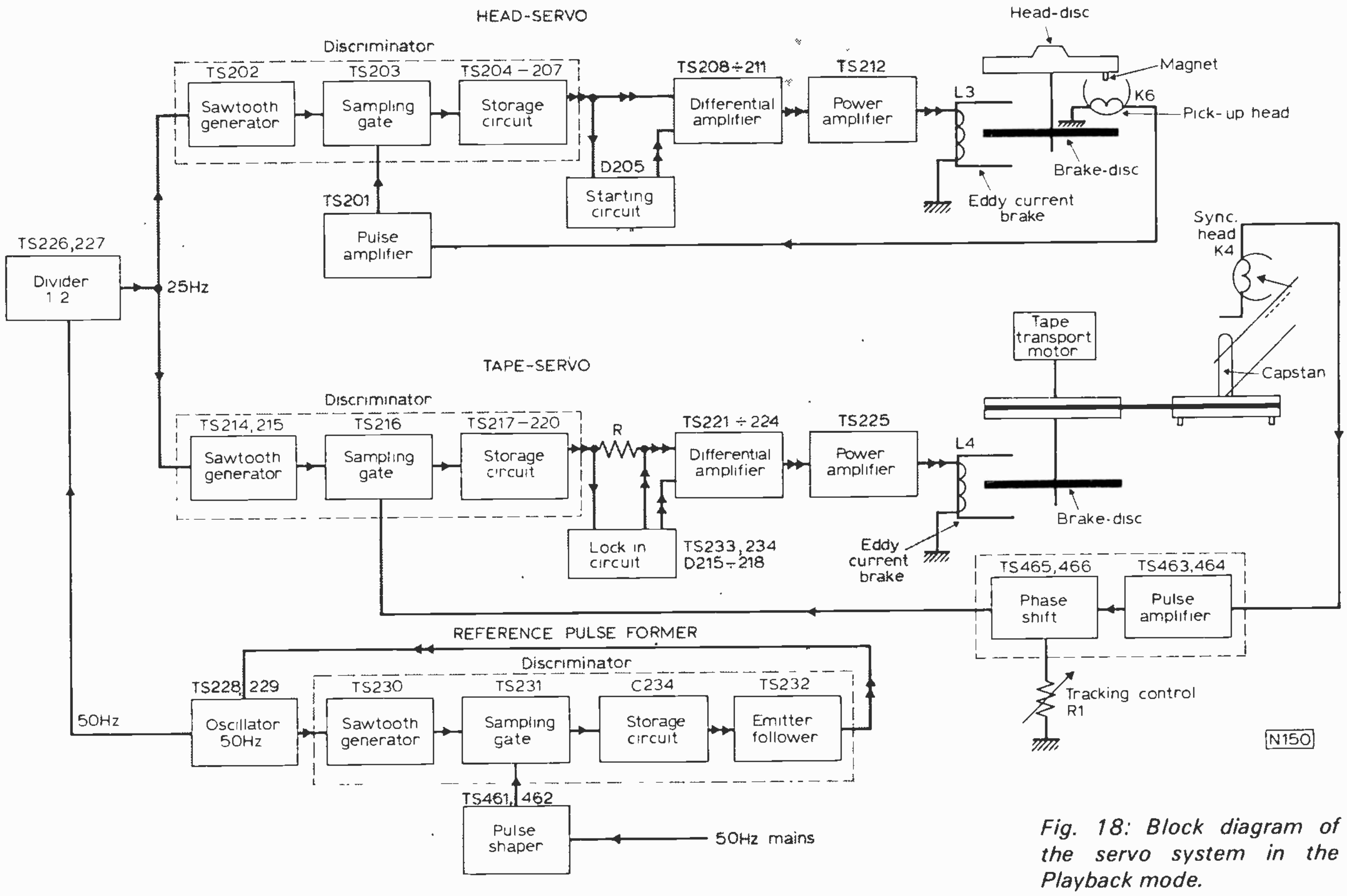


Fig. 18: Block diagram of the servo system in the Playback mode.

The direct feed to the differential amplifier will be a d.c. voltage plus a ripple a.c. caused by the sample rate in the discriminator. The second input contains just the d.c. component of the error. Once the servo has locked the ripple voltage will fall because a constant-rate sample of the same potential is being made and then smoothed by the storage circuit. If the servo loses lock then the gate position will travel up or down the ramp producing the varying ripple voltage which is then used to produce an output from the differential amplifier.

The big advantage if producing both inputs of the differential amplifier from the error voltage is that the difference between the two will always be comparatively small. Hence the servo is always inside its normal lock-in range, and is able to lock from the start of a mode with maximum speed. The output of the differential amplifier is amplified by TS212 and fed to the eddy current brake to control the speed of the head drum. The video head is now locked directly to the picture information being recorded and phased so that the field sync is being recorded at the beginning of a new scan of the tape.

Capstan servo

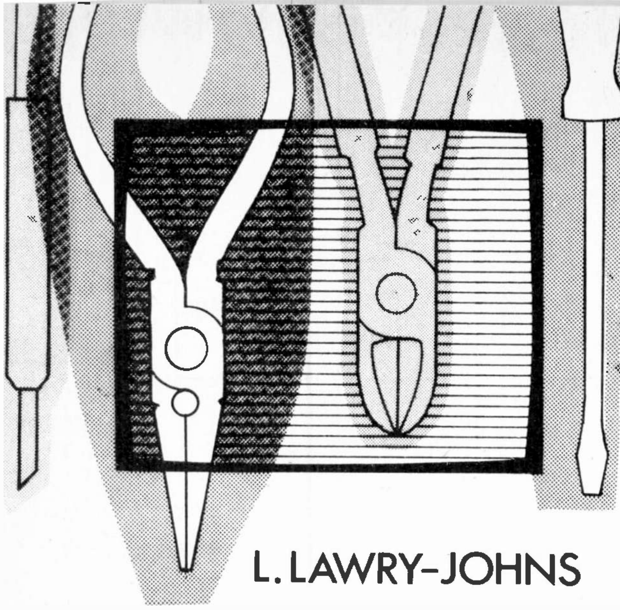
The techniques used in the tape-capstan servo are very similar indeed to those used with the head drum, the only differences being the introduction of a lock-in circuit between the storage stage and the differential amplifier, and the absence of a pulse amplifier in the feedback path. The discriminator is the same, in principle, as before; only the feedback signal has changed and this takes the form of a 25Hz pulse derived from a sync head on the capstan flywheel.

The error signal from the storage stage TS217/220 has its d.c. component directly coupled to the differential amplifier, while the a.c. component is fed to a lock-in circuit which amplifies the a.c. error and stores it on a 10μF capacitor, producing a smoothed d.c. voltage. A portion of this voltage is added to the original error and applied to one input of the differential amplifier. The remainder of the d.c. voltage is fed via a diode limiting circuit (to prevent the servo from going outside its correction range) to the second input.

The reader will notice that up to now all the correction on the speed of the capstan servo has been long-term d.c. correction because of the slow tape speed changes required. Remember that the guard band between video tracks on the tape is very small indeed, and any rapid correction could cause the servo to overshoot the information on the tape. A small amount of a.c. correction is however applied in the form of feedback from the output to the input of the differential amplifier. The error output of the differential amplifier is now fed via a power amplifier to the eddy current brake on the tape transport capstan motor.

During the record mode the capstan and the head drum are synchronised directly to the incoming picture information. The head drum is locked in such a way that the field sync information is recorded at the beginning of each new video track, and the capstan produces a synchronised and continuous tape speed. Should the frequency of the reference field pulse shift, then both servos will compensate for the change simultaneously.

continued on page 45



SERVICING TELEVISION RECEIVERS

DECCA DR1 SERIES

PART 2

L. LAWRY-JOHNS

Poor Sync

Line sync problems do not necessarily originate on the lower deck however. The video amplifier and sync separator valve (PFL200) is on the upper deck and a defect in either stage can cause impaired sync. At first sight one would suppose that both the line and field sync would be affected by a fault here, and this is quite true. Sometimes however one is affected more than the other, and this can set one off on a wild goose chase resulting in the loss of quite a lot of time and patience while checking around the timebase components down below when the trouble is lurking up aloft with the responsible component laughing its head off. It is essential therefore to check the PFL200 valve and one or two items associated with it. Suspect components are the screen grid feed resistor to the sync section (R66) and the screen grid decoupler in the video section (C51).

Field Timebase

Before getting too wrapped up in the video stage however let's descend once more to the lower deck to have a quick look at the field timebase. This gives less trouble than may be expected (well fancy that!).

The heart of the field timebase is the 30PL14 which has proved to be a more reliable valve than the PCL85 (albeit more expensive on a one off basis), but for the benefit of newcomers we must at once say that one cannot interchange these valves as they are completely different – not only because of the different pin connections. Having said that, there will probably be a host of people who will proclaim the 30PL14 to be the world's worst valve etc. We can quote only our own experience however, which is that whilst the 30PL13 did not wear so well the 30PL14 has proved to be much better and we rarely have to change one (we admit that they aren't used very much, but there have been several very popular chassis in which it has been used, for example the Thorn 980 series of v.h.f. only models).

As far as poor field sync is concerned first bear in mind our remarks on the video and sync separator stages. In the timebase itself there is an interlace filter using a clipper diode (D2) which is biased by R113 (1·8MΩ). This resistor is one of the items to check when weak field sync is experienced.

The majority of troubles however are more likely to be loss of height, poor linearity and varying field hold. Loss of height can be due to a faulty valve, as can any number of other field faults. So the rule is to check the valve first and then go on to check other components as necessary.

Lack of Height

Loss of height which is even at the top and bottom of the raster should direct attention to the supply from the boost h.t. line to pin 9 of the valve. There is a point to watch here. If the set has been used on 625 lines and there has been trouble with the width (set boost) circuit it is possible that the 68kΩ resistor R165 has also suffered some damage which may have been missed with the set boost control set to maximum in order to obtain barely adequate width. This could result in a lower supply to the height control. Assuming that R165 is in order and that the lack of height is also obvious on 405 lines, resistors R163 and R143 should be checked. If these are in order check C122 (2μF) for leakage. The height control itself could be defective but this is less likely.

Linearity Faults

If the bottom of the picture is well up but not folded it is most likely that the output pentode's cathode decoupler (C124) has dried up, the resultant loss of capacitance resulting in heavy current feedback causing reduced scan particularly in the lower half of the screen. This is well known of course and should be the first suspect. A component which is often neglected however is the anode and screen grid decoupler, whether this is a separate electrolytic or part of the main smoothing block. A separate electrolytic, C127, is used here and this can dry

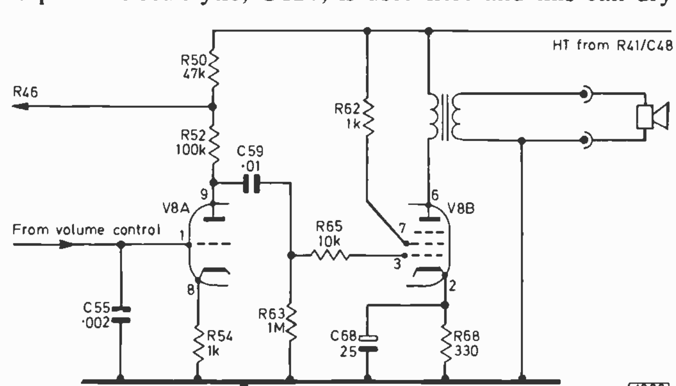


Fig. 2: Audio circuit used in Models DR20/21/23/24.

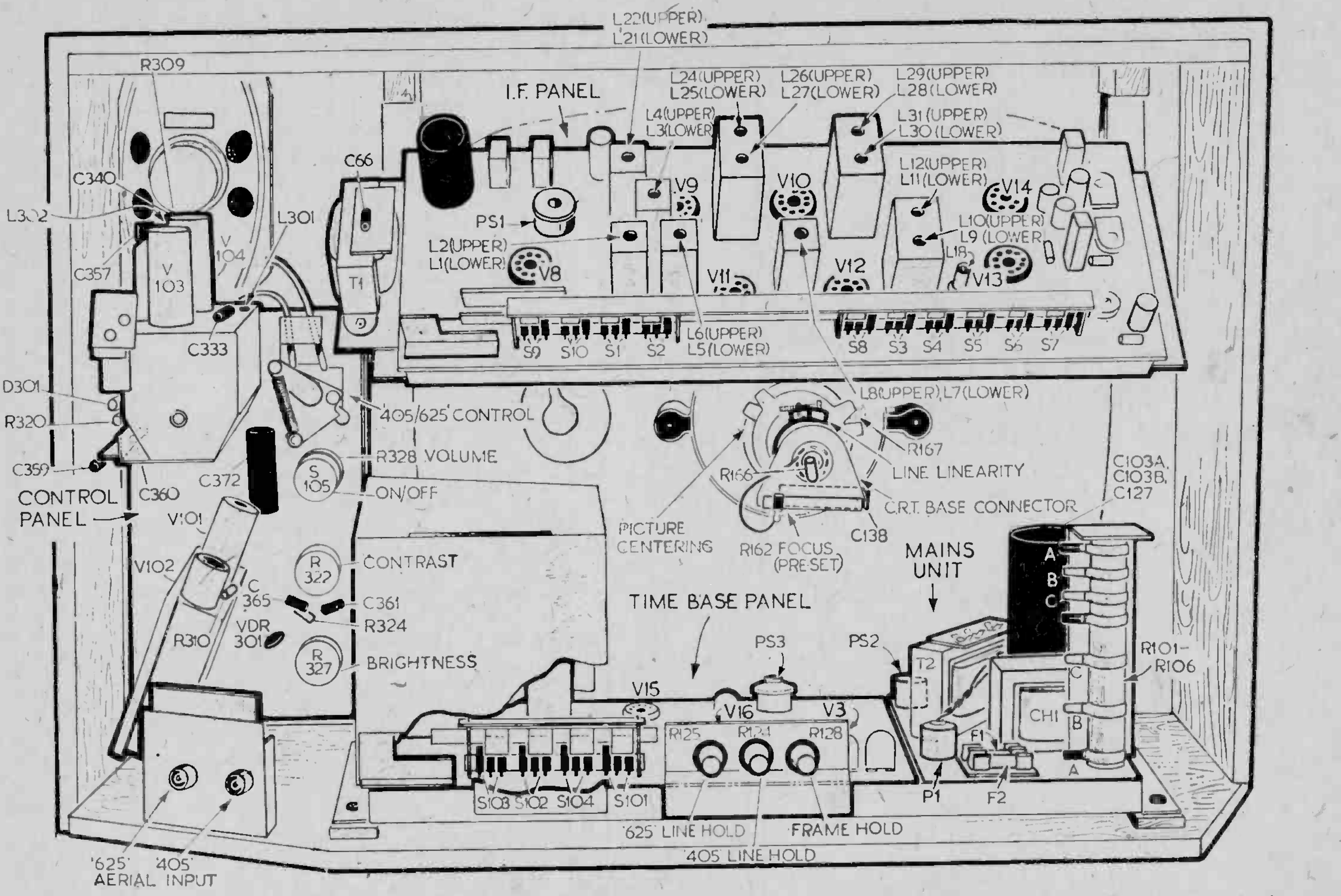


Fig. 3: Rear chassis view, DR1 series receivers. In the DR20 series, V10 and V14 are omitted and a transistor u.h.f. tuner is used. Diagram reproduced from "Electrical and Electronic Trader" Service Sheet 1729/T291 by kind permission of the Editor.

up on its own account. The resultant feedback is quite severe and the linearity suffers. This can cause some head scratching when the more usual causes have been checked out to no avail. In all cases of poor field linearity the value of R145 should be checked.

Field Hold Range

Should the field hold control be at the end of its travel and the 30PL14 not be at fault check resistor R127 and capacitor C115, observing the voltage rating of this latter component.

Field Collapse

When the fault is non-operation of the field timebase, denoted by a white line across the centre of the screen, the first thing to do is to ascertain where the voltages are wrong. Pin 2 should record about 20V (across R145). If this voltage is present it can be assumed that the output section is in order (with the voltages at pins 6 and 7 being roughly right at about 205V and 215V respectively) and that the fault is likely to be in the triode stage. The voltage at pin 9 is the clue here. If this is a lot lower than the expected 80V, check at the height control and if the voltage here is low check C122 and the feed resistor R163. These components could well be in order if the stage is not oscillating however, as the current drawn by the stage is then much higher and the anode voltages lower.

If the voltages are all correct and a hum test at pin 3 fails to open up the raster it is likely that the scan coils are at fault or the height stabilising thermistor is cracked (R167 included in the deflection coil housing). If R167 is suspected it can be shorted out to restore near normal working until another one is fitted. Otherwise the scan coils should be unplugged and a continuity test made on the field windings which are in series.

The Upper Deck

When these sets were young, faults in the upper deck were few. As time goes by however we have found quite a lot of different defects occurring around the i.f. stages. One trouble spot in the DR1 series is the screen grid supply to pin 8 of V10. If the set is left working on 405 there is no trouble. If the set is consistently used on 625 lines however the current drain is increased due to R20 which is connected to chassis. R23 deteriorates fairly rapidly, resulting in a severe (perhaps varying) loss of sound. Similar remarks apply to R8 and R17, but in the latter case the picture is also affected of course.

These resistors change value because they were too small for the job in the first place. When other resistors in this position are found in a distressed condition however it is more likely that either the associated valve has an internal short or that the decoupling capacitor is leaky or short-circuit.

Valve Interelectrode Shorts

Now EF184 valves are particularly prone to develop internal shorts, so the drill is to check with a meter from the resistor to chassis to record the short and then to remove the valve. If the short goes along with the valve all well and

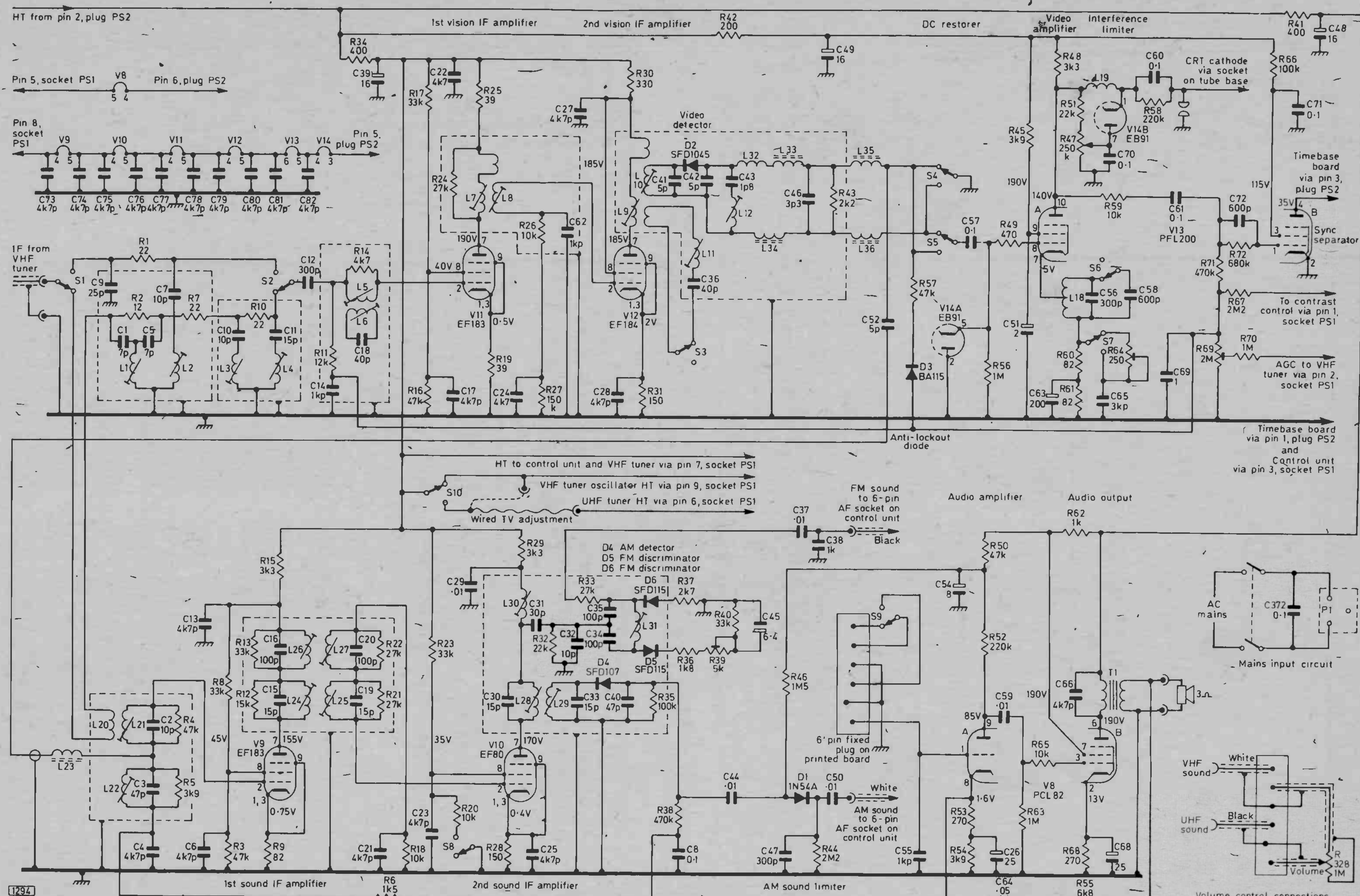


Fig. 4: Circuit diagram of the i.f. panel, DR1 series receivers. The system switch is shown in the 405-line position. Voltages shown apply to 625-line operation. The feed from the brightness control passes via pin 4 of socket PS1 and pin 4 of plug PS2. The main differences in Models DR20/21/23/24 are that V10 and V14 are omitted, V14A being replaced by a BA130 silicon diode with R56 changed to 470kΩ, the picture quality (definition) control R64 is deleted, and in the single sound i.f. stage V9 R15 is changed to 330Ω and R9 is decoupled with an 0·0047μF capacitor. The audio circuit is shown in Fig. 2.

good. If the short remains check the associated decoupling capacitor. If for example the short is at R30, the associated decoupler is C27.

Video/Sync Valve

The other weak link on the upper deck is the PFL200 valve. It can lose emission to give a weak picture or no picture at all, or can develop trouble in the sync section only so that although the picture has its full contrast it cannot be locked either vertically or horizontally.

Electrolytics

Upon looking at the circuit one may be struck by the unusually large number of electrolytic capacitors: practically every h.t. line is separately decoupled. Fortunately these capacitors are of a reliable type and the only electrolytics likely to give trouble are the main smoothers (C103).

Tuner Units

The tuner units are securely bolted to the front control panel which is in turn securely bolted to the cabinet – none of your skimpy little plastic fittings here.

The v.h.f. tuner requires no comment as it probably isn't used except for installations served by a v.h.f. relay network (some blocks of flats still translate down to v.h.f.). In this case all that will be required is a clean up job on the turret contacts and perhaps an occasional valve change (mainly the PCC189 which seems to lose emission fairly quickly).

As far as the u.h.f. tuner is concerned, a valved type is used on early models (DR1 etc.) and a transistorised one in later models (DR20 etc.). Servicing is mainly concerned with the valves and the correct meshing of the tuning gang. The stators of the gang are soldered into position and there are times when the solder cracks. As a result the vanes move slightly, fouling the rotor. This can be checked visually and if necessary the stator wedged into position and resoldered.

The whole panel can be unplugged from the main chassis if necessary.

Audio Circuits

The only other possible trouble spot worth mentioning is the audio output stage where the PCL82 is likely to require replacement. As usual, if the PCL82 has been playing up it is necessary to check the condition of its cathode bias resistor R68 since this is frequently damaged due to overheating and can change value. The net result is a short life for the new PCL82.

There are a number of differences between the PCL82 audio circuit used in earlier models (DR1 etc.) and later ones (DR20 etc.). R68 is 270Ω in earlier models and 330Ω in later models which omit the negative feedback loop.

Notes on Controls

The boost voltage, set by means of R171, should be 800V. Measure at the junction C137/C134/R165.

A local/distance (sensitivity) control is provided. This is R69 at the rear right-hand side of the upper deck. Set for best compromise between the v.h.f. signals available. It can be used to reduce sound-on-vision or vision-on-sound – on v.h.f. of course.

DR1 series receivers are fitted with a picture quality control (R64). This can be set for optimum definition.

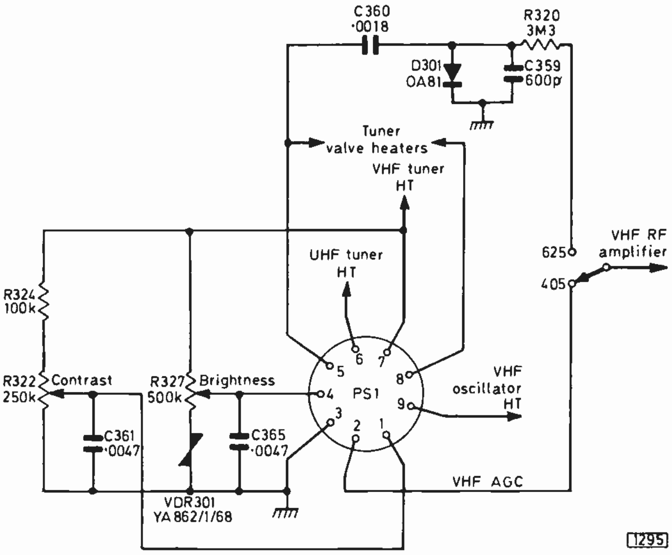


Fig. 5: Control panel circuitry, DR1 series receivers, showing connections to plug PS1. The a.c. heater waveform is fed via C360 to D301 which rectifies it to produce a negative voltage which on 625 is applied via R320 to the v.h.f. r.f. amplifier to bias it off. Models DR20/21/23/24 are fitted with a transistor u.h.f. tuner and a v.h.f. tuner using a PC97 and PCF802 instead of a PCC189 and PCF86. The 12V supply for the transistor u.h.f. tuner is obtained from pin 6 of plug PS1 via a potential divider consisting of a 15kΩ 4W resistor and 12V zener diode. Pin 7 feeds the controls and the v.h.f. tuner mixer, pin 9 feeding the v.h.f. oscillator and r.f. stage, the network C360/D301/C359/R320 not being required.

NEXT MONTH: INDESIT MODEL T24EGB

CEEFAX/ORACLE

reception techniques

Steve A. MONEY T. Eng. (CEI)

PART 5

LAST month we had a look at the way in which Random Access Memory (RAM) devices could be used to construct a page memory for a teletext decoder. Let us now consider an alternative approach which can be equally effective.

When data is received and stored it starts off with the character at the top left-hand corner of the page and then progresses from left to right across each of the rows of characters and down the page, row by row, from top to bottom. Similarly when the text is displayed the data is retrieved in this same sequence from the page memory and used to build up the text display on the screen. Because of this orderliness in the arrival and display of the data it is possible to make use of a sequential access memory for the page store.

Sequential Access Memory

In the random access memory each individual storage cell can be directly selected by applying the appropriate address code to the memory. If the data is dealt with in strict sequence however, this facility is not an essential requirement for the store. In a sequential access memory individual cells cannot be directly selected and only two stages of the memory device connect to the outside world, one being at the input and the other at the output.

Once data has been written into a selected cell in a random access memory it will remain in the same cell until it is overwritten by new data. In contrast the data stored in a sequential access memory moves continuously from cell to cell through the memory array.

Perhaps the easiest way to understand the operation of a sequential access memory is to visualise it as a kind of electronic equivalent to a conveyor belt or escalator along which a number of packages are travelling. In an electronic memory each of these packages will represent the data for one of the characters to be displayed in the page of text.

Suppose we go along to the input end of our imaginary conveyor belt to see what goes on there. At this end a man stands by the belt and loads the packages on to it. As one parcel moves along the belt the man selects the next one and places it on the end of the belt. After a while we shall have a line of these packages spaced out along the belt as illustrated in Fig. 26.

Assuming that our man places the packages on the belt at a constant rate they will be spaced out at equal distances along the belt. The first of the parcels placed on the belt will be furthest away from the starting point and the other parcels will follow it in the same sequence that they were originally placed on to the belt.

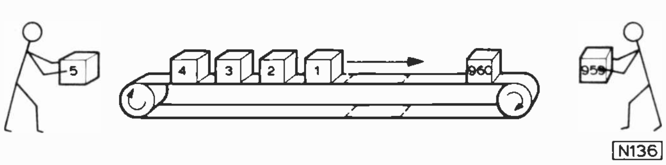


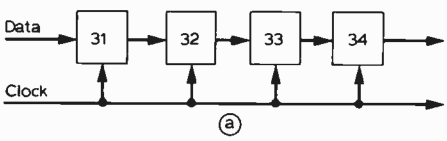
Fig. 26: The conveyor belt analogue of a sequential access memory. Each package represents one character.

If the conveyor belt is sufficiently long it will be possible to have perhaps 1,000 parcels travelling along it at the same time. A page of teletext information contains 960 characters. If each character is represented by one of the packages on the belt then it would be possible to have the equivalent of a whole page of data travelling along the belt at one time. Whilst the parcels are travelling along the belt they are effectively being stored, since at some later time they will arrive at the far end of the belt and become available for use again. If, therefore, we have an electronic equivalent of this conveyor belt it would act as an effective page memory.

What happens at the far end of the belt? Some time after they were placed on to the belt the packages will arrive in sequence at the far end. Here we might find another man who takes the parcels off as they arrive and who then stacks them neatly into a large pile. In the electronic system this would be equivalent to the retrieval of the data from the store and its use to build up the page display.

Shift registers

What would an electronic equivalent to a conveyor belt consist of? Usually the system would make use of large shift register type devices. We have already met the shift register which was used in converting the received data from its serial form into a set of parallel data signals on the main data bus which feeds the rest of the decoder system. For this a relatively short shift register which has only eight stages is used. A large sequential access memory suitable for use as a page store would use much longer registers with perhaps 1,024 stages in a single package. Only the input and output stages of the register need be brought out to connection pins on the device and often the individual stages of the register might have a simpler circuit arrangement.



Cell	30	31	32	33	34
Before	0	1.	0	1	0
After	–	0	1	1	1

ⓑ N137

Fig. 27: (a) A small part of the shift register. (b) The error introduced in the data in cell 33 due to its slowness in accepting new data.

Basically the shift register consists of an array of memory cells somewhat similar to those used in a random access memory device. In our random access memory the cells were arranged in a matrix, and each individual cell could be coupled to either input or output by applying an appropriate address code. In a shift register, on the other hand, the cells are arranged to form a long chain with the output from one cell driving the input of the next cell in the chain. When a clock pulse is applied simultaneously to all of the cells in the chain the data transfers from cell to cell so that, after the clock pulse, the data pattern in the chain has moved along by one cell position and a new piece of data has been written into the first cell of the chain. As successive clock pulses are applied the data is moved steadily along the register as if it were travelling along a conveyor belt.

In the shift register there is no longer any need for address inputs to the cells and this results in a great reduction in the amount of interconnecting wiring on the chip, so producing a simpler and smaller chip. Since there are no address inputs the number of leads on the package is also reduced. Apart from the power supplies and a clock signal the only other lead wires required are for the data input and output. As a result it is possible to produce a 1,024-stage shift register in an 8-pin DIL package.

Shift registers, like random access memories, can be designed for either static or dynamic operation according to the structure of the individual storage cells used to make up the device. As with the random access memory the static type device is more convenient to use because the data remains stored indefinitely between clock pulses. In a dynamic shift register the signal stored in the cells slowly leaks away and after a time some of the data may be lost unless a further clock pulse is applied. When a clock pulse is applied the data moves along the register and at the same time is effectively refreshed. To prevent loss of data the clock pulses must be applied at regular intervals and for typical devices a minimum clock rate of some 50 to 100 pulses per second is needed. This requirement need not present any major problems in a teletext memory system.

Timing errors

One of the problems that can arise with very long shift registers is that the timing of the data transfer operation becomes critical when simple cells like those used in random access memories are employed. Because of different wiring path lengths on the silicon chip the clock signal may not arrive at all of the cells at the same time. In addition the cells themselves may vary slightly in the time they take to react to the clock pulse.

Let us look at a small section of a long shift register as shown in Fig. 27(a). Suppose that cell 33 is slower than the others when accepting data. When the clock pulse occurs data transfers from cell 31 to cell 32 and also from 33 to 34. Due to its slowness however cell 33 does not accept its data from cell 32 until that cell has been overwritten. As a result cell 33 now takes up the new state of cell 32 and the data originally held in 32 is lost. Fig. 27(b) shows the state of the data signals before and after the transfer operation.

Because of this faulty transfer action some of the data stored in the memory may be lost and other data duplicated as the pattern travels along the register. Often this effect is cumulative and in a short time the data becomes completely corrupt and useless.

Master-Slave operation

To overcome these timing problems a technique known as Master-Slave operation is generally used. Each stage of the register will now consist of two cells, known respectively as the master and the slave. A section of such a register is shown in Fig. 28. In each stage the master cell is driven from the output of the previous stage whilst its output is used to drive its slave cell. All of the master cells in the chain are fed by one clock 01, and the slaves are driven by a second clock 02.

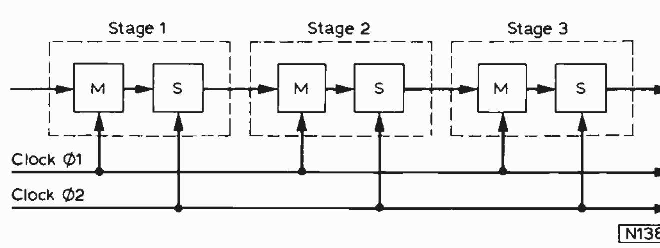


Fig. 28: Arrangement of cells in a Master-Slave register. A phase difference exists between the two clock signals.

The actual transfer operation is carried out in two steps. Firstly clock pulse 01 is applied to the master cells and these take up the data state of the previous stage in the chain. After this first step is complete the clock 02 is applied to the slave cells and these take up the state of their own master cells. At the end of this second step the data pattern will have effectively moved along the shift register by one stage. With this two-step action the data is held in either the master or slave cell until the next cell in the chain is ready to accept it.

Most modern shift registers use this technique. Often the two clock signals 01 and 02 are generated on the chip itself so that only one clock input need be applied to the device. The transfer 01 may be carried out on, say, the 0 to 1 transition of the input clock whilst the second part of the transfer occurs on the 1 to 0 transition. Older devices may need a two-phase input clock for correct operation.

Recirculation

Let us take another look at our conveyor belt system. It can be seen that when the packages reach the far end of the belt they are either removed by the man working there or they fall off the end of the belt. In either case the data they represent is effectively lost from the memory.

At intervals of about 25 seconds, the selected page of data is received as a short burst of signals. In the meantime the display on the screen has to be scanned several hundred times and for each scan the page of data must be read out from the page memory. If the data is lost when it reaches the end of the shift register the system is not likely to be very successful. Some arrangement is needed to ensure that after data has reached the end of the register and been displayed it will automatically be put back into the start of the register so that there will be data available for the next scan of the display.

Suppose we bend the path of our conveyor belt so that it forms a circle as shown in Fig. 29. This arrangement is something like the luggage carousel used to deliver the passengers' luggage at an airport. The end of our belt is now alongside the start so that packages arriving at the end of the belt can be rapidly transferred to the starting point and sent off on another circuit around the track. Once our page of data has been loaded into the memory it can be left to travel around the circle indefinitely. Data can now be picked off to produce the display and then replaced to make another circuit before the next display scan.

The way that this recirculation process is built into an electronic memory is shown in Fig. 30. A changeover gate system is used at the input to the memory register with one input of the gate being fed from the far end of the register.

To write the page of data into the memory the Write input is set to 1. This causes gate G3 to open and, because of the inverter G1 the path through gate G2 is closed. An OR gate G4 is used to accept data from either G2 or G3 and pass it to the input of the memory register. With Write at 1 therefore, data from the input is passed via gates G3 and G4 and into the memory register, where it passes along the register until a complete page is stored.

Once the complete page is held in the register the Write input can be set to 0. Now gate G3 closes, cutting off the input signals, and gate G2 opens to connect the data from the far end of the shift register back into its input. Now the page of data will circulate around the memory register indefinitely unless the Write input is again set to 1.

Data taken from the output of the shift register can be used to build up the display and at the end of each scan the first character of the page will arrive back at the end of the register ready for the start of the next scan.

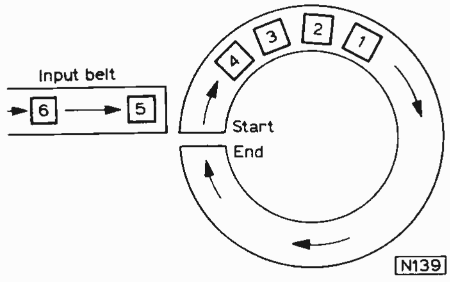


Fig. 29: The luggage carousel analogue of the recirculating shift register.

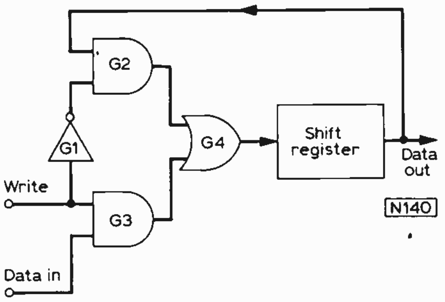


Fig. 30: Logic arrangement to allow recirculation of data.

Most of the large shift registers likely to be useful for making up a page memory have the recirculation circuits built into the chip. An external control signal is used to make the register load or recirculate as required.

Memory control

Since there are seven bits in the data word for each character of the text a practical page memory needs seven shift registers, one for each data bit. All seven shift registers are driven by the same clock signal so that the bits of each data word move along the memory registers in synchronism.

One problem which arises with a shift register memory, where there is no direct addressing system, is that of keeping track of the position of the data along the memory. This can be solved by adding an eighth register which is used to provide a control track. This extra register is driven by the same clock as the data registers so that the control signal moves along in synchronism with the data.

When the first character of a new page is loaded into the memory a 1 is loaded into the control register. After this all other data words are accompanied by a 0 in the control register. Now there will be a single 1 bit travelling around the control register to indicate the position of the first data word of the page stored.

Currently available shift registers suitable for use in a page memory have 512, 1024 or 2048 stages which means that the length of the register does not match the 960-word length of a teletext page. Suppose we use a 1024-bit shift register for the memory. When the complete 960 data words for the page have been loaded the first word will still be 64 stages short of the end of the register. In order to be able to read the data the word must be shifted to the end of the register so another 64 clock pulses must be applied. The easiest way to do this is to keep the clock running into the register until the 1 in the control track is detected at the output of the register. At this point the data is ready to be read out for the display operation. After each display scan the same operation can be carried out to get the first word of data back to the output of the register ready for the next reading operation.

Available devices

RAMs

Having seen how RAM or shift register devices can be used for the page memory let us review some of these devices that are currently available.

There are two popular random access memories which were originally developed by the Intel Corporation and are now being produced by a number of other manufacturers as well. First we have the 1103 which is a 1024-bit dynamic type memory in an 18-pin DIL-type package. This unit is also made by Signetics, National Semiconductor and ITT. Intel also produce an improved version known as the

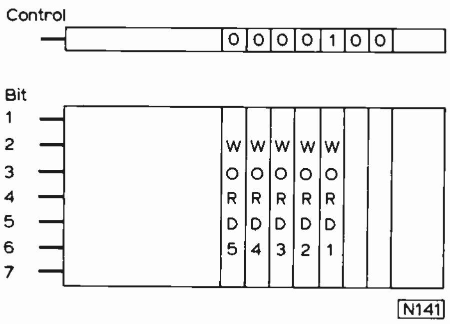


Fig. 31: Use of a control track to identify the position of Word 1 in a shift register.

1103A which is a direct replacement but does not require a Precharge signal. The price of 1103 devices is about £7 each.

The second industry standard type, popular with the computer equipment makers, is the Intel 2102 which is a 1024-bit static RAM contained in a 16-pin DIL package. It has the advantage of requiring a single +5 volt supply and matches directly into 74 series TTL circuits. National, Fairchild and ITT also produce the 2102 whilst the Signetics 2602 and Texas TMS4033 are direct equivalent types. Because of its popularity the 2102 is relatively cheap at some £3·00 to £3·50 each for the standard version in a plastic package. There are high speed versions also available but the standard 1μs version is adequate for use in a teletext memory.

Shift registers

For shift register memories the most convenient device is likely to be the Signetics 2533 or one of its equivalent types such as the Texas TMS3133 or the faster Fairchild 3355. These are 1024-bit static shift registers with recirculate logic built into the chip. They come in 8-lead DIL cases and need +5V and −12V supplies. Once again the output can be coupled directly to TTL devices. The cost varies between about £4·00 and £7·00 depending upon the particular type.

All of the devices described use MOS (Metal-Oxide-Silicon) type technology which employs field effect transistors on the chip instead of the bipolar types used for TTL type logic devices. In general MOS devices are slower than the TTL types but require much less power which is a great advantage when there may be 2000 to 3000 transistors on the chip. The inputs on MOS devices can exhibit very high impedance and are sometimes prone to damage by static electric charges. Most current devices like the 2102 have built-in protection against static but it is still a wise precaution to handle the devices with some care.

There are many other types of RAM and shift register devices which could be used but most are faster than is needed for teletext and hence more expensive.

Suppliers

Intel type devices can be obtained from Rapid Recall Ltd., 9 Betterton St., London WC2H 9BS. Signetics and Texas Instruments devices are obtainable from S. D. S. Components Ltd., Hilsea Industrial Estate, Portsmouth, Hants and National Semiconductor types are available from Jermyn Industries, Vestry Estate, Sevenoaks, Kent.

Now that the data has been stored in the page memory the next stage is to produce the display on the television screen. Next month we shall see how the characters are generated for the display.

THE PHILIPS VCR

continued from page 37

Playback mode

As we have seen earlier in the series, the servo reference in the playback mode is mains frequency, and the head drum servo locks directly to this reference once it has been processed and divided by two. Fig. 18 shows the block diagram of the machine in the playback mode; the head drum servo should need no explanation.

The capstan servo is again very similar to the arrangement used in the record mode apart from the fact that the feedback signal is delayed by TS465 and TS466. This provides a method of accurately phasing the position of the tape so that the video head is scanning through the centre of the recorded information. The capstan servo feedback signal is of course the picture frequency control track.

When both of the servos are locked in the playback mode the feedback pulse from the head drum is coincident with the mains reference, causing the video head to start its scan of the tape. The capstan has positioned the tape so that the control track pulse from the tape is again coincident with the mains reference, and hence the control track pulse is also coincident with the beginning of the head scan across the tape. In the record mode this was the point at which the field sync information was recorded, so it can be seen that the servo has in fact reproduced the exact conditions that were present during the recording of the material.

Conclusion

The purpose behind this series of articles has been to give the reader a basic idea of the problems and techniques used in the low-cost range of video tape recorders. Special attention has been paid to the VCR because it combines all the basic theory, together with some of the more unusual techniques, in one machine; and as the reader is more likely to meet this particular machine than any of the others, it seemed the most logical choice for a more detailed examination.

Videotape recording is at the moment a large and rapidly expanding field of electronics which is just beginning to make an impact on the domestic market. In the future it is going to make an even bigger impression. Digital techniques have many applications in the VTR, and it must surely be just a matter of time before the domestic machine makes use of these. One aspect has to be sorted out before very long however, and that is the tape format and recording standards that are going to be used. Personally I think this is going to be a much bigger problem than any other in the future development of the domestic videotape recorder.

SAFETY NOTE

In a recent service bulletin issued by Combined Electronic Services Ltd., the Philips service organisation, warning was given of a possible fault condition on early N1500 VCRs.

Routine tests have shown that there is a danger of the right-hand timer spindle (Set Recording Time) becoming live, due to a fault in the timer motor.

All recorders with serial numbers below 76,000 should be checked for this fault, using a flash tester with an output of greater than 2000V a.c. Multimeters or "Megger" type insulation testers are not adequate to carry out this test.

Each C.E.S. service depot is equipped with a suitable flash tester and can carry out the necessary tests.

LONG-DISTANCE TELEVISION

ROGER BUNNEY

Not many days after writing the last column, news that I'm sure will produce a chill in many a DXer's heart came in: the Italian TV service RAI is to adopt the PAL system – and has already been seen using the PM5544 test pattern! The first news came from Ian Beckett (Buckingham) who noted the pattern floating over the conventional monoscope card (number 23, from Mt. Cammarata). Shortly after word came from Hugh Cocks (Devon) that he had seen the pattern, again on channel IA. Then a new reader, Kevin Jackson (Leeds), reported that he had managed to obtain a clear photograph – which we are reproducing with this column – of the pattern: the identification RAI can be clearly seen at the bottom.

James Burton Stewart (Buckingham) sent us a report on the situation in Italy. The Inter-ministerial Economic Planning committee (CIPE) decided in favour of the PAL system rather than SECAM on August 1st. The original recommendation had been made last April, but the government has taken till now to reach a formal decision. There is no official date so far for the start of colour programme transmissions, but the expected date is September 30th 1976. During the long years of debate in Italy on the merits of the two systems both France and West Germany exerted economic and political pressure to choose SECAM and PAL respectively.

Whilst considering this part of the globe, Tele Monte Carlo, after a period of testing with the PM5540 pattern, has now started test transmissions using the PM5544 – with identification "Tele Monte Carlo".

Reception conditions

Due to the amount of news and comment this month I am having to condense my report on conditions to a brief summary. There were excellent Sporadic E openings until the middle of August, when conditions seemed to terminate abruptly. Until the 16th there were SpE signals from most parts of Europe – the USSR, Scandinavia and Italy in particular. RUV (Iceland) ch. E4 put in a welcome appearance on the 12th. The prolonged hot weather lifted Tropospheric conditions, resulting in several West German u.h.f. stations being received here and also, at the start of the month, a new one for me, Schoten (BRT) on ch. E62. MS was also more active at the beginning of the month, with a peak around the 11–14th. From the 17th to the time of writing most DX signal propagation modes seem to have died!

News Items

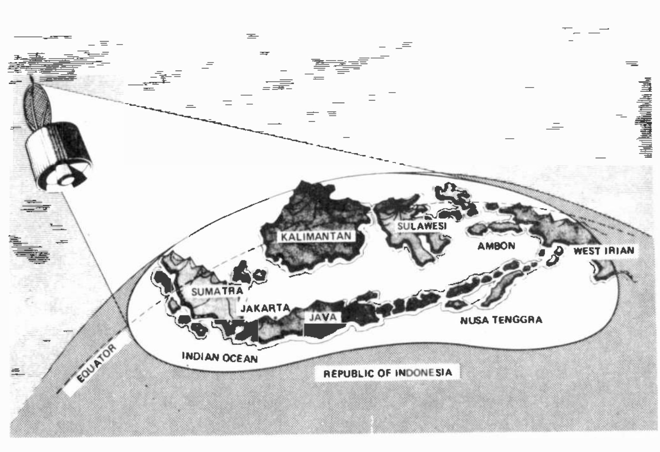
Italy: The Italian government has decided to legalise the pirate relay TV transmitters sited around the countryside relaying foreign TV broadcasts. These relay stations operate at upwards of 250MHz: special converters are available so that the signals can be received on normal Italian sets. The transmitters are to be moved to the h.f. end of Band V. Michael Dolci reports good signals from one of the first to open up in his area, operating at 810MHz. At a tangent, Michele also reports that a number of "free f.m. stations" are being operated from hillside sites. The Bergamo transmitter operates at 103MHz, with good modulation. Other stations operating between 102-103MHz include Milano, Paruie, Brexia, Palermo and Cetamio. F.M. DXers take note!

France: From September 1st, French first chain services will be available in colour from third chain transmitters when there is no third chain programme. The v.h.f. first chain transmitters will remain in operation of course with their 819-line monochrome transmissions. The first of the u.h.f. first chain transmitters will come into operation on January 1st, in the Paris area.

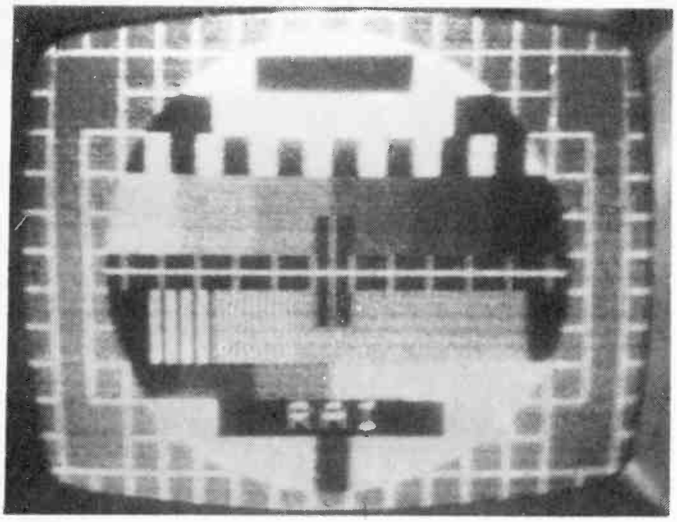
West Germany: A network to provide TV programmes for UK servicemen in W. Germany is being established. Initially, a selection of BBC and ITV programmes will be recorded in London by LWT and the tapes flown out for broadcasting over a new u.h.f. transmitter network. Eventually a programme source centre will be established in London, operated by LWT, providing direct onward transmission of programmes to W. Germany. Test transmissions in W. Germany are already being made from the Celle transmitter. It is expected that by 1978 the British Army on the Rhine will have a single colour TV channel with programmes selected from the BBC and ITV networks. The material will be sent via Swingate (Dover) to Roetgen in N. Germany. A further link operation will then feed 50 low-power u.h.f. transmitters (Marconi) serving all UK service personnel. Marconi are at present studying the possibility of using either a Tropospheric scatter system or a microwave link chain for the Dover-Roetgen path.

Indonesia: Pye TVT is to install ten new transmitters, upgrade five regional studios and provide additional radio link equipment giving network coverage of the Indonesian Archipelago via a new satellite system. The network is expected to come on air next November (1976). All regional stations will have equipment to process the incoming satellite feed of network programme material in addition to comprehensive facilities for local programme production.

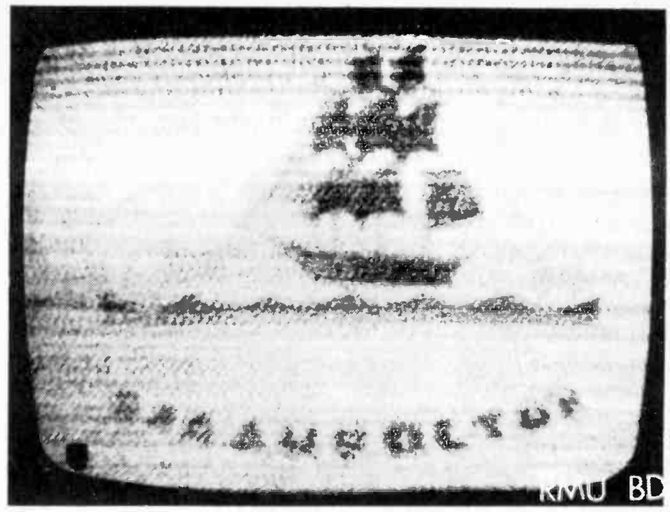
India: The ATS-F satellite should by now be in position at 35° East, the test programme completed and programme transmissions started. According to the EBU, programme times are 0330-0630 and 1130-1530 GMT, on 860MHz. The satellite



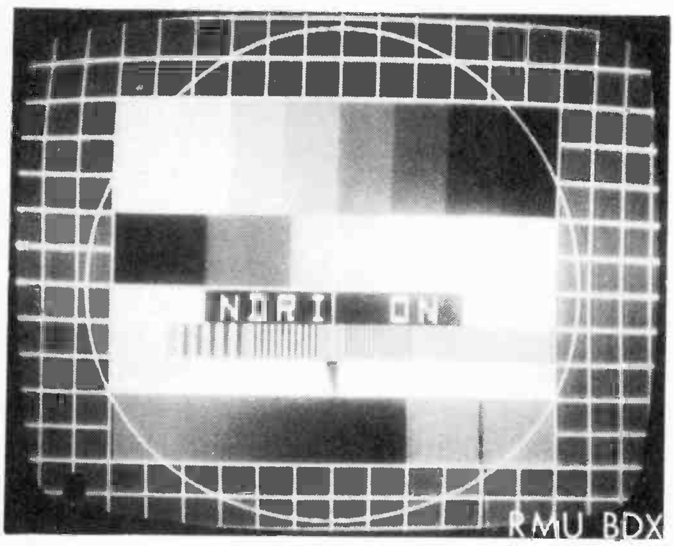
Coverage area of the projected Indonesian Satellite.
(courtesy International Broadcast Engineer)



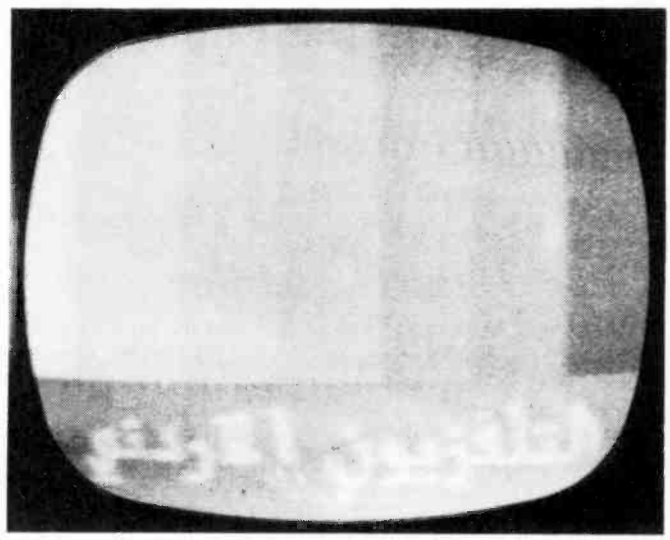
The new PM5544 card as used over RAI, ch. IA. Photograph by Kevin Jackson.



The Vladivostok ch. R1 caption received at 1900 CET by Ryn Muntjewerff.



New identification for the NDR-1 chain. Photo courtesy Ryn Muntjewerff.



Jordan Television ch. E3 received in Holland at 1555 CET on June 10th. Photo courtesy Peter Vaarkamp.

has an 80W transmitter on board: this feeds a 9m parabolic array with a gain of 33dB, giving an e.r.p. of 160kW along the main axis of the beam – this has a beamwidth between –3dB points of 2·8° and is aimed at the town of Nagpur. F.M. video modulation is used. The EBU expect that signals from the satellite will be received in Europe, and NASA has agreed to provide five minutes of unmodulated carrier transmission for test purposes and measurements. This is the first use of satellite transmissions in a broadcast TV band.

Hungary: Hetesi Laszlo tells us that there is a new transmitter mast in operation at Budapest, on ch. R1. A photograph showing the new structure alongside the much lower old one is included this month.

Professional DX-TV

The latest edition of the *EBU Technical Review* gives an interesting insight into the way in which the excellent Tropospheric conditions experienced in the Mediterranean can be exploited professionally. At present there is no permanent microwave link for television use between Cyprus and the European mainland and consequently no normal method of live programme insertion into the CBC programme schedules. A 10kW transmitter operating on ch. E9 with vertical polarisation has been built on the Island of Rhodes some 280 miles north west of Mt. Olympus, Cyprus, however. As a result of the prevailing conditions, the signal tends to be of low level during the winter months but rises to very high levels during the summer. Unfortunately there is also a ch. E9 transmitter at Beirut, some 160 miles to the south east, and for much of the time this also produces high-level signals.

Two receiving sites on Cyprus have been commissioned, one at the Mt. Olympus transmitter site, some 2000m high, and the other at Diorios, this one being only some 300m high. Initially, two eleven-element Yagi aerials with a gain of 15dB were used, but these have been replaced by four corner reflector types with greatly improved front/back ratios. A commercial preamplifier is used and the signal is then fed into a professional off-air receiver.

It has been found that the higher site gives a stronger signal but with considerable interference from the Beirut transmitter. When the interference is excessive the signal is taken from Diorios instead, this site being screened. At times the signal from the lower site is stronger than that from the higher site. Both signals are microwave linked back to the main studio centre, where signal selection is made.

Band III SpE

In the latest WTFDA bulletin there are photographs of some quite incredible Band III SpE DX–TV reception. Glen Hauser of Enid, Oklahoma logged WJCT-TV7, WFLA-TV8, WJHG-TV7, WFTV-TV9, WTVT-TV13 and possibles WVAN-TV9 and

WFSU-TV11 on June 30th. The shots show mainly clear but noisy signals, with no evidence of ghosting or other multipath effects. The distances were all around 1,020-1,090 miles. Bob Seybold also noted Band III SpE, Dunkirk NY KOAM-TV7 on June 16th.

Photographs

Most DX-TV enthusiasts hurry their films to the local chemist for printing, only to find on receipt of the prints that the reproduction is mediocre. A frequent complaint is that the screen content is "burnt out", i.e. over-exposed. The reason is that commercial printing is done on a mass production basis and the printing machine takes into account the average brightness of the whole negative area (not unlike mean-level a.g.c.!). With TV pictures there is usually a screen surround section that is completely black: the machine exposes for this as well, resulting in over-exposed screen information.

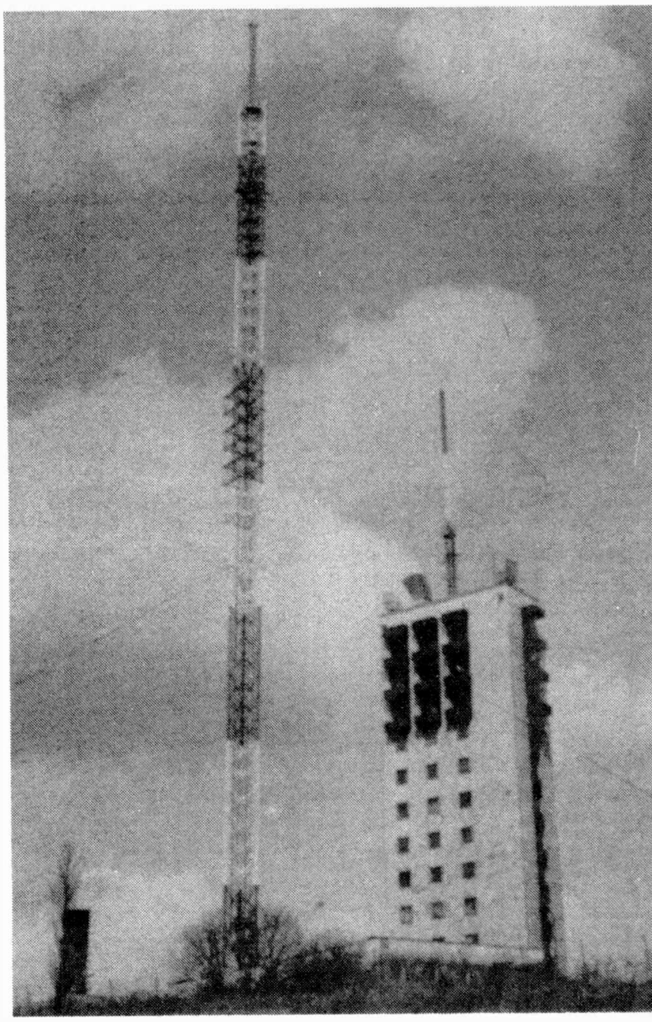
The end of this problem now seems to be in sight. Graham Harrison of 24 Oxford Road, Hollington, St. Leonards-on-Sea, Sussex, has offered to process and print black and white film for DX-TV enthusiasts. The scale of charges – somewhat below normal retail prices – is set out below. Graham is an experienced DXer and will obviously be aware of the exposure required. This will be done individually by hand, not by machine. We hope enthusiasts will avail themselves of this offer.

Contact prints are 3p each; enprints 6p each; $4\frac{3}{4}\times6\frac{1}{2}$ prints 10p each; $6\frac{1}{2}\times8\frac{1}{2}$ prints 17p each; 10×8 prints 25p each. Post and packing is 25p.

TV Receiver Developments

Some more news from the US following our comments last month. We understand that one US setmaker, Zenith, is using a surface-wave i.f. filter system in the models it has introduced this year.

Another development completely eliminates the need for a field hold control. A count-down system develops field sync pulses by dividing the line sync pulses. The system is already being used in several US sets, with the removal of any sign of the familiar field hold control – and of the field oscillator stage itself! Information kindly supplied by the WTFDA, USA.



The new transmitting mast for Budapest ch. R1 towers above the old mast.

From Our Correspondents . . .

Much of the information we publish in the column each month is passed on to us by readers both in the UK and overseas. Without this feedback of information the column would be much more sparse and DX enthusiasts much less the wiser. So we'd like to thank all those who have sent in news items and at the same time ask others who may have news, however insignificant it may seem, to let us know. Sometimes this enables us to predict an event before it occurs!

Peter Vaarkamp (Holland) has sent in a lengthy report this month. He comments that the CS U 01 Czechoslovakian electronic test pattern is known as the EZO pattern: Bratislava carries the identifications 02-KA; 1.TV; CST 61, while the ch. R5 Poprad transmitter relays both the PM5544 and the EZO patterns with identifications 05-KH; HPS-MD; CST-61. Hungarian test transmission times are 0900-1300 on Tuesdays, Thursdays and Fridays and 0900-1200 on Wednesdays and at the weekend. Programmes start at 1700 on all days. Swiss TV is now starting test transmissions later, at 1000, in order to reduce costs. NOS (Holland) is considering increasing the height of the Markelo transmitting mast in order to improve the coverage in parts of Holland. A welcome development in W. Germany is the inclusion of the station identification on the Fubk pattern – up till now only the network or other basic information has been given. So far however only two stations have been seen carrying their own identification – Wendelstein and Dillberg. The Harz ch. E10 transmitter has been noted with the identification "NDR 1 ON" on the Fubk pattern: the significance of "ON" is not known at present. Finally, Peter has sent a shot showing a colour bar pattern with Arabic writing across the bottom received in Holland by T. V. Dalen: the signal, via SpE on ch. E3, is from Jordan Television. The writing translates as Radio 18 Television. The shot is shown this month and is excellent reception indeed.

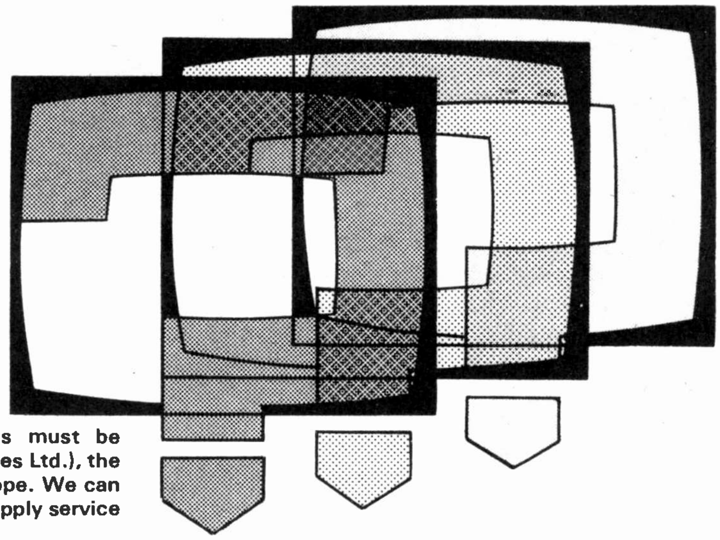
James Burton Stewart tells us that the IBA Black Mountain transmitter (ch. B9) is radiating the PM5544 test pattern: this is due to the Ulster control room being unmanned, control being via Caldbeck in the Borders. The PM5544 generator has been installed and the policy seems to be to reduce the number of UK control rooms still further. Will test card F eventually give way to the PM5544?

Hugh Cocks has received another truly exotic signal on channel E2, with French speech. Initially there was a line sawtooth, followed by a caption "Comme Ca" and then coloured people dancing. Since a signal with French speech has been noted before by others I suspect a new transmitter in either Zaire or Gabon: we're investigating. The time was 1844-2000 on August 21st.

Garry Smith (Derby) has been very active with MS reception during the recent Perseids meteor shower. The most startling signal was TSS (USSR) ch. R6 on the 0249 card. Other signals received in Band III via MS were from Switzerland, RAI (Italy), NRK (Norway) and DFF (GDR).

M. Baloch (Libya) has reported a most unusual sighting. At the end of June he noted on ch. E5 a test card with the identification "Rediffusion" at the top and "London" at the bottom. This was followed by a studio picture. I suspect that this may have originated from Malta, since the Malta Broadcasting Service has links with the London based Rediffusion company. The present transmitter operates on ch. E10 but there was a long-term plan to establish a new transmitter (now built I understand) to transmit to Southern Italy. Maybe this was on test, relaying a local signal. Any ideas anyone?

Your PROBLEMS solved



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PHILIPS G19T213A

There are striations, about 1½in. wide, down the left-hand side of the screen. For the first half hour they are quite bright, then they fade quite a lot. The trouble started after the line output transformer was replaced. All line timebase valves, and the capacitors connected to the transformer tags, have been replaced and the voltages seem to be correct. The problem is present on both systems, and with a set-top or outdoor aerial.

The line linearity coil damping resistor R5015 (1kΩ, 1W) is connected between tags C and D of the line output transformer and is often omitted on transformer replacement. Check that it is present and in good condition. Other possibilities are that the new transformer is faulty, or that C2070 which feeds line flyback blanking pulses to the c.r.t. grid is leaky. (Philips 210 chassis.)

FERGUSON 3712

The original fault was sound but no picture. This was put right by fitting a new line output transistor panel complete with transistor and a new e.h.t. rectifier assembly. Now the fault is that about seven minutes after switching on the picture fails, the sound remaining o.k. Switch the set off for five minutes and on switching on again the picture returns, lasts for another seven minutes, and so on.

You don't say whether the raster disappears or whether the vision goes leaving a blank raster. If the latter is the case, check the video transistors VT104, VT107 and VT116 and the electrolytic coupler (C174) to the base of VT116. We feel it is more likely that the raster disappears however and that the line drive is intermittent. First make sure that plug/socket 20 is making good contact, then suspect the line driver transistor VT402 (MJE340), the line oscillator transistor VT403 (BC157) and the electrolytic capacitor C414 (10μF) which decouples the supply to VT403's emitter. If you have a 'scope and the manual, waveforms 10, 35 and 36 will immediately indicate the source of the trouble. (Thorn 8000 chassis.)

MURPHY V2417S

When this ex-rental set was bought it was discovered to have a PY800 boost diode instead of a PY88. This was immediately changed. More recently field jitter has started. At first this is only slight, at the bottom of the raster, but gets worse. After changing the PCL805 field timebase valve the fault clears, but returns after a few weeks. The focus is also not all it should be despite trying the different focus tappings.

The effect of fitting a PY800 instead of a PY88 would be to slightly increase the heater current. We doubt whether any harm will have been done. For the field timebase problem, replace the output pentode's cathode bias components (3R37 360Ω and 3C18 50μF), then if necessary the feedback capacitor 3C17 (0·015μF) connected to its anode, and its control grid coupling capacitor 3C15 (2,200pF). If the picture size is normal and no ballooning occurs when the brightness control is advanced (if it does, replace the DY802 e.h.t. rectifier, then suspect the line output transformer) the c.r.t. itself is probably responsible for the poor focus. (Rank A774 chassis.)

FERGUSON 3712

The fault in this set seems to be in the video amplifier/a.g.c. driver section. It appears on the picture as overshoot which varies considerably in intensity. The whites of the test card overshoot and shade out in various colours, and no adjustment to the presets produces a cure. The tuner and i.f. strip voltages are correct but the voltage at the emitter of the video emitter-follower is rather high at 20V – higher when first switched on – instead of about 12V.

A certain amount of streaking is common on these models, but only at high contrast and brightness settings. In view of the high voltage at VT107 emitter this transistor, its emitter load resistor R140 (1·2kΩ) and the a.g.c. transistor should be checked, the latter by substitution. Confirm that the full 180V is available to the RGB output transistors, then suspect the MC1327PQ integrated circuit (IC3). (Thorn 8000 chassis.)

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TELEVISION NOV. 1975

STELLA ST1100

This monochrome portable will operate normally for a random period ranging from five minutes to over two hours and then appears to "die". On closer inspection there is a faint line whistle and very low sound, the HT1 rail being down from 11V to 4·3V. All semiconductor devices in the power supply circuit have been replaced. The 11V supply to the audio circuit has been removed without improvement. In the fault condition there is reduced HT2 current and reduced current flowing in the field output stage, but the line output stage current increases from 1A to 1·6A though nothing appears to be overheating. The line output transistor has been replaced without changing the situation and I now suspect the line output transformer. Incidentally, the voltages in the power supply regulator circuit differ from those given in the manual: for example the AD149 regulator transistor has 16V at its base instead of 12V, 16·2V at its emitter instead of 12·3V, though the collector voltage is correct at 11V.

The high regulator voltages should not cause concern – mains supply variations and tolerances in the power supply components are responsible. The essential voltage here, 11V at the output, is correct. Regarding the fault, it would seem that the line output stage is being loaded down. Try progressively unloading it by disconnecting in turn the line scan coils, the DY51 e.h.t. rectifier and the various diodes/rectifiers fed from taps on the line output transformer. If the HT1 line remains low when these checks are made the line output transformer could be developing short-circuit turns and require replacement. Before doing so however try another line output transistor and check C2097 (3,200μF). (Philips T-Vette Model 11TG190AT.)

DECCA CTV19

The picture on this set was restored by fitting a new line output transformer, but the following fault was found to be present – pulsating broad blue horizontal lines across the screen. Shortly after, this was followed by the picture going out of focus, then complete loss of brilliance. The horizontal lines and loss of brilliance suggested that the flyback blanking transistor in the cathode circuit of the PL802 luminance output pentode was the cause of the trouble, so this was replaced, partially restoring the brightness. On checking around the line output stage I then discovered that the focus control had burnt out. This was replaced, but the new control started to smoke when advanced, stopping when turned back. The slider of the control is connected to the TV6·5 focus rectifier diode via a 270pF capacitor (C416) which seems to be satisfactory.

It would be advisable to replace the 270pF capacitor – leakage is often not detectable on an ohmmeter test. The focus rectifier can also result in the focus control burning. Again, substitution is the only reliable check.

HMV 2659

There is intermittent high-frequency instability of the picture brightness on BBC-1 (405 lines). ITV is o.k. Also there is an occasional high-frequency horizontal shimmer or shudder on both 405-line pictures.

Note the effect of the brightness control on the fault. If turning this up makes the fault worse, change the e.h.t. rectifier tray. If increasing the brightness has no effect on the pulling, etc., check the 6F28 video output valve's bias stabilising resistor R38 (39kΩ). (Thorn 1400 chassis.)

BUSH TV85

This set suffers from lack of height – there is a 2in space at the top and bottom of the test card. The height can be increased so that the raster fills the screen, but the picture is then tall. Also BBC only is available on the push-buttons – adjustment will not bring in ITV.

Check the PCL82 field timebase valve, the 100μF decoupling electrolytic connected from pin 2 (cathode) to chassis and the 0·1μF coupling capacitor wired via a 1kΩ resistor to pin 3.

For the other fault examine the tuner mechanism. You will see that the buttons not only operate the tuning slug but also the slide selector which selects Band I or Band III. It is possible that the return spring has broken.

KB CK500

The colour on this set is excellent. There is however the following fault. It is impossible to advance the contrast control for normal contrast without the picture blurring. If the contrast is reduced to minimum there is a sharp but "gutless" picture. With correct contrast, subtitles – for example football results – blur badly.

There is a 4·7MΩ resistor at each end of the focus v.d.r. (R429h and R431h). Check these – they often increase in value to cause the symptoms you describe. Also check the 2·2MΩ resistor (R276h) which feeds the focus voltage to pin 9 of the c.r.t.

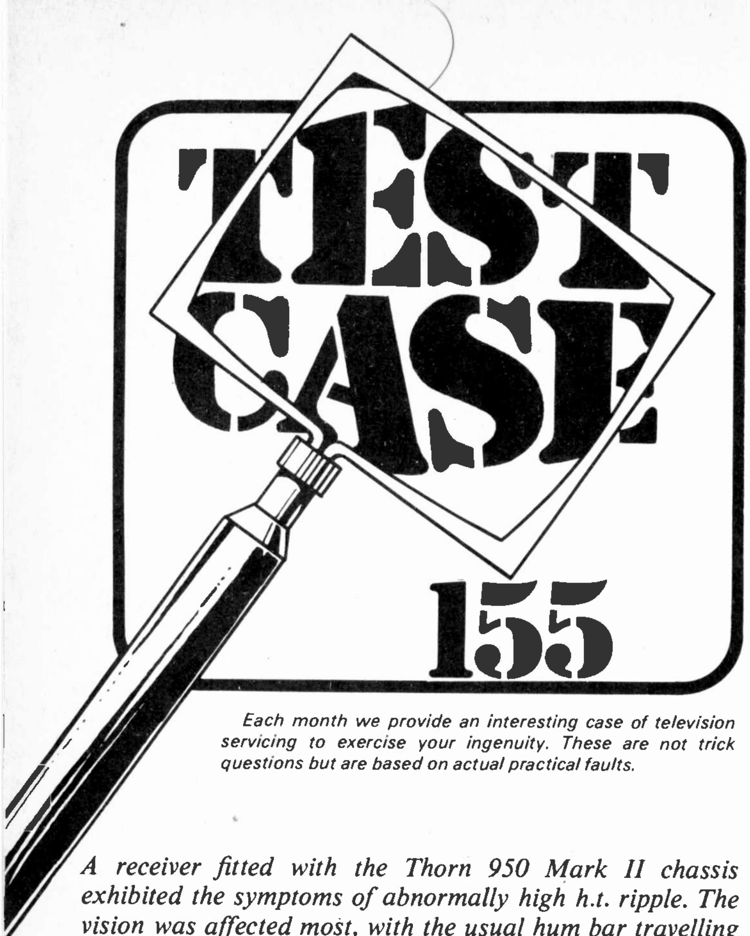
If necessary, adjust the beam current limiter preset control (R144d). To do this it is first necessary to remove either the aerial socket or the tuner. Then turn the brightness and contrast controls to minimum and measure the voltage at the cathode (pin 9) of the PL509 line output valve (TP27). Finally turn the contrast control to maximum and the brightness control to mid travel and adjust R144d until the voltage at TP27 is 0·95V higher than the previous reading. This should be done with the set displaying a test card.

The c.r.t. could be getting slightly soft, though we wouldn't have thought this likely on a set of this age. (ITT CVC5 chassis.)

INVICTA 7039

The sound is o.k. but there is no raster due to absence of e.h.t. All the line timebase valves (PCL84, PL36, PY800, DY87) have been tested by substitution, and a new boost capacitor and line output transformer fitted. The line whistle is very low. If the scan coils are disconnected, the line whistle increases and a blue spark can be drawn from the glass of the DY87 e.h.t. rectifier though its heater doesn't glow. On two occasions it was possible to get a picture, but the fault returned. The heater voltages are badly down at the PCL84 and the c.r.t. Other voltages are reasonable.

The thing to do is to discover why the PCL84's heater voltage is low (should be 15V). As this is the line oscillator (triode section) there will be little line drive and therefore no e.h.t. if the valve is being under-run. Since the pentode section of this valve provides the audio output however it is difficult to see how the sound can be completely in order should the valve be badly under-run. The PCL84 and c.r.t. are the final heaters in the chain, the supply to the PCL84 coming from the u.h.f. tuner to tag 32 on the printed panel. There could well be a low-resistance path to chassis on the tuner itself – or through one of the valves in the tuner. We assume that the other heater voltages are more or less correct – otherwise check the heater dropper circuit. (Pye 11U series.)



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

A receiver fitted with the Thorn 950 Mark II chassis exhibited the symptoms of abnormally high h.t. ripple. The vision was affected most, with the usual hum bar travelling down the screen and bent verticals, and also a very mild hum from the loudspeaker. Since this symptom is usually produced by an open-circuit or dried up electrolytic capacitor, the reservoir/smoothing electrolytics were shunted in turn with a known good capacitor. When the test capacitor was bridged across either element of the dual unit the hum was completely cured, both on picture and sound.

The chassis was then given over to the junior technician for replacement of the dual unit (C112/C113). After replacement and the usual chassis dust and clean-up the receiver was reconnected to the mains for final adjustments prior to return to the customer. The set warmed up normally, but to the amazement of both the junior and senior technician the symptoms were exactly as before – mild hum on sound and hum bars on the picture.

Again the bridging test with a known good capacitor was tried; and again the symptoms disappeared! The possibility of the replacement electrolytic being defective was feasible, the junior technician being convinced that this could be the only answer. Not so said the senior technician who, with long years of taming electrons, had experienced paradoxes equally as curious. While the junior was obtaining the same symptoms with a second hooked-in replacement, the senior technician unearthed an old capacitor bridge and proved that the original unit was well up to value on both sides.

The oscilloscope was then brought into service, with the Y input switched to a.c. and the Y amplifier set to full gain. The peak-to-peak hum voltage across both electrolytics was displayed and found to be exactly the same. After a quick glance at the circuit diagram the senior technician went straight to a component, made one simple resistance check and proclaimed the mystery solved.

What clue did the technician obtain from the oscilloscope test, and what component was most likely to be at fault? See next month's Television *for the solution and for a further item in the* Test Case *series.*

SOLUTION TO TEST CASE 154 (Page 603 last month)

The mild non-linearity of the line scan, resulting in compression at the right-hand side of the screen, was caused by phasing error in the flywheel line sync circuit. Some earlier sets using flywheel sync often suffered from horizontal picture shift when the phasing was in error, and when an attempt was made to centre the picture by using the shift magnets to shift the whole raster one edge of the picture would cut off.

The symptom under discussion was similar, but the somewhat different circuitry resulted in mild non-linearity rather than a definite vertical edge cut off. The circuit is shown in Fig. 1, the arrangement being quite commonly encountered in sets of continental origin – a similar circuit is used in the ITT CVC5/7/8/9 series and also earlier Rank 90° colour models however. The sync pulses are fed to the junction of the two series connected discriminator diodes while anti-phase flyback pulses are integrated and applied to the opposite ends of the diodes. The main change from normal practice however is in the filter/load arrangement, which gives a wider pull-in range.

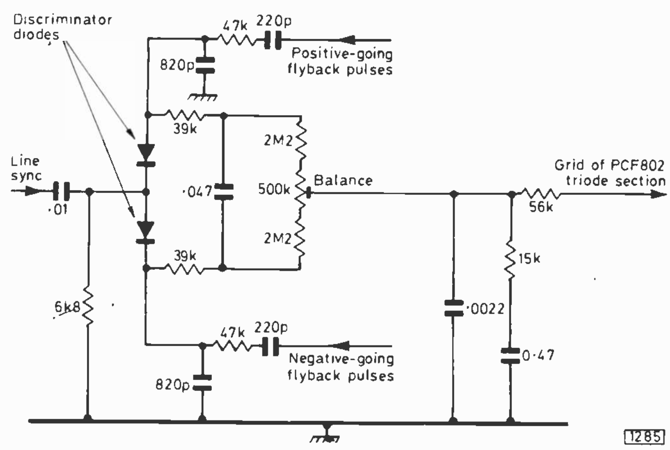


Fig. 1: Flywheel sync circuit used in the Grundig Models R500E/GB, T2002E/GB and P2002E/GB.

The technician was presented with a good clue when he found that the preset balance control had no influence when adjusted in accordance with the manual instructions, i.e. with the sync pulse input shorted out. The circuit is effectively a bridge, the diodes forming two arms and the resistor chain the other two arms. Since the diodes were found to be o.k., the fault was most likely to be due to one of the resistors changing value. On checking, it was discovered that one of the 2·2MΩ resistors had increased in value to over 20MΩ. Replacement cleared the phase error and enabled the circuit to be set up correctly.

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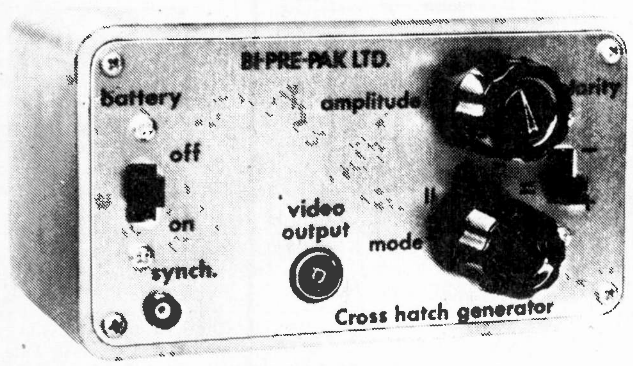

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