SERVICING·VIDEO·CONSTRUCTION·COLOUR·DEVELOPMENTS

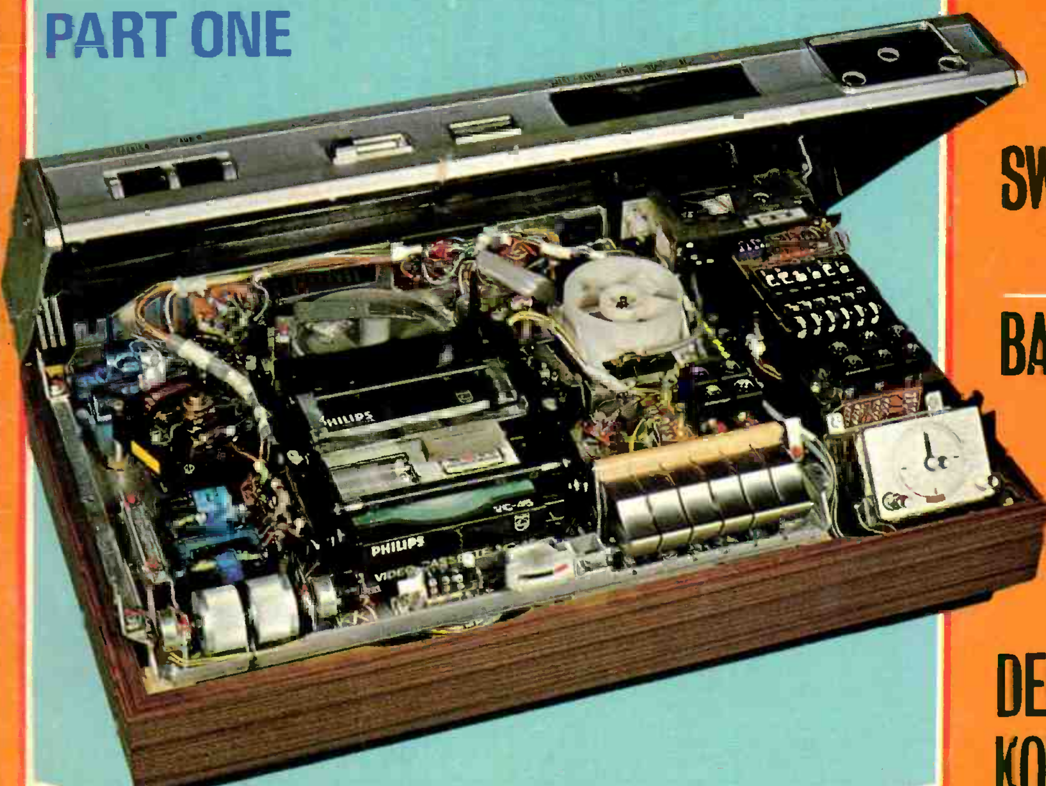
Television

OCTOBER 1975

40p

INSIDE THE PHILIPS VIDEO CASSETTE RECORDER

PART ONE



also:

SWITCH-MODE TV POWER SUPPLIES

BASIC TRANSISTOR LINE OUTPUT STAGE OPERATION

Servicing:

DECCA DR1 SERIES; KORTING COLOUR SETS

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
MC 1327PQ	1.01
MC1330P	0.76
MC1351P	0.75
MC1352P	0.82
MC 1358PQ	1.85
MC1496L	0.87
MC3051P	0.58
MFC 4000B	0.43
MFC 4060A	0.70
MFC6040	0.91
NE555	0.72
NE556	1.34
PA263	1.90
SL414A	1.91
SL901B	3.84
SL917B	5.12
SN 76001N	1.45
SN 76003N	2.92
SN 76013N	1.95
SN76013 ND	1.72
SN 76023N	1.95
SN76023 ND	1.72
SN 76033N	2.92
SN 76227N	1.46
SN 76530P	1.05
SN 76533N	1.20
SN 76666N	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
TBA 560CQ	4.10
TBA570	1.17
TBA641	0.76
TBA673	2.28
TBA700	2.59
TBA720Q	2.45
TBA750Q	2.33
TBA800	1.75
TBA 810AS	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

TO-3	0.06
TO-66	0.06

VALVES

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

ZENER DIODES

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

VDR'S, PTC & NTC RESISTORS

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

RESISTORS

Carbon Film (5%)	ea
¼W 5.6 Ω-330k Ω (E12)	1.5p
⅓W 10 Ω-10M Ω (E24)	1.5p
1W 10 Ω-19M Ω (E12)	3p
2W 10 Ω-10M Ω (E6)	5p

WIREWOUND (5%)

2½W 0.22 Ω-270 Ω	15p ea
5W 10 Ω-8.2k Ω	13p ea
10W 10 Ω-25k Ω	18p ea

CAPACITORS

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

MASTHEAD AMPLIFIERS

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

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

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

PATTERN GENERATORS

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

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

COLOUR/BAR GENERATORS

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

VHF/UHF CONVERTERS

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

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

P. & P.: UK £0.12 per order.
Overseas: At cost.
Please add VAT at 25% on all items except test generators which are at 8%.
All prices subject to availability.
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Telex: 45457 (A/B Mercury Calgton)

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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Television

SERVICING
VIDEO
CONSTRUCTION
COLOUR
DEVELOPMENTS

VOL. 25
NO.12
ISSUE 300
OCTOBER
1975

this month

Due to pressure on space, we regret that the concluding part of the series Large Screen TV Oscilloscope has been held over until next month.

OUR NEXT ISSUE DATED NOVEMBER WILL BE PUBLISHED ON OCTOBER 20

TV'S AND SPARES TO THE TRADE
MONOCHROME TELEVISIONS

BBC 2 Dual Standard TV's (19", 23") in batches of 10 – £2.00 each. (makes include Bush, Thorn, Philips, Pye/Ekco, Baird). Many with transistorised tuners.
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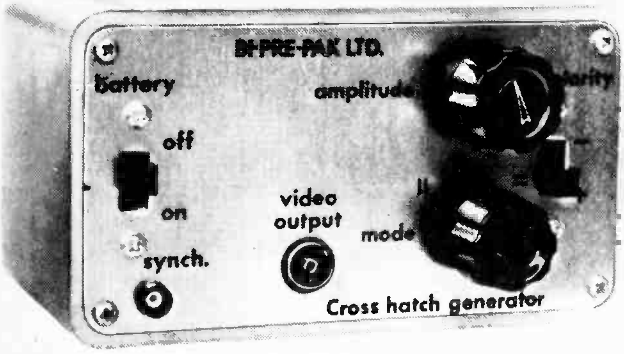

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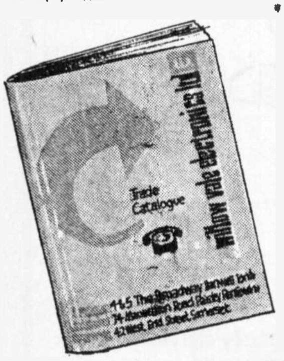

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SERVICING: THEN AND NOW

The TV receiver has always been a relatively elaborate piece of electronic equipment, certainly so far as domestic items are concerned. It has one great advantage however when it comes to fault-finding: it is a superb diagnostician of its own ailments. It sits there and tells you just what's wrong – no sound, no vision, no raster, lack of height or width, poor linearity or synchronisation, overloading, instability and so on. Simple! And so it generally was, with the possible exception of the line output stage which has always had a number of things to go wrong with it and tends to vary somewhat in circuit arrangement from make to make.

In addition, the valves stood there either shining more or less than they should or not at all, proclaiming further where next to look for the fault. All this made servicing a fairly simple matter, though there was always the odd difficult one due to an obscure capacitor, an unsuspected dry-joint or maybe a switch or valveholder that wasn't behaving correctly. Most of the time however you could go straight to the trouble spot after a brief examination.

We are talking about what once was the case! Major changes over the years have increasingly altered the situation. First came the printed circuit board, which made component replacement more tricky and gave rise to obscure track faults. Engineers soon got used to dealing with them however. Next came transistors. They don't glow, so you have to spend more time, taking voltage and resistance measurements, to find what is – or isn't – up. But again servicemen soon got the hang of things.

At about this time however diagnosis began to become more of a problem. The business of powering the transistors from a rectifier fed from a winding on the line output stage was introduced. Thus failure of the line output stage removed the signals as well and no sound or raster no longer meant a quick dive into the power supply.

Then in 1967 came colour, and most of us lost ours at the thought of what lay in store for us. Help was at hand however since again the set provided its own fault diagnosis. There was either more or less of one or another colour than there should be, or unlocked colour, a PAL switching defect or no colour at all. Fortunately these faults indicate what action is required and can usually be settled after checking a few voltages. We have been lucky that decoders have nearly all been fully solid-state, operating at low voltage, and thus highly reliable. Convergence problems also proclaim themselves and often show up on the panel in the form of a burnt out pot. Not too much to confuse us here then.

The next thing to come along was the integrated circuit, clinging to the board with its multitude of legs and hiding as best it can anything amiss. Once again it's a question of voltage readings, but there can be temperamental devices that won't yield until substituted, which is a rather involved procedure.

But wait a minute! We started off with the all valve, hand-wired monochrome set. Many such fellows are still around and worthy of attention when they fall to some illness. Gradually however the situation has changed. When we approach a set nowadays we can no longer tackle it with the certainties of yore. Now we first have to find out what species it is, then try to clear our minds to work out what we might have to expect. It means a continuous process of mental reorientation, and the need to keep in the back of our minds a vast store of basic TV receiver techniques. Not only UK ones either.

So although the TV set is still a fine diagnostician, the problems of deciding where to go once the symptoms have been assessed is no longer a simple matter. This makes life more interesting of course: it also makes it far more demanding and means that skill in servicing is becoming an ever more arduous business. And things are beginning to get a lot worse.

For one thing the number of different species of semiconductor devices lurking here and there in TV chassis is ever increasing. All have their own problems and some are decidedly difficult to check with any certainty save by substitution. The big change that is occurring however is in power supply arrangements. That once simplest of things is rapidly becoming the most complex. By now most service engineers tackle the simple series regulators used in mains-battery portables without too much head scratching. But how many are happy with chopper stabilised circuits, even though they've been around since 1967? In August we highlighted an even more complex system: Thorn's Syclops combined line output and regulated power supply circuit. There is no doubt that it will bring with it its own genre of faults and problems. This month we highlight (see *Switch-Mode Power Supplies*, page 587) some more novel power supply arrangements – including a blocking oscillator system and a pulse-width modulator. As these sorts of things become more common, life is going to get far more complex for the service engineer. A blown mains fuse will probably become the most difficult fault to trace!

We have been expected to take on more and more, with new devices and circuits appearing at an accelerating rate. The knowledge required to deal with all this is considerable indeed. There can be no doubt on the question as to whether the financial rewards are commensurate. Don't all shout at once!

teletopics

NOTHING BUT GLOOM

The economic troubles in the domestic electronics industry predicted at the time of the last budget, with its increase in the VAT rate on radio and television goods to 25%, are now setting in with a vengeance. A substantial recession in the industry and trade was, in view of the general economic situation, quite likely without any help from the chancellor. The swingeing VAT increase however has turned a trade downturn into something fast approaching a major crisis. So far as the trade is concerned we have had similar reports from every part of the UK: buyers and new renters have dwindled to insignificant numbers. On the manufacturing side Pye, Rank and Philips have each closed two plants, Decca have closed their Battersea colour television plant, GEC have cut production by 40% since last January whilst there has been one factory closure and layoffs elsewhere at Thorn. Even the servicing side, which often benefits when customers put off acquiring a new set, is suffering: BRW have cut their service staff by 25%, and there have been 225 redundancies at Loyds.

Worse if anything is the crisis in colour tube manufacturing (there isn't any monochrome tube production in the UK now). Pilkingtons, who produce glassware for Thorn tubes, are closing their plant – said to be the most modern of its type in Europe – for blowing tube glass, in turn seriously jeopardising Thorn's colour tube plant. Both these plants have been making substantial losses. Meanwhile the government seems to be taking an inordinate length of time to reach any conclusions about the trade's claims that Japanese colour tubes, imports of which have soared, are being dumped in the UK. Whatever the truth of this, one fact is certain. To be economic, modern colour tube plant has to operate at high production levels, and the runs must be large. These conditions cannot be met when the setmaking industry is in severe recession. The fact seems to be that there is excess colour tube plant throughout the world, and whilst the Japanese too have been suffering from recession nevertheless their total production levels have remained far higher than anyone else's.

The 1973 TV boom in the UK was engineered by the previous government's unwise (to put it mildly) tax/credit moves. It led to complaints that UK manufacturers were slow in gearing themselves up to supply the market, and an all out effort was made to increase production. The subsequent restrictions and tax increases have left setmakers with hardly a market at all – since April, UK colour receiver production has more than halved compared to 1974, and that was already well down on 1973. We've suffered many booms and slumps previously as a result of government stop-go economic policies, but never before has there been a slump of this severity. Present prospects offer no hope whatsoever of any improvement, and there are rumours that at least one major setmaker will pull out.

TELETEXT LATEST

The BBC's Director of Engineering James Redmond commented recently that "we in the BBC feel that refinement of the parameters of the transmitted Ceefax waveform is now complete". This follows extensive testing throughout the UK and on the continent, at both u.h.f. and v.h.f. A few minor modifications have been made to the original specification published in 1974, mainly to bring the coding system into line with international standards and with BS4953, and to increase the range of characters available.

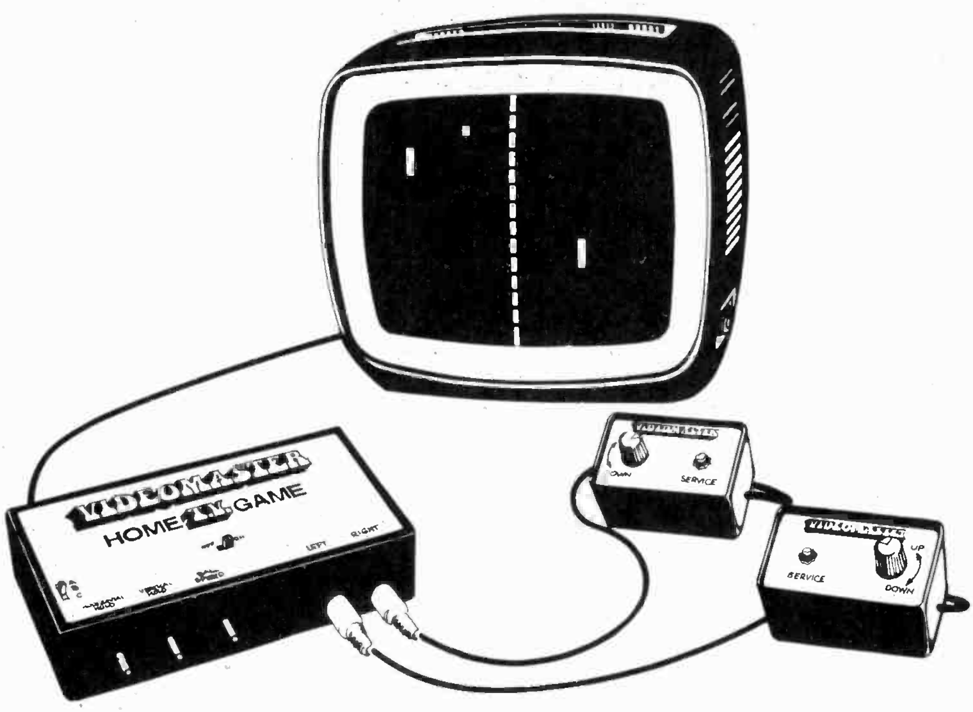
Now that Ceefax/Oracle has been fully tested in service and the specification virtually finalised a final decision can and should be made to go ahead with Teletext on a permanent basis. This is not a development that will call for any great expenditure: from the broadcast point of view it's a matter of a few tens of thousands of pounds. The receiver decoders are expensive at present, mainly because they are hand made and specialised i.c.s for the application are not yet available. The point is that having got this far there is valuable export potential: it would be a great loss to allow the technique, in which the UK is well ahead of others, to be taken up and exploited abroad.

VIDEO DISCS

News continues to trickle out on the various video disc systems under development, though their introduction on the market still seems some time away. In our last comment on the subject (August) we made a slip in suggesting that the RCA disc system used laser scanning. In fact the disc's groove is tracked by a special sapphire stylus with a built-in metal electrode which responds to capacitance changes. The playing time obtained from a 12in disc is half an hour.

SERVICE CHARGES

The RTRA has recently been conducting a survey into TV servicing charges – those actually made rather than those recommended. The replies are still being processed but preliminary results indicate that dealers are charging an



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average minimum of £4 excluding VAT for an outside call within five miles, £3 exclusive of VAT for making an estimate, whether accepted or not, and £4·50 an hour for work done in their workshops. The largest variation so far discovered is in the charges made for external calls: the lowest reported charge was £1·50 and the highest £7·50, both exclusive of VAT.

CHEAPER TV GAMES

It is understood that the price of TV games could fall substantially following the development of an integrated circuit specifically designed for this application. A price of about £20 for an eight-game unit, including tennis and football, has been suggested by The Television Sports Company. In addition to incorporating the logic circuitry required, the i.c. also provides sound effects, driving the loudspeaker directly. Games are expected to be available to the trade by the end of October, in time for the Christmas trade.

REPLACEMENT FOR THE DIAC

The BR100 diac used to trigger the thyristor in thyristor-stabilised power supply circuits has proved to be a somewhat troublesome device. One fault it commonly causes is intermittent field jitter. Rank are to replace it in their A823/AV chassis with a 4EX581 trigger diode to provide improved h.t. stability. The series current limiting resistor must be 47Ω instead of 10Ω when a 4EX581 is used. The device is already used elsewhere in this chassis – in the over-voltage protection circuit on the timebase panel. Since the same basic power supply circuit is used in the Philips G8, Pye 731 and GEC C2110 series solid-state chassis this change might be a useful dodge for service engineers to try.

BACKFIRE AERIAL FROM TELERECTION

An interesting new aerial is being added to the Telerection range (Telerection Products Ltd., Lynch Lane, Weymouth, Dorset DT4 9DP). This is a backfire type (see Fig. 1) and features very wide bandwidth with excellent gain. The principle of the backfire aerial was first put forward by H. W. Ehrenspeck in the early 1960s, and Telerection have the licence to produce this type of aerial in the UK. Basically the aerial consists of a large rear reflector and small front reflector, with the dipole sitting between the two. The two reflectors form a cavity resonator. The gain of the basic assembly is 13dB, and the bandwidth 450-900MHz: there is also an add-on director assembly – with seven directors – which increases the gain to 15dB. The price of the basic unit is expected to about £5·50. Telerection worked on developing and testing the aerial for eighteen months, and a balun is at present being designed to go with it. The aerial has been tested by rental organisations, and the makers say that the polar response makes it a particularly useful array where ghosting is experienced. With its wide bandwidth, its use with a rotator would enable a number of transmitters to be received in suitable locations.

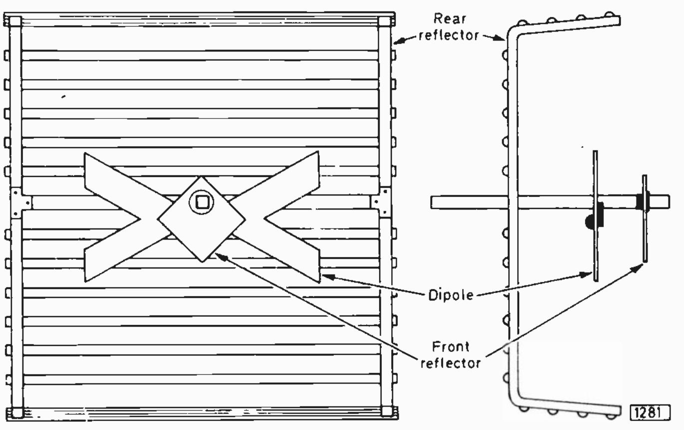


Fig. 1: Front (left) and side views of the Telerection backfire aerial. An add-on director chain is also available.

SETMAKERS INCREASE RETAIL INTERESTS

The two largest UK TV setmakers have been consolidating their positions by making fresh advances into the retail side. The latest news is that Thorn have bought the J. and F. Stone chain (about 150 shops) from Great Universal Stores. They already own the Rumbelows chain – which is established mainly in the North and Midlands, while the Stone chain is mainly in the South – in addition to their Radio Rentals, DER and Multibroadcast outlets. Earlier this year the Philips group took charge of the Loyds (previously Civic) chain of radio and TV shops.

FUSE CODING

If you've seen a fuse given a rating in say AT and wondered what on earth ampere-turns could have to do with fuses the answer is they haven't. A stands for Amperes of course, T for the German Träge, which means surge-resisting. Other ratings you will come across include AF, Ampere-Flink (quick-blow), and AMT, Ampere-Mittel-Träge (semi surge-resisting). This continental system is being increasingly used.

TRANSMITTER NEWS

The BBC has interchanged the channels used for BBC-1 and BBC-2 transmissions from its **Weardale** (Durham) relay station: in future BBC-1 will be on channel 44 and BBC-2 on channel 51.

The following relay stations are now in operation:

Bedlinog (South Wales) ITV channel 24 (HTV Wales programmes). Receiving aerial group A.

Belfast (Black Mountain) BBC-1 channel 39, BBC-2 channel 45, ITV channel 49 (Ulster Television programmes). Receiving aerial group B.

Bolehill (Derbyshire) BBC-1 channel 57, ITV channel 60 (ATV programmes), BBC-2 channel 63. Receiving aerial group C/D.

Innerleithen (Borders, Scotland) BBC-1 channel 58, ITV channel 61 (Border Television programmes), BBC-2 channel 64. Receiving aerial group C/D.

Llanelli (South Wales) BBC-Wales channel 39, BBC-2 channel 45. Receiving aerial group E.

Kilmacolm (Strathclyde) ITV channel 24 (Scottish Television programmes). Receiving aerial group A.

Ripponden (West Yorkshire) BBC-1 channel 58, ITV channel 61 (Yorkshire Television programmes), BBC-2 channel 64. Receiving aerial group C/D.

All these relay transmissions are vertically polarised.

ITALY ADOPTS PAL

After a ten year debate over which colour system to adopt, the Italian government has finally decided in favour of the PAL system. The date of the start of the colour service has not yet been announced however.

Korting

Colour Receivers: Fault Guide

John Coombes

AMONGST the various W. German colour chassis that have been marketed in the UK one of the most widely distributed is the Korting 90° chassis. This is a hybrid design using four valves in the timebases and, like most other W. German chassis, uses colour-difference c.r.t. drive, with transistor colour-difference output stages driving the c.r.t. grids. The more unusual technical features of the chassis were described in our July 1973 issue, in the *Colour Receiver Insight* series of articles. The UK agents for Korting are Europa Electronics Ltd., Howard Place, Shelton, Stoke-on-Trent ST1 4NW.

A TAA630 integrated circuit in the decoder takes care of chrominance signal demodulation, PAL switching, G −Y matrixing and colour-difference signal preamplification. Earlier versions used a TAA640 intercarrier sound i.c. followed by a four transistor audio amplifier. In later versions the intercarrier sound i.c. is either a TBA480 or TBA120S, while the audio channel consists of a TBA800 i.c.

Brightness Control Circuit

An unusual feature of the chassis is the brightness control arrangement. This acts on the c.r.t. grids by setting the clamping level in the colour-difference output stages. The control is connected between +250V and −280V lines, the former being obtained by rectifying the field flyback pulses and the latter by rectifying line flyback pulses. This can cause a misleading symptom since if the field timebase fails there will be no positive supply to the brightness control and the raster will be blacked out. The idea of the arrangement is to provide c.r.t. protection, i.e. no vertical white line if the field timebase fails. It is worth remembering however that absence of a raster can be due to a fault in the field timebase.

Chassis Arrangement

There are a number of printed panels and subassemblies and the simplest way of summarising faults is to deal with each in turn.

Tuner Unit

A six pushbutton v.h.f./u.h.f. tuner unit incorporating an AF106 i.f. preamplifier is used. This is ideal for extra gain in fringe areas. The common fault here is the AF239 r.f. amplifier transistor T3 going short-circuit or sometimes open-circuit. In either case the result on the screen is a very snowy picture.

Power Supply Faults

A common fault is no sound or picture due to one of the 3·15A mains fuses (see Fig. 1) having blown. The usual cause is that one of the mains filter capacitors C689 (0·22μF), C690 (0·1μF) or C691 (0·22μF) has gone short-circuit due to a transient spike on the mains. If these capacitors are found to be all right the cause of the blown fuse is almost certainly that the h.t. rectifier GL601 (type BY103) is short-circuit. This is mounted on panel N.

Also mounted on this panel is a 500mA fuse (Si4) which feeds the valve heaters (PY500A, PL509, PCF802, PCL805). On early models this fuse would blow for no apparent reason. On later versions the fuse was changed to an anti-surge type, stopping the trouble.

Field Timebase

A PCL805 is used for the field timebase circuit (see Fig. 2), the triode section of the valve being used as a blocking oscillator. Its anode is fed in the conventional manner from the boost rail. A tertiary winding on the field output transformer provides field flyback blanking pulses – these, along with the line flyback blanking pulses, are amplified by T302 (BF179C) on the blanking panel (A) and are then applied to the c.r.t. first anode circuitry. As already mentioned, the positive supply for the brightness control is obtained from the field output stage – from the anode of the pentode section of the PCL805 via the flyback pulse limiting v.d.r. (R345, type E299DE/P354) which rectifies the asymmetrical anode waveform, charging its reservoir capacitor C326 (0·33μF) to 250V.

Field Collapse

Field collapse can be caused by the valve itself of course but a common cause of this fault is an open-circuit resistor in the feed from the boost rail to the anode of the triode section of the PCL805 (where there should be 200V). The height control is fed via two series connected 330kΩ resistors (R314 and R315) both of which can go open-circuit. The slider of the 1MΩ height control R323 is connected via another 330kΩ resistor R322 to the primary winding of the blocking oscillator transformer. R322 can also be the cause of field collapse – sometimes this is intermittent. We have also encountered field collapse due to the primary winding of the blocking oscillator transformer going open-circuit.

Lack of Height with Top Expansion

Lack of height with top expansion has been traced to R334 (47kΩ) in the field linearity feedback circuit being open-circuit.

Preset Brightness Control

There is a preset brightness control (R361, 1MΩ) mounted on this board (G). The track can become dirty, blacking out the screen. When this occurs the main

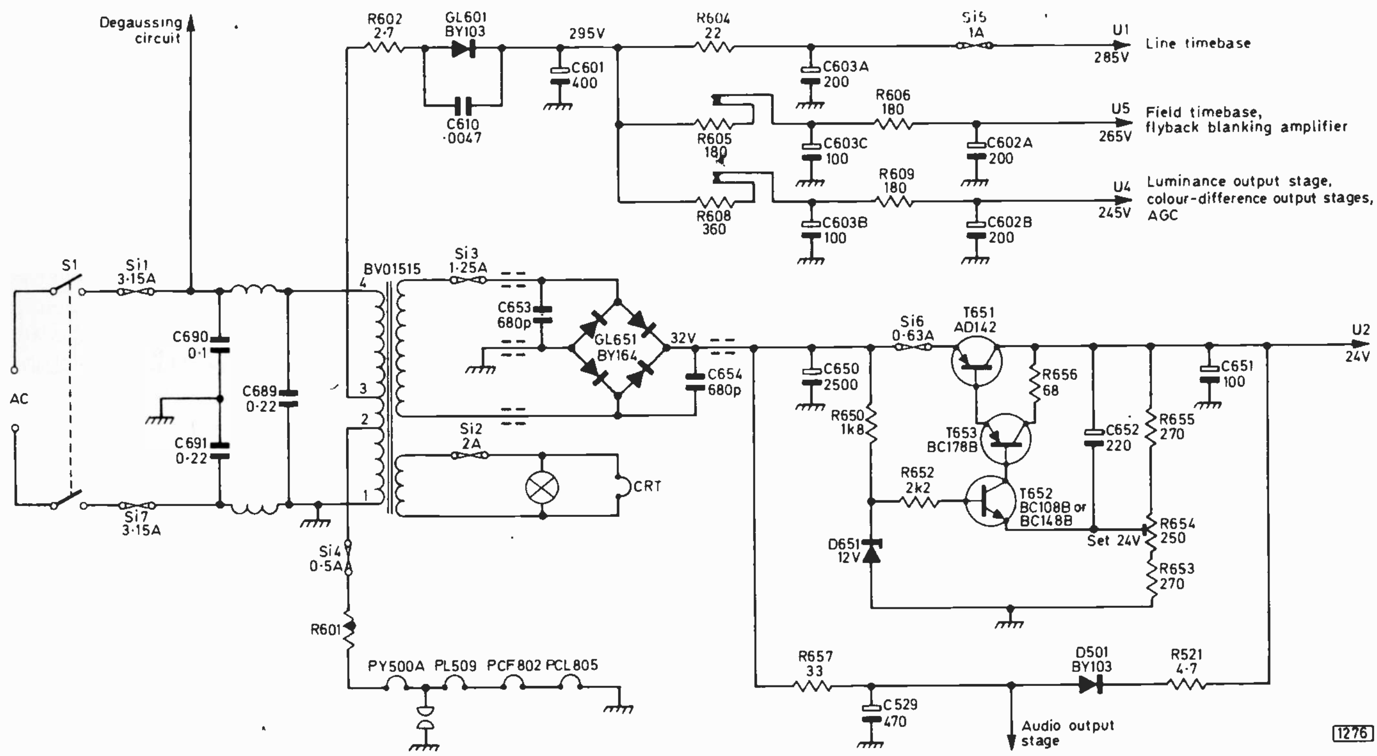


Fig. 1: Power supply circuits. D501 and R521 protect the audio output transistors.

brightness control cannot be advanced to produce screen illumination.

Line Timebase Panel

The line timebase (panel H) in this chassis is very reliable. There are one or two common faults however. The PCF802 (V401) can stop oscillating resulting in the usual overheating in the line output stage. Replacing the PCF802 usually cures this fault. It can however be due to short-circuit turns on the oscillator coil (BV04584). The PL509 (V402) line output valve and PY500A (V404) boost diode can suffer from low emission.

The h.t. supply for the line timebase goes via a link from pin 4 on the power supply panel to pin 5 on the line timebase panel. This suffers from dry-joints, resulting in loss of raster. The same situation arises when the line timebase h.t. supply fuse Si5 (1A) on the power supply panel has blown. The usual cause of this is a faulty PY500A.

The usual *RC* drive waveform shaping network is connected between the pentode anode of the PCF802 and chassis. The components are C419 (220pF) and R418 (33kΩ). The PL509 will have a very short life if C419 is leaky.

Note that there are some unusual features of the width/

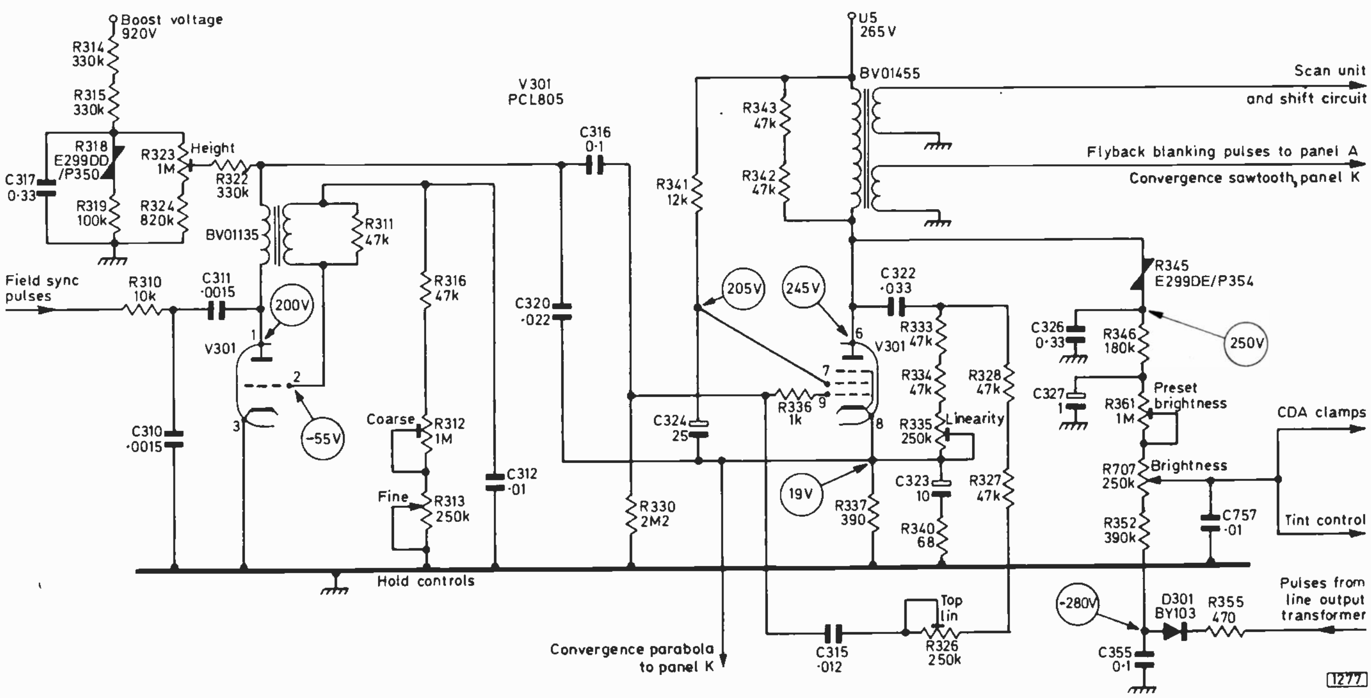


Fig. 2: Field timebase and brightness control circuits. In later production R324 is omitted and the blocking oscillator timing capacitor C312 is changed to 0.015μF.

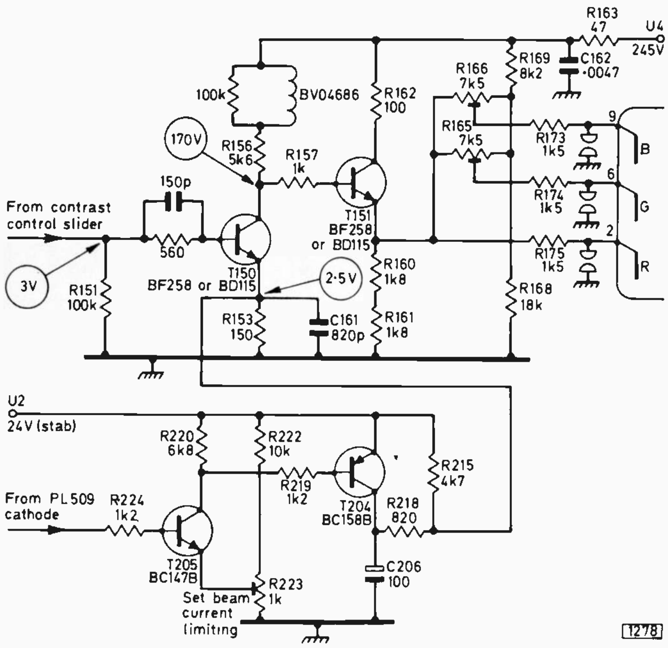


Fig. 3: The luminance output stage and beam limiter circuits. In later versions R165, R166, R168 and R169 are omitted and an AA117 diode is added between the base and emitter of T150, cathode to base; also C206 is changed to 220μF and a 100Ω resistor (R217) is added between the collector of T204 and the junction of C206/R218.

e.h.t. stabilisation circuit. Instead of being connected to chassis in the conventional manner the v.d.r. (R440) is connected to a point on the line output transformer where negative line flyback pulses are present. This gives a steep control action. There is also a second feedback control loop which compensates for very short duration e.h.t. load variations.

Beam Limiter Preset Control

The e.h.t. tripler can be damaged in several ways. One is incorrect adjustment of the beam limiter preset control R223 (1kΩ) which is on board Y. If the tripler is faulty at the end connected to the c.r.t., i.e. there is a breakdown of the insulation here, this is likely to be the case. The correct method of adjusting R223 is as follows. Advance the contrast and brightness controls to maximum, then reduce the setting of R223 until the last step of the grey-scale wedge is completely dark and the second form last wedge is just visible.

Focus Faults

The focus control network is fed from the tripler. A defocused picture should direct attention to the 33MΩ

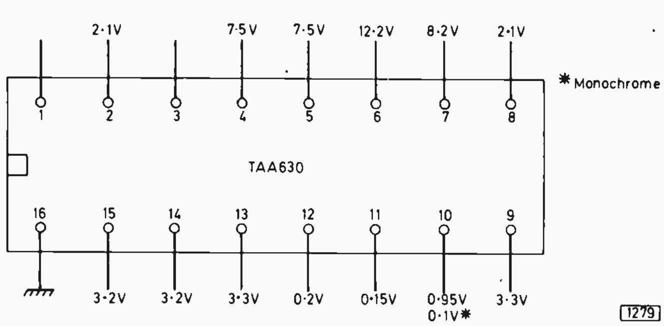


Fig. 4: D.C. voltages at the pins of the TAA630 i.c. in the decoder. Measured with a valve voltmeter and signal present.

resistor R437 between the tripler and the focus control. The trouble can also be due to the nut and lock-fit washer securing the focus control to the panel not making. Check this because it can result in the focus control (R436, 10MΩ) being ruined. The trouble sometimes does not show up until a week or so after a control has been replaced.

Luminance Output Stage

The luminance output stage (or video output stage as Korting prefer to call it) is mounted on the c.r.t. tube base panel (B). It is somewhat unusual (see Fig. 3) in that it consists of two transistors, T150 which develops the 130V peak-to-peak c.r.t. cathode drive signal, and the emitter-follower T151. It is common for these transistors to go open-circuit. This seems to be because of the way in which they are fitted to the printed board and heatsinks: they are fitted too tightly, so that when they heat up the expansion results in a break within the transistor. The more serious condition is when T151 goes open-circuit, since its emitter voltage is then low and the drive to the c.r.t. cathodes is at maximum. The same state of affairs arises when T150 goes short-circuit. The e.h.t. tripler can be ruined due to the excess c.r.t. current. C161 going short-circuit will have the same result since the working bias on T150 will be reduced and the beam limiter action rendered ineffective.

Beam Limiter Panel

The beam current limiter panel (Y) is important since as we have already mentioned if the preset control is misadjusted the tripler – also the c.r.t. – can be ruined. The beam limiting action takes place in the emitter circuit of the first luminance output transistor T150: excess beam current raises T150's emitter voltage, thus driving it towards cut off so that the c.r.t. drive is reduced. An incorrectly set beam limiter can result in the tripler going short-circuit due to the excessive load. Another result is the 47kΩ resistor in the c.r.t. final anode connection burning up. The c.r.t. can be ruined since if the set is left on too long in this condition the final anode seal breaks.

The two transistors in the beam limiter circuit, T204 (BC158B) and T205 (BC147B), also give trouble. A quick check is to adjust R223: if the transistors are faulty, the control will have no effect. Again, the tripler can be ruined.

Decoder Panel

On the decoder panel (F), no colour is a common fault. It can be caused by the TAA630 i.c. – check the voltages (see Fig. 4). The trouble can also be due to the capacitors in the reference oscillator (T737, BC107A) collector tuned circuit being leaky. These are C788 (100pF) and C787 (150pF). One can be misled however since no colour can be due simply to the colour-killer threshold control R876 (50kΩ) being incorrectly adjusted. The result may be no colour on all three u.h.f. channels or just one. The correct adjustment procedure is to remove the aerial and advance the control until red, green and blue dots are seen on the snowy picture: then turn the control anti-clockwise until the dots just disappear. This gives correct working colour.

The rather unusual ident stage consists of an *RC* oscillator (T748, BC147B). If the amplitude control (R883, 250Ω) in this stage is incorrectly set you can get green and purple pictures, i.e. incorrect ident. This is sometimes experienced when a new set is unboxed. ■

ULTRASONIC REMOTE CONTROL

PART 2

A. WILLCOX

IMPORTANT

See announcements at the conclusion of this article

THIS month we complete the circuit description with the transmitter unit, going on to describe construction and installation of the system in a television receiver. We conclude with suggestions on replacing a mechanical tuner by a varicap unit.

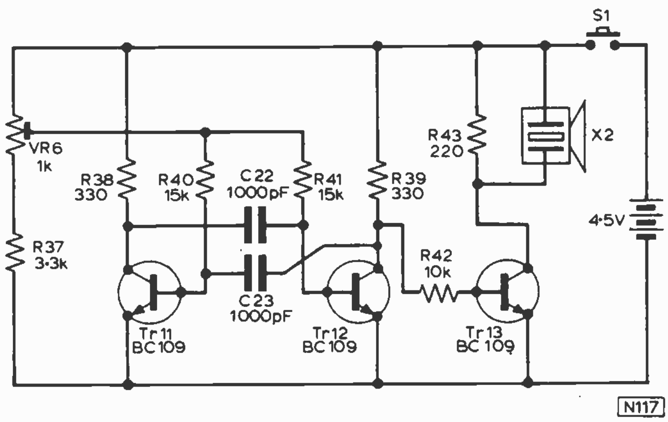


Fig. 4: Circuit of the hand-held transmitter unit.

The ultrasonic transmitter

The circuit is quite straightforward and is shown in Fig. 4. Transistors Tr11 and Tr12 form a multivibrator preset by VR6 to run at 40kHz. The squarewave output at Tr12 collector is fed to the output switch Tr13. The result is a squarewave applied to the transducer, and a continuous 40kHz sound signal emitted when the push switch S1 is depressed.

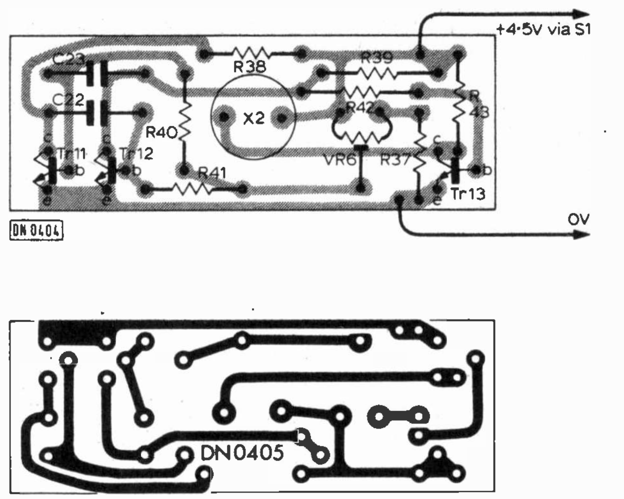
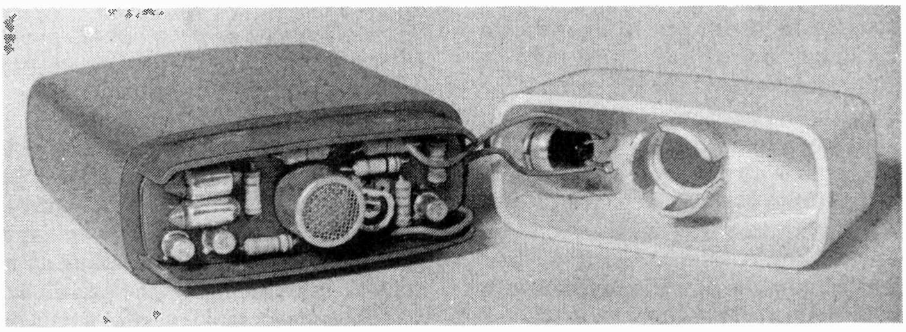


Fig. 5: P.C.B. design and component layout for the ultrasonic transmitter unit, both shown full size.

Transmitter construction

An Ever Ready pocket torch case is used to house the transmitter, after first removing the bulb-holder assembly and clear plastic lens. The 4½V flat battery intended for the torch is retained, but the connections to it are soldered, and the battery is inserted contacts downward into the case.

The corners of the printed circuit board, as shown in Fig. 5, must be suitably shaped so as to fit firmly in the case on top of the base of the battery. The top part of the case snaps on, with S1 mounted in place of the original slide switch, and the transducer occupying the space previously filled by the bulb and holder.



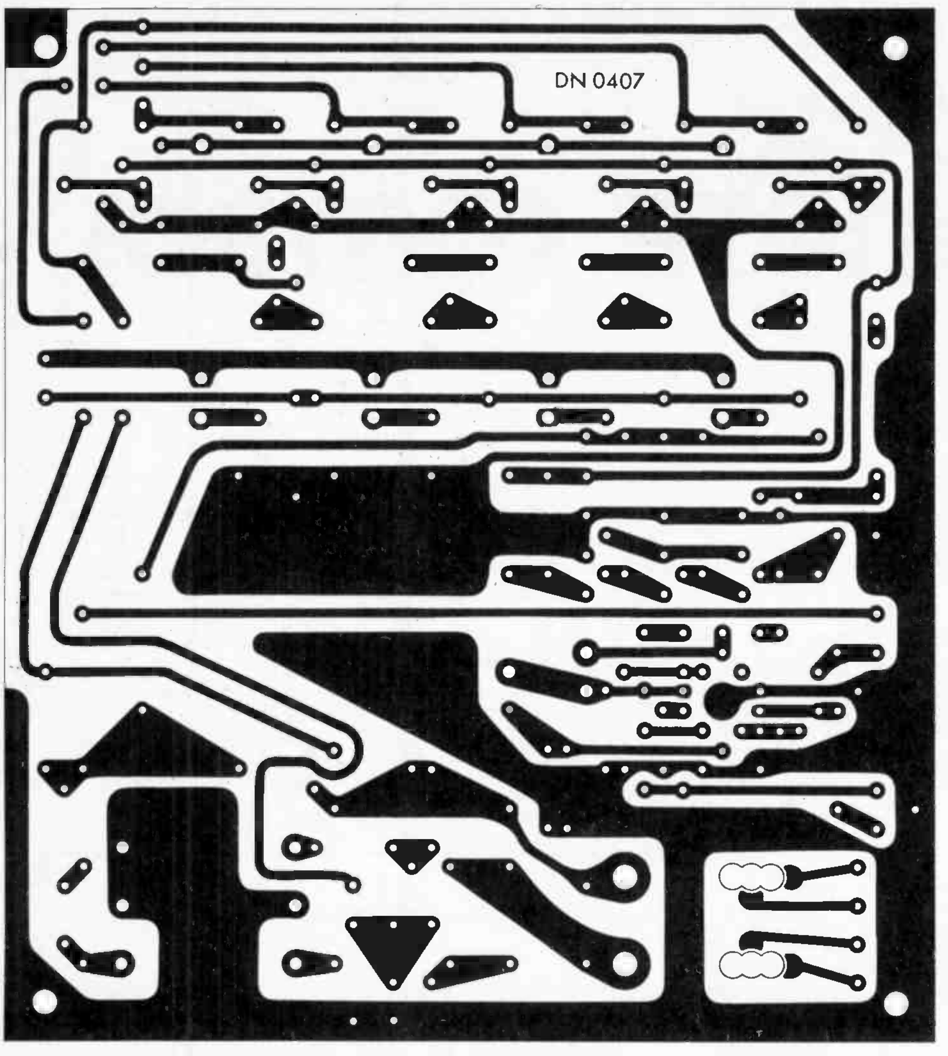


Fig. 6: The p.c.b. design (left) and component layout (right) for the Receiver/Control unit, both shown full size. For details of connections to the relay contacts, see text.

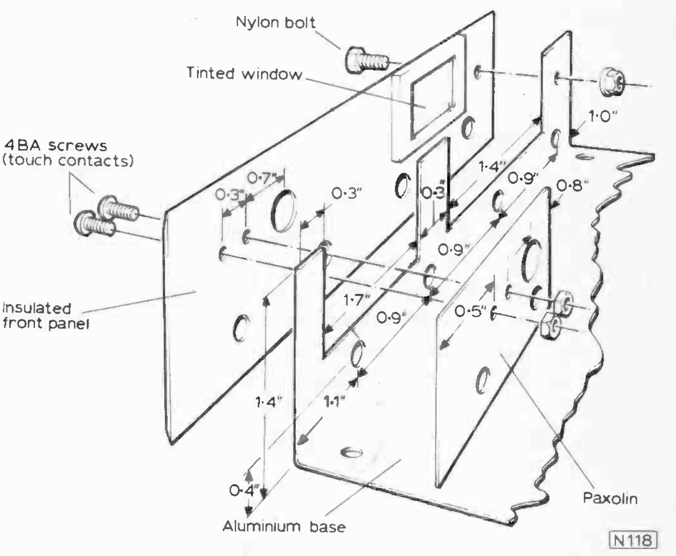


Fig. 7: Arrangement of front panel on the prototype Receiver/Control unit. The panel itself was made from material 3mm ($\frac{1}{8}$in) thick.

Receiver/control unit construction

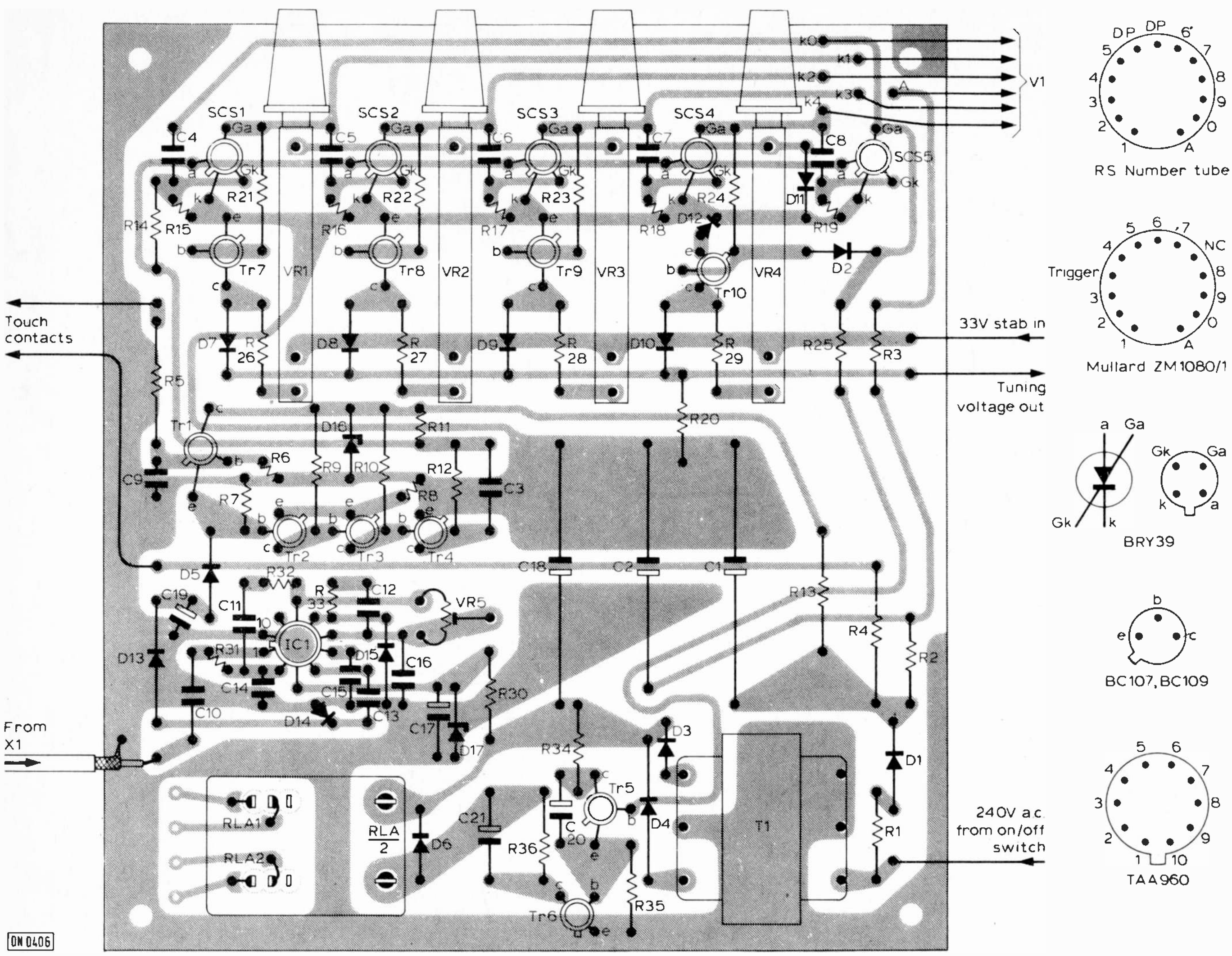
The printed circuit board design and component layout are shown in Fig. 6. Assembly is quite straightforward, the only component to watch being the mains transformer. This has its mounting lugs removed and is inserted upside down into the p.c.b. Care must be taken to install it correctly because, once fitted, the connection details are obscured.

In the prototype, the printed circuit board was mounted on short stand-offs on an aluminium base, shaped so as to accept an insulated front panel (see Fig. 7). The panel is secured by a nylon nut and bolt at one end, and by the 4BA touch contacts at the other. The aluminium must be cut away to allow a good clearance for the touch contacts, and also to provide a window for the number tube.

Installation in the Receiver

The aluminium base must be connected to the receiver chassis by a braid or heavy gauge wire, and the live connection to the receiver side of the set's on/off switch. The lead from the stabiliser i.c. on the tuner panel to the existing tuning potentiometers must be removed and rewired to the potentiometers on the printed circuit board. On some receivers a tuning range control is fitted between the i.c. and the potentiometers, and if this is retained it should be adjusted to near minimum resistance. A low resistance path is required here to avoid interaction between the potentiometers due to the change in load condition with their position.

If, when in use, a station is selected having a lower tuning voltage than that of the one already on, all of the isolating diodes will be reverse biased until the tuning reservoir capacitor discharges (via R20) to the new value. If the time constant here is long there will be an annoying lag between channel selection and the station actually appearing. A suitable value for this capacitor would be $0 \cdot 1\mu F$ to $0 \cdot 5\mu F$.



If the unit is to be installed in a colour receiver with an existing varicap tuner, a.f.c. will probably be incorporated. Under certain conditions the a.f.c. circuit can lock on to the sound carrier instead of the vision carrier. To avoid this some means of briefly shorting out the a.f.c., until the tuning voltage settles, is usually built into the push-button unit. Rank's solution to the problem is to reduce the a.f.c. holding range by means of a preset control, and this is the method best employed with the present unit. The Grundig range of colour receivers operates without any a.f.c. at all, but it must be admitted that this range is prone to tuner drift, and would benefit from a mild a.f.c. circuit.

Standby Connection

The method used to connect the relay contacts to the set will vary widely, depending on the particular receiver. If it is a conventional valve receiver one set of contacts could be used to switch the h.t. line, while the other contacts would switch the heaters. It is usual to run the heaters at a reduced current in the standby mode, in order to speed the warm-up time. If this is done, a dropper of suitable resistance and wattage should be installed in the set, and wired across the heater switch contacts. As a guide, a value similar in resistance and rating to that already existing in the heater line could be used.

In the case of a colour TV the c.r.t. heater will have its own supply and would need to be switched separately. A 2Ω 2·5W resistor left in series with the heater would reduce the current suitably for the standby mode. This arrangement is suited only to solid-state receivers because only two sets of contacts are available on the relay. If in any doubt regarding the c.r.t. heater winding (a mistake could prove expensive) it would be wiser to switch the live lead to the set complete, and tolerate a longer warm-up time. If any spark suppression capacitors are felt necessary they should be of 1000V working, and are best mounted elsewhere on a tag strip.

Sound Mute

Should the standby facility not be required, the relay contacts could be employed to mute the sound circuitry. Capacitor C20 could be omitted because a delay would no longer be necessary. Use in this way is less than ideal because sound mute would only be obtained with station No. 4's picture displayed (on No. 0). Assuming sound muting would most often be required during the commercial breaks or 'New Faces', station No. 4 would be most usefully tuned to ITV! When the sound needs to be returned the channels can be flipped through back to the required station.

Transmitter setting up

The preset control VR6 in the transmitter is adjusted for maximum output from the receiver transducer as measured

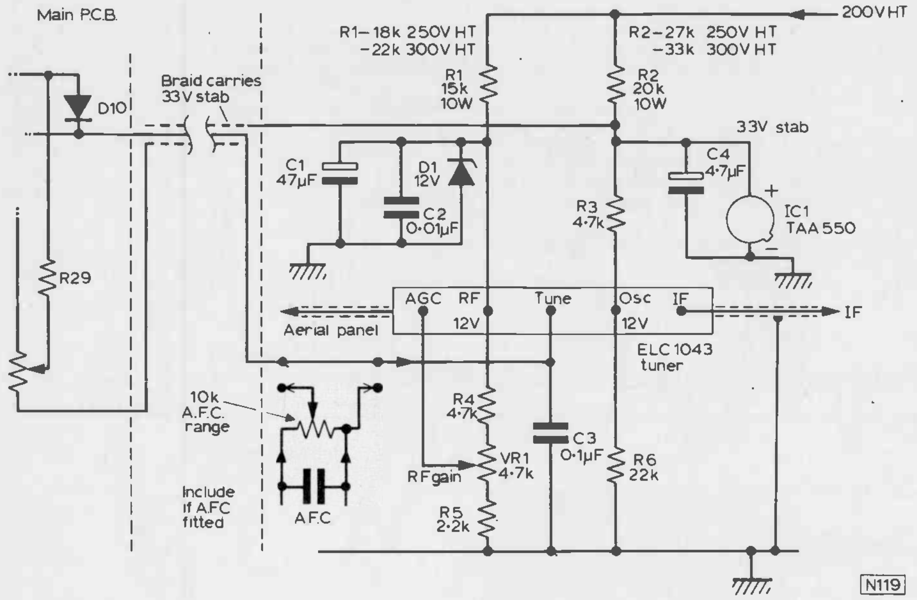


Fig. 8: Suggested circuit for using a varicap tuner in place of a mechanical tuner.

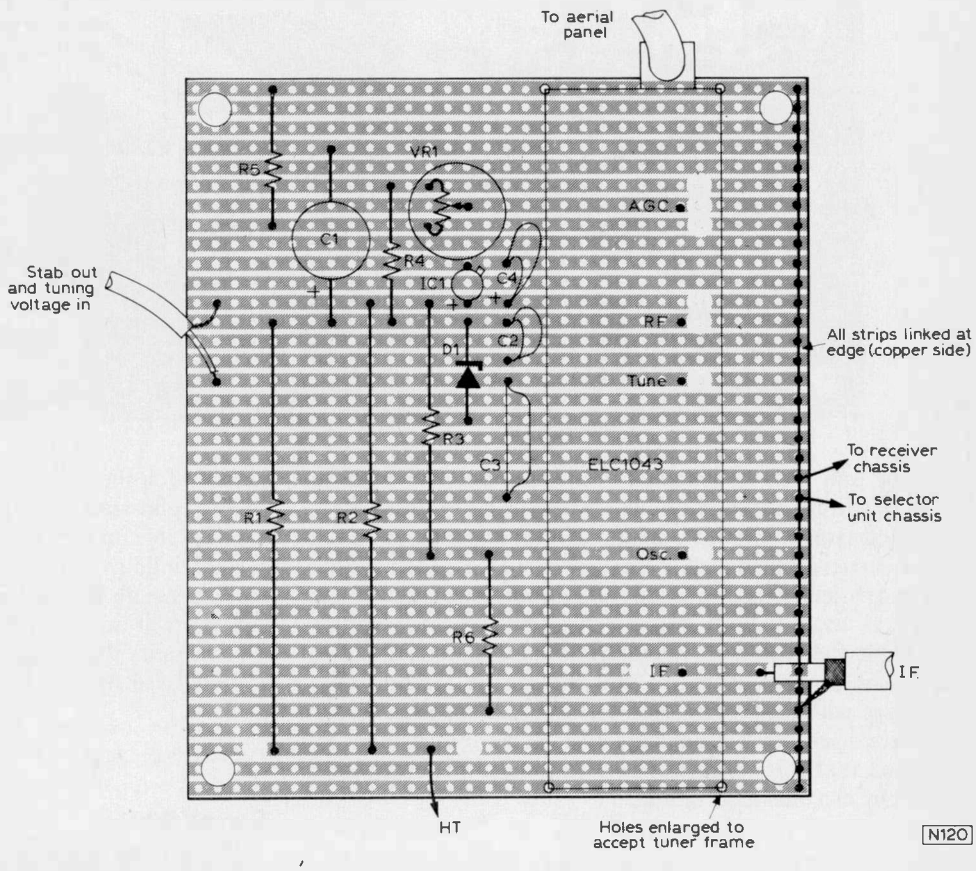


Fig. 9: A suitable stripboard layout for the circuit of Fig. 8, viewed from the component side.

★ Components list

TUNER PANEL

Resistors:

*R1	15kΩ 10W W/W	R5	2·2kΩ
*R2	20kΩ 10W W/W	R6	22kΩ
R3, R4	4·7kΩ	R3 – R6	±5% ½W

VR1 4·7kΩ horizontal sub-min. preset.

Capacitors:

C1 47µF 40V electrolytic
C2 0·01µF L.V. disc ceramic
C3 0·1µF polyester
C4 4·7µF 35V tantalum

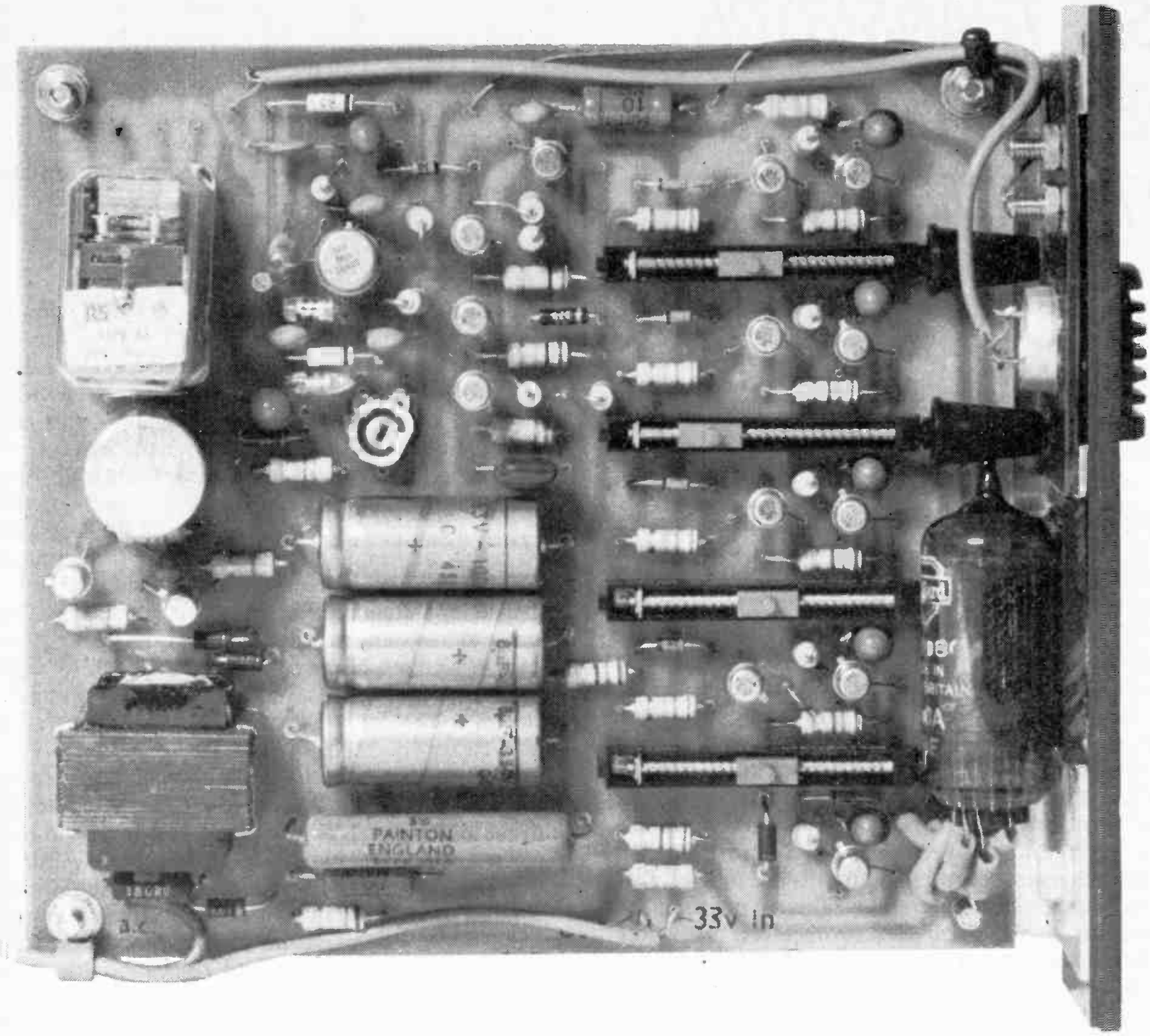
Semiconductors:

D1 BZY88C12 12V 400mW zener
IC1 TAA550 33V stabiliser

Miscellaneous:

ELC1043 u.h.f. varicap tuner; Stripboard 85·8 x 96·5 mm (3·3 x 3·8 in), 2·54 mm (0·1 in) matrix; Aerial isolating panel.

***NOTE** – Value varies with receiver h.t. line voltage. See Fig. 8.



with an oscilloscope on pin 1 of the i.c. About 3V p-p should be obtained with both transducers almost touching, reducing to a few millivolts at normal distance. If an oscilloscope is not available, D5 can be temporarily disconnected and the voltage across C19 monitored with a d.c. voltmeter. Normally VR5 on the receiver will be in the maximum gain position (fully clockwise), but it has been included in case any problem is experienced with interference from any source.

Mechanical tuners

Obviously this unit cannot be used with a receiver fitted with a mechanical tuner. It may well be feasible to modify such a set to use a varicap tuner, and a suggested circuit for obtaining the necessary power supplies is given in Fig. 8. A suitable stripboard layout is shown in Fig. 9. Note that the values of R1 and R2, the power supply dropping resistors, depend upon the h.t. rail voltage of the particular receiver used.

Correction

We regret that two errors occurred in information given in Part 1 of this article. In Fig. 1 and in the Components List, the type number of the Silicon Controlled Switches should have read BRY39. In Fig. 1, the voltage shown against the SCS anode rail should be 0·9V.

Note

Using the component values specified, a holding current of about 1mA flows through the active SCS. Although this is within the specified range of the BRY39, it has been found to give occasional erratic operation of the shift register. Where readers encounter a similar problem, the author recommends that R11 should be decreased to 2·2kΩ. To maintain the correct time-constant, C3 must then be increased to 0·047μF.

To supply the extra current to the stabilised 12V rail, R13 should be changed to 47kΩ. A 5W component should be used, mounted on long leads to take the heat clear of nearby electrolytic capacitors.

Ultrasonic transducers

As our September issue went to press we heard from Hall Electronics, quoted as a source of the transducers used in this project, that they would be passing readers' orders to:

L. A. Cole
188 Dyke Road,
Brighton BN1 5AA

who specialise in handling small orders and are able to offer the transducers at a price of £3·75 per pair, including postge and VAT.

Future orders should be sent direct to Messrs. L. A. Cole. Readers who have already placed orders at the price quoted in our last issue will be receiving refunds for the balance. ■

BASIC TRANSISTOR LINE OUTPUT STAGE OPERATION

John A. Reddihough

THE basic essentials of a transistor line output stage are shown in Fig. 1(a). They comprise: a line output transformer which provides the d.c. feed to the line output transistor and serves mainly to generate the high-voltage pulse from which the e.h.t. is derived, and also in practice other supplies for various sections of the receiver; the line output transistor and its parallel efficiency diode which form a bidirectional switch; a tuning capacitor which resonates with the line output transformer primary winding and the scan coils to determine the flyback time; and the scan coils, with a series capacitor which provides a d.c. block and also serves to provide slight integration of the deflection current to compensate for the scan distortion that would otherwise be present due to the use of flat-screen, wide deflection angle c.r.t.s. This basic circuit is widely used in small-screen portable receivers with little elaboration – some use a pnp output transistor however, with its collector connected to chassis.

Circuit Variations

Variations to the basic circuit commonly found include: transposition of the scan coils and the correction capacitor; connection of the line output transformer primary winding and its e.h.t. overwinding in series; connection of the deflection components to a tap on the transformer to obtain correct matching of the components and conditions in the stage; use of a boost diode which operates in identical manner to the arrangement used in valve line output stages, thereby increasing the effective supply to the stage; omission of the efficiency diode where the stage is operated from an h.t. line, the collector-base junction of the line output transistor then providing the efficiency diode action without, in doing so, producing scan distortion; addition of inductors to provide linearity and width adjustment; use of a pair of series-connected line output transistors in some large-screen colour chassis; and in colour sets the addition of line convergence circuitry which is normally connected in series between the line scan coils and chassis. These variations on the basic circuit do not alter the basic mode of operation however.

Resonance

The most important fact to appreciate about the circuit is that when the transistor and diode are cut off during the flyback period – when the beam is being rapidly returned from the right-hand side of the screen to the left-hand side – the tuning capacitor together with the scan coils and the primary winding of the line output transformer form a parallel resonant circuit: the equivalent circuit is shown in Fig. 1(b). The line output transformer primary winding and the tuning capacitor as drawn in Fig. 1(a) may look like a series tuned circuit, but from the signal point of view the end of the transformer primary winding connected to the power supply is earthy, giving the equivalent arrangement shown in Fig. 1(b).

The Flyback Period

Since the operation of the circuit depends mainly upon what happens during the line flyback period, the simplest point at which to break into the scanning cycle is at the end of the forward scan, i.e. with the beam deflected to the right-hand side of the screen, see Fig. 2. At this point the line output transistor is suddenly switched off by the squarewave drive applied to its base. Prior to this action a linearly increasing current has been flowing in the line output transformer primary winding and the scan coils, and as a result magnetic fields have been built up around these components. When the transistor is switched off these fields collapse, maintaining a flow of current which rapidly decays to zero and returns the beam to the centre of the screen. This flow of current charges the tuning capacitor, and the voltage at A rises to a high positive value – of the order of 1·2kV in large-screen sets, 200V in the case of mains/battery portable sets.

The energy in the circuit is now stored in the tuning capacitor which next discharges, reversing the flow of current in the circuit with the result that the beam is rapidly deflected to the left-hand side of the screen – see Fig. 3. When the tuning capacitor has discharged, the voltage at A has fallen to zero and the circuit energy is once more stored in the form of magnetic fields around the inductive components. One half-cycle of oscillation has occurred, and the flyback is complete.

Energy Recovery: First Part of Forward Scan

The circuit then tries to continue the cycle of oscillation, i.e. the magnetic fields again collapse, maintaining a current flow which this time would charge the tuning capacitor negatively (upper plate). When the voltage at A reaches about –0·6V however the efficiency diode becomes forward biased and switches on. This damps the circuit, preventing further oscillation, but the magnetic fields continue to collapse and in doing so produce a linearly decaying current flow which provides the first part of the forward scan, the beam returning towards the centre of the screen – see Fig. 4. The diode shorts out the tuning capacitor but the scan correction capacitor charges during this period, its right-hand plate becoming positive with

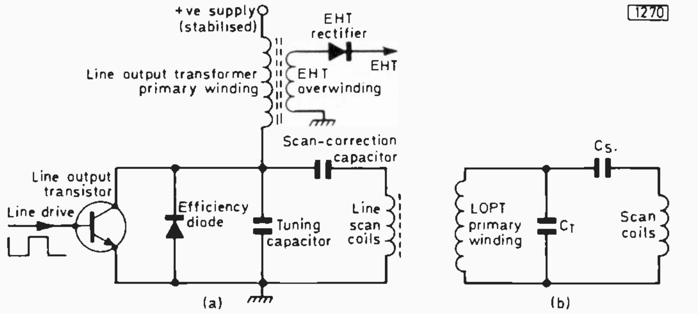


Fig. 1: (a) Basic elements of a transistor line output stage. (b) Equivalent parallel tuned circuit during the flyback period when the transistor and efficiency diode are non-conducting.

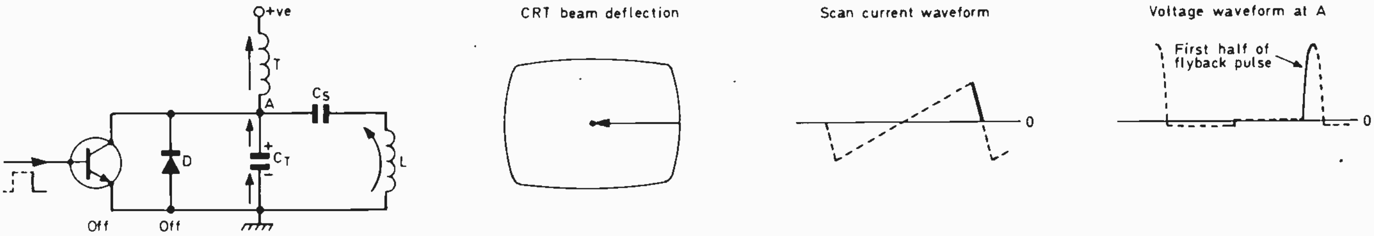


Fig. 2: Conditions during the first half of the flyback – beam moving from the right-hand side towards the centre of the screen.

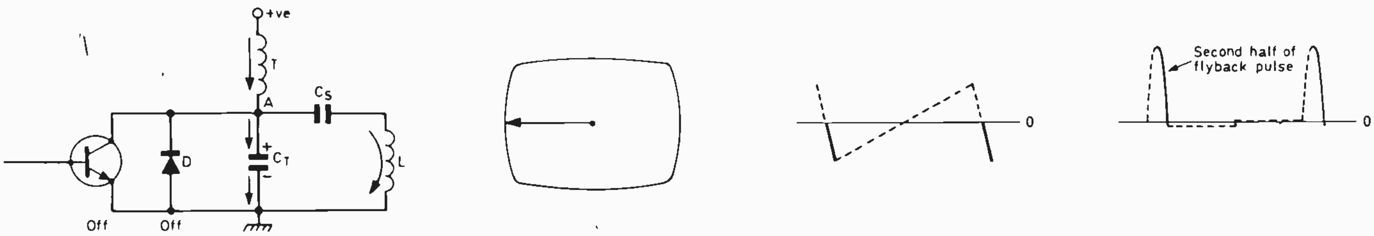


Fig. 3: Conditions during the second half of the flyback – beam moving from the centre towards the left-hand side of the screen.

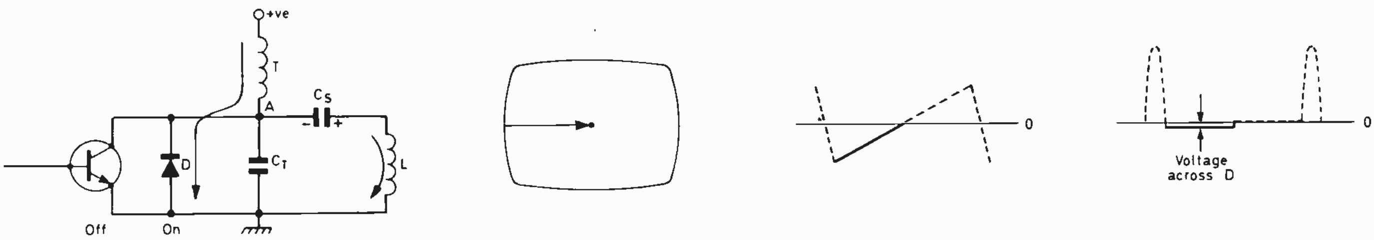


Fig. 4: Conditions during the first part of the forward scan – beam moving from the left-hand side towards the centre of the screen.

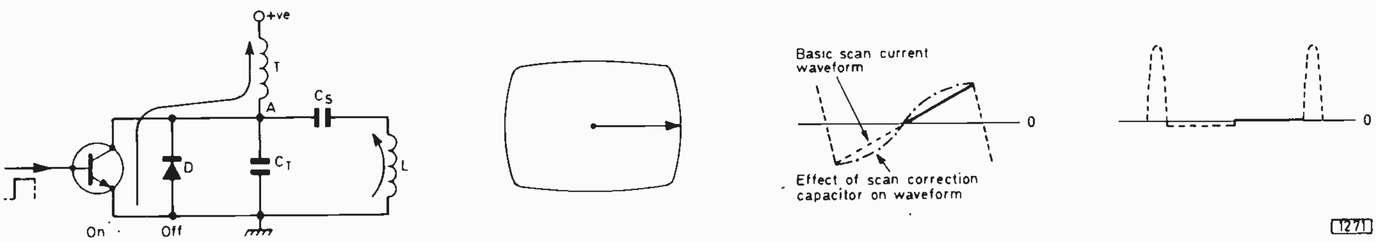


Fig. 5: Conditions during the latter part of the forward scan – completion of beam deflection to the right-hand side of the screen.

respect to its left-hand plate, i.e. point A.

Completion of Forward Scan

When the current falls to zero, the diode will switch off. Shortly before this state of affairs is reached however the transistor is switched on. In practice this is usually about a third of the way through the scan. The squarewave applied to its base drives it rapidly to saturation, clamping the voltage at point A at a small positive value – the collector-emitter saturation voltage of the transistor. Current now flows via the transistor and the primary winding of the line output transformer, the scan correction capacitor discharges, and the resultant flow of current in the line scan coils drives the beam to the right-hand side of the screen – see Fig. 5.

Efficiency

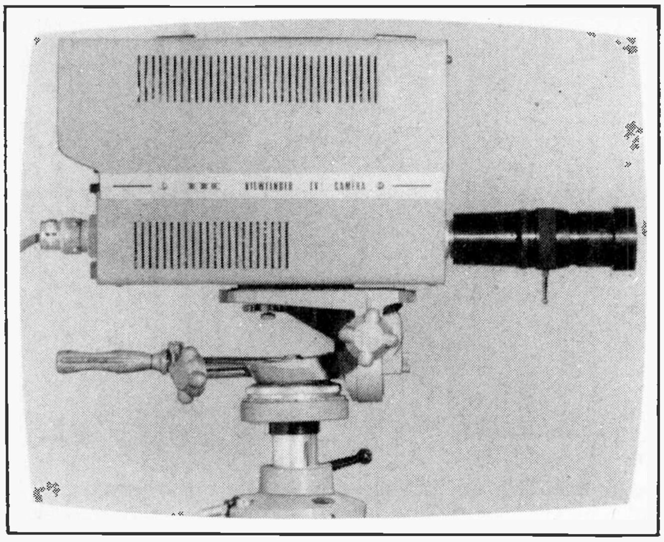
The transistor is then cut off again, to give the flyback, and the cycle of events recurs. The efficiency of the circuit is high since there is negligible resistance present. Energy is fed into the circuit in the form of the magnetic fields that build up when the output transistor is switched on. This action connects the line output transformer primary winding across the supply, and as a result a linearly increasing current flows through it. Since the width is dependent on the supply voltage, this must be stabilised.

Harmonic Tuning

There is another oscillatory action in the circuit during the flyback period. The considerable leakage inductance between the primary and the e.h.t. windings of the line output transformer, and the appreciable self-capacitance present, form a tuned circuit which is shocked into oscillation by the flyback pulse. Unless this oscillation is controlled, it will continue into and modulate the scan. The technique used to overcome this effect is to tune the leakage inductance and the associated capacitance to an odd harmonic of the line flyback oscillation frequency. By doing this the oscillatory actions present at the beginning of the scan cancel. Either third or fifth harmonic tuning is used. Third harmonic tuning also has the effect of increasing the amplitude of the e.h.t. pulse, and is generally used where a half-wave e.h.t. rectifier is employed. Fifth harmonic tuning results in a flat-topped e.h.t. pulse, giving improved e.h.t. regulation, and is generally used where an e.h.t. tripler is employed to produce the e.h.t. The tuning is mainly built into the line output transformer, though an external variable inductance is commonly found in colour chassis so that the tuning can be adjusted.

A following article will go into the subject of modern TV line timebases in greater detail. ■

CCTV



PART 19 — Peter GRAVES

IN this article, the last of the present series, we shall be looking at the future of CCTV equipment and applications. Although prophesying technical innovations before the invention of the crystal ball means treading on dangerous ground, some broad lines of development can be discerned.

First, equipment size. Transistors have reduced cameras to a more manageable and convenient size while still using the same tube and deflection components. A camera using a 1in vidicon can now be made small enough to sit in the palm of a hand. For some purposes (such as the inspection of small pipes) even this is not small enough and $\frac{1}{2}$in vidicons are available. This is probably the smallest tube size that is practical, but the precision engineering which is necessary makes them very expensive – say £500 plus!

Fibre optics

In passing, it should be noted that other techniques are available to extend the camera's range. Fibre-optic probes, coupled to the vidicon faceplate and having a lens at the far end, can be inserted in areas inaccessible to a normal camera. A typical application is the inspection of the interior of steam turbines for signs of damage or erosion. With a probe, only a small inspection plate need be opened, eliminating the costly and time-consuming exercise of lifting the outer casing that would otherwise be needed.

Camera tubes of the types discussed in these articles (vidicon, plumbicon, orthicon, etc.), however small, are still thermionic devices with all their inherent disadvantages – bulk, heavy power supplies, high voltages, fragility and inefficiency. Improvements in integrated circuit fabrication techniques and better materials make the solid-state pickup device a feasible proposition. Soon it will be possible to have the entire camera circuitry mounted on a few 'chips' where the lens will be the biggest part of the camera!

The problem, common to the development of flat-face displays and cheap TV recorders, is the vast amount of information that must be handled. A single field from a standard 625-line picture can be thought of as being made up of about 120000 discrete points all of which respond to a number of different levels of illumination and all of which must be interrogated for the information they contain (their position and amount of illumination) once per field.

Solid state

There are at present two contenders for an all solid-state pickup device and examples of both are available on the commercial market. These are: Charge coupled devices (CCD's) and photodiode arrays. The CCD has been described in detail in this magazine (October, 1974), but the photodiode array may be a little less familiar. Both are monolithic, that is, formed from a single slice of semiconductor material, and both use an array of photodiodes formed on the surface of the slice. The diodes are reverse biased so that the depletion layer of the diode acts as the dielectric of a tiny capacitor which charges to the applied voltage.

If the photodiode is left in darkness very little of the charge leaks away but, if it is exposed to light, electron-hole pairs are formed in the depletion layer and the capacitor becomes leaky. The stronger the light, the greater the leak. By reading off the amount of charge on the capacitor at fixed intervals (recharging it immediately after) the amount of light that has fallen on it can be measured. CCD's move the charge from the diodes into a series of "boxes" formed by depletion layers in the material, themselves formed by potentials on suitable electrodes. By altering the potentials on the electrodes the "boxes" together with their enclosed charges can be shuffled along the material and measured as they 'fall off the end'. Fig. 1 shows how this is done.

The diode array must have each individual diode interrogated in turn. Fig. 2 shows a very small part of a diode array, laid out as a conventional circuit. The field effect transistors (MF1, MF2, etc.) can be thought of as high-speed switches, shorting out source and drain (s and d on MF1) when a suitable bias potential is applied to the gate terminal (g on MF1). In this case they are shown as MOSFETs, metal-oxide-silicon field effect transistors, from the method of manufacture commonly used for this type of application. Applying bias onto the line marked X (Fig. 2) will turn on all the FETs along that line (MF1, MF4, etc.) switching the diodes (D1, D3, etc.) to the appropriate horizontal bus-bar.

To scan TV line 56 (an arbitrary choice of number) line Y is turned on so that all the diodes along TV line 56 (D1, D2, etc.) are connected to the output bus. Bias pulses are then applied in turn to line X, line X + 1, line X + 2 etc., switching each diode along the line in turn to the output so that the amount of charge

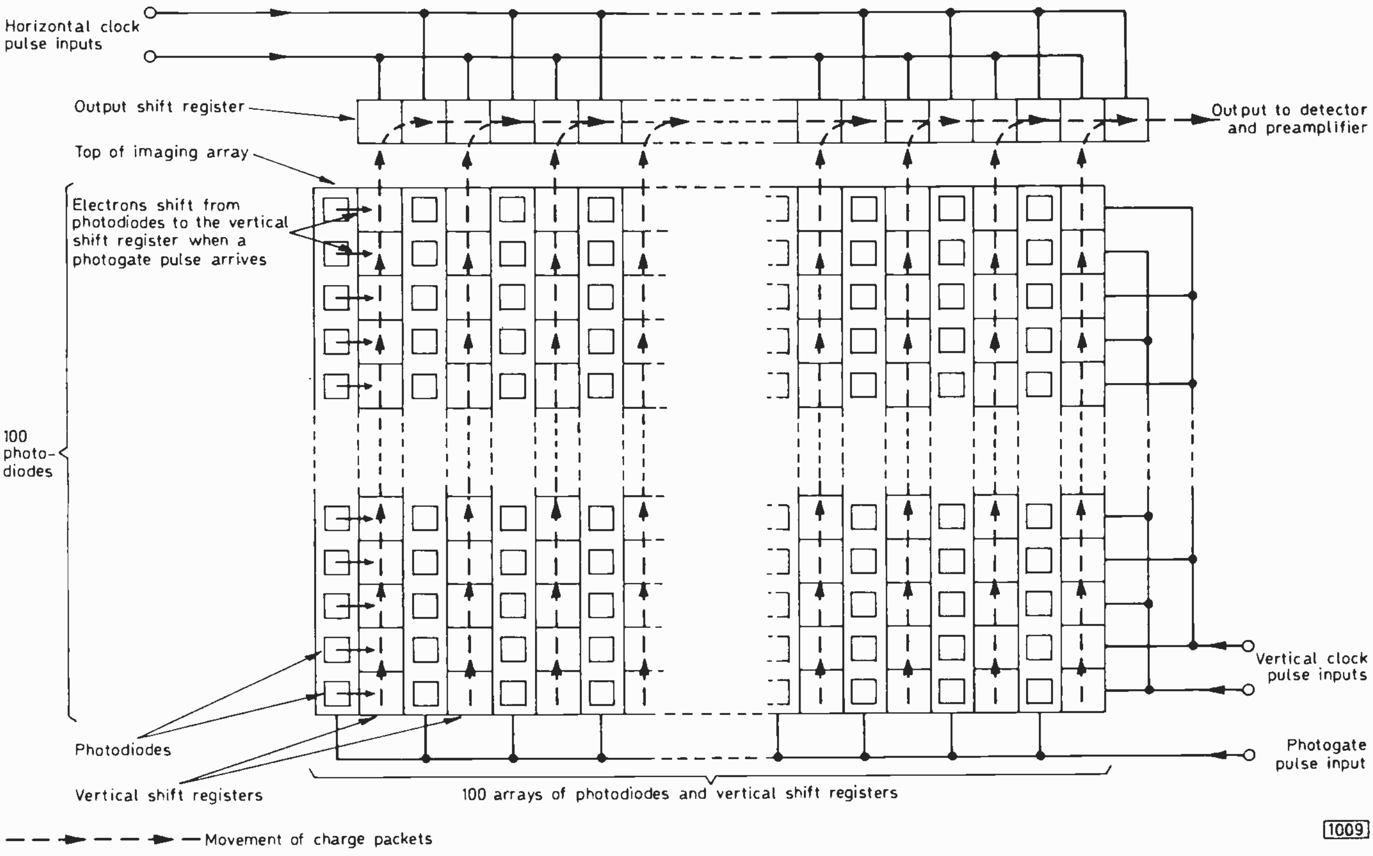


Fig. 1: Basic arrangement of one type of charge coupled device, the Fairchild CCD201 image sensor. Once each field when the photogate pulse arrives half the photodiodes discharge into the adjacent shift registers. The action of the vertical clock pulses then moves the charge packets along the vertical shift registers into the horizontal (output) shift register which is emptied (read out) between the arrival of each set (line) of charge packets from the vertical shift registers.

on each diode can be processed as part of the overall image focused on the diodes. Note that when line X is biased on, although FETs MF1, MF4, etc. are all turned on, only D1 is connected to the output as MF6, etc. are off. When the scan reaches the end of TV line 56, MF3 is turned off and MF6 is turned on, lines X, X + 1, X + 2, etc. are again switched in sequence from left to right. This time diodes D3, D4, etc are connected to the output rail so TV line 57 is scanned.

At present, it would appear that the CCD has an important future in the production of high resolution pictures. The diode array is much more complicated to construct and has not yet matched the performance of the CCD. However, this sort of device is used in applications needing only low resolution images.

Displays

It will be apparent that whichever device becomes standard a great deal of auxiliary circuitry will be needed which adds to the complexity of solid-state pickups and raises problems in the manufacturing field and of reliability. Similar problems bedevil flat face displays, the dream of TV development engineers for many years. Although a practical device, suitable for a full resolution TV picture, has yet to be demonstrated, there are a number of promising leads. Electroluminescent displays, using materials that glow under the influence of electric fields are now available but the problems of driving the number of points needed for TV work have not yet been solved. Liquid crystals, or their new cousin, liquid vapour, displays also show promise but suffer from the same problems. No clear leader has emerged and it would be difficult to decide which one to back!

Television recording at present requires complex equipment to record and play back the amount of information making up even a short video sequence. Both videodisc and videotape recorders require complicated electromechanical servo systems to keep everything running in exact synchronism. A fortune awaits the inventor of the cheap, portable video recorder. Once this can handle colour, CCTV will be a very serious rival to cine film, overcoming its disadvantages (processing delays, for instance) and offering many advantages; instant replay, editing, and reusable tape being a few of them.

On the applications side perhaps the most exciting developments will be in the direct use of information (using the word in its widest sense) from the video waveform without the intervention of a human operator, particularly the recognition of

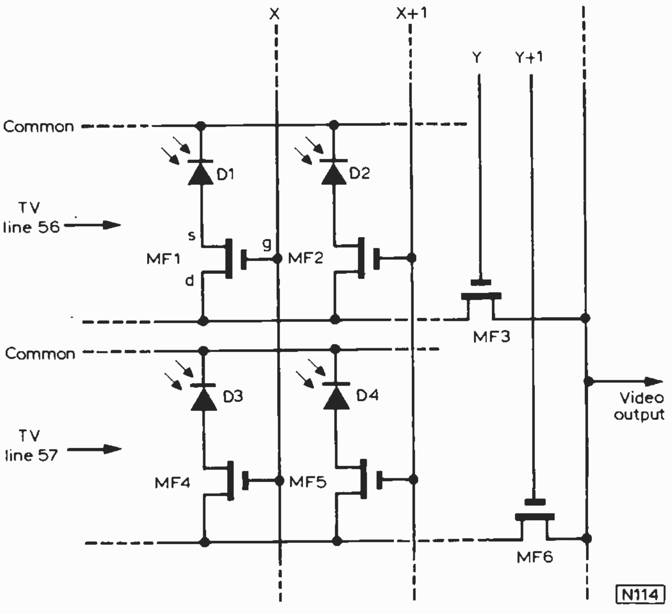


Fig. 2: Arrangement of part of a photodiode array.

particular objects or patterns. Equipment that can recognise events from changes in the video waveform level are already available.

As a simple example, suppose a camera is looking at some field of view, somewhere in which a light will appear. It might be desired to know when the light has appeared and where or, alternatively, the information could be used to drive the camera's pan and tilt head to follow the motion of the light if it moves. It is assumed that the light is brighter than any other part of the field of view. A suitable auto-target circuit would help here by turning the gain down, thus reducing the average background level when the light appears. The light can be detected from the video waveform (clamped to provide a fixed zero reference level) with a simple level detector (a Schmitt trigger circuit, for instance). The turn-on level of the detector is set above the level of the background but below the level of the light (which would appear as a 'spike' on the video waveform) when it is present. The smoothed output from the detector (typically, it would be turned on for part of a few lines once a field) operates the Light Present indicator and initiates whatever action may be necessary.

If the field of view is fixed (i.e. the camera is stationary) then the position of any point can be deduced from the time taken for the scanning beam to reach it. Let us take the start of the field sync pulse as the zero time reference point (any fixed point would do) and assume the light to be a true point source occurring half-way along line 214. The scanning beam will take some time (say, t milliseconds) from the start of the preceding field sync pulse to reach the point where the light is. If you like, the field sync pulse starts a clock which runs while the beam is scanning and is turned off by the light detector output. If the light moves to the right the time will increase, if the light moves downwards onto the centre of the next line down then the time taken will increase by one line period and so on. It will be apparent that the position of any point on the raster is characterised by a unique time interval from the start of the field sync pulse. By interpreting this time with suitable circuitry the position can be obtained in terms of angles from the horizontal and vertical planes – more useful to a human observer.

Following

If the camera is to follow a moving light then a zero position must be defined. Typically, this will be the centre of the picture. If the light is not at the centre then the time taken for the scanning beam to reach the light will be different from the time taken for it to reach the centre of the picture. The amount of difference is interpreted as two error signals – one for the horizontal error and one for the vertical error, with respect to the centre, zero, point. The magnitudes and directions of these signals are proportional to the amount of displacement from the centre and the direction of displacement from the centre respectively. The error signals are then used to drive the pan and tilt head to which the camera is attached, in directions so as to reduce the errors to zero. That is, to try to drive the camera so that the light is in the centre of the screen once more. Servo systems using feedback, of which this is an example, are more complicated than this description suggests but the basic idea remains the same.

On the same theme – detection of video level changes – consider a camera used for security purposes and looking at a fixed scene. Any change in the scene such as an intruder entering or, unfortunately for outside work, the sun going behind the clouds, will cause a change in the video signal level, which can be detected and used to trip an alarm. Monitoring the auto-target voltage will do the job, in the same way as an a.g.c. line in a radio indicates changes in signal level. The alarm can ring a bell or perhaps switch the camera's output onto a main monitor for further inspection. If only a small area is under surveillance, say a doorway in a room, then this facility can be added to standard equipment without disturbing it. A photocell is stuck onto the face of the camera monitor over the area under surveillance, the output from the cell is amplified and passed to level detector circuits which trip the alarm (Fig. 3).

By coupling the video output from a camera to a memory unit (and equipment using this technique is commercially available) comparison circuits can be used to compare successive fields and detect areas where changes have taken place. These can be indicated on the monitor with bright-up pulses on the picture where a change has taken place. This is a valuable tool for analysis of, for instance, changes in smoke patterns from factory chimneys.

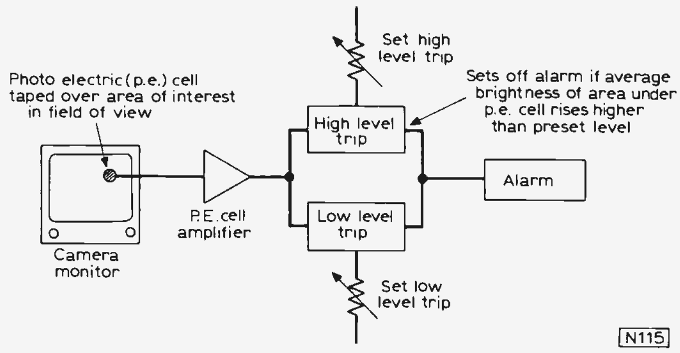


Fig. 3: A simple "add-on" movement detector, which requires no electrical connection to the television system.

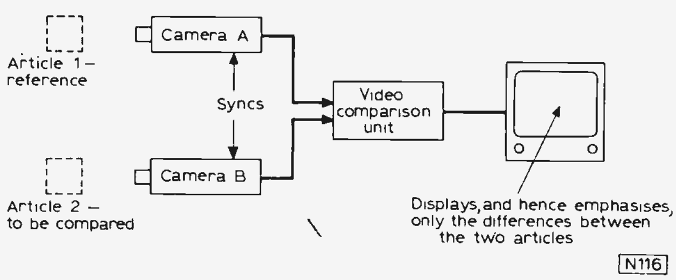


Fig. 4: Basic arrangement of an image comparator.

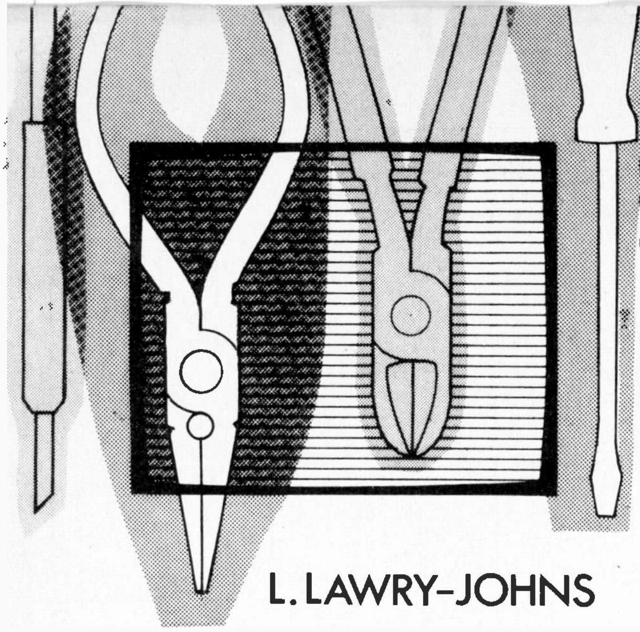
Comparison circuits can also be used to compare the video outputs from two cameras and give no output (i.e. a blank screen) in areas where the pictures are identical but feed the output from one or other camera to the monitor where they differ. In this way differences are emphasised. A typical application is illustrated in Fig. 4, where a comparison article, say a jar of (clear) liquid, is compared with a jar from the production line and possibly having floating, opaque, impurities whose presence is immediately obvious from the monitor. Level detectors can be used to reject faulty units. This method is sensitive to changes in patterns, omissions or extras, and can be used for a variety of applications.

Reading machines

Recognising lights, present or absent, or gross changes in video level is one thing, recognising and identifying patterns of light and shade as specific objects without a human operator intervening is quite another. A lot of work is being done on machines which, coupled to a camera, will enable letters to be read by processing the output signal. This is not the place to go deeply into the method, but it will be appreciated that it is extremely involved. The successful application will mean the bypassing of the slow, costly, and error-prone feeding of information into a computer by a human operator.

The next step is the recognition of objects, you and I have little trouble in saying: that is a tea cup or even, that is a willow-pattern tea cup, but to build a machine that will do even the first thing is immensely difficult, and then it won't be able to recognise a saucer!

Closed circuit television can extend the range of human vision in environments from the high vacuum of outer space to enormous depths under the sea, from near absolute zero to the interiors of furnaces, unrestricted by the limitations of the visible spectrum. Its signals can be used to protect, control, and entertain. Great things are promised for the future! ■



SERVICING TELEVISION RECEIVERS

DECCA DR1 SERIES

L. LAWRY-JOHNS

A little while ago we were asked when we had dealt with the servicing of the Decca DR1 series of receivers. Upon looking up the date, we found to our surprise that we had not "done them" at all. In view of the large group of models using this chassis we thought we had better rectify the omission without further delay.

Model Variations

The following models used the original chassis: DR1, DR2, DR2X, DR3, DR3X, DR121, DR122 and DR123. The later Models DR20, DR21, DR23 and DR24 used the same basic design but omitted the second sound i.f. stage V10 and the EB91 (V14) video d.c. restorer and interference limiter – the d.c. restorer section was replaced with a BA130 diode while the interference limiter was simply removed.

Other differences lie in the type of tuner unit fitted and the tuning arrangements. The earlier models use valves throughout, the later ones (DR20 etc.) being up-dated with a transistor u.h.f. tuner (AF239 r.f. amplifier plus AF139 mixer).

Servicing Aspects

There is very little to worry about in servicing these sets – no varicap tuner, sensitive control voltages or a.f.c. to be taken into account when checking for faults.

Although the sets are only a few years old and a large number are still in use (there would be no point in this article if this were not so) the differences in the design of more recent sets make servicing them almost a different art, though we still use the same equipment.

The layout is of the two-deck variety, with the signal stages on the upper deck and the timebases and power supply on the lower. During the first few years the majority of faults occurred in the power supply and the timebases. More recently however several common faults have been developing in the i.f. stages. We will deal with these later.

Power Supply Faults

The mains input is via a plug and socket from the on/off switch. From this socket the neutral is taken to chassis, the live to a 1A antisurge fuse (F1) then to the centre of the right side dropper. The lower sections of the dropper concern the heater supply to the valves, via a VA1015 thermistor. The upper sections concern the h.t. supply which is taken via another fuse (F2) to the BY100 h.t. rectifier. This incidentally is drawn the wrong way round on most service sheets, though the fact is unlikely to cause much confusion as it is so obvious.

Whilst the lower sections of the dropper do not give much trouble, the same cannot be said for the upper part which consists of three 17Ω sections. The top one goes first as a rule (thus producing no sound and vision due to lack of h.t.) and as this is generally followed after a period by the next one down we replace both with a 33Ω RS dropper section. The first 17Ω section doesn't seem to fail so often (don't ask me why).

If your neon screwdriver (which you keep in your top pocket except in the summer when you forget it and use your wet finger because you are too lazy to get the meter out) lights up on all sections of the dropper and the valves light up but there is no other sign of life it is likely that the h.t. fuse F2 has failed.

Now there is usually a reason for this, so it is unwise to replace the fuse without finding out why it has blown. This may or may not be easy. Fortunately the power supply to the upper deck is via a plug and socket, so this can be removed to see if the meter needle moves from a near short reading. If a short is still indicated and can be traced via the several decoupled h.t. lines, all well and good. It could well be however that the h.t. lines are clear and the fault does not occur until the line output stage has had time to warm up. Whilst this condition can be due to several different causes, we have found it prudent to check the red and black leads to the line scan coils. These can short to the outer screening (which connects to chassis). If this is found to have occurred it is also prudent to check the scan correction capacitor of whichever system is in use at the time. If the set is being used on 625 lines for example, check C137.

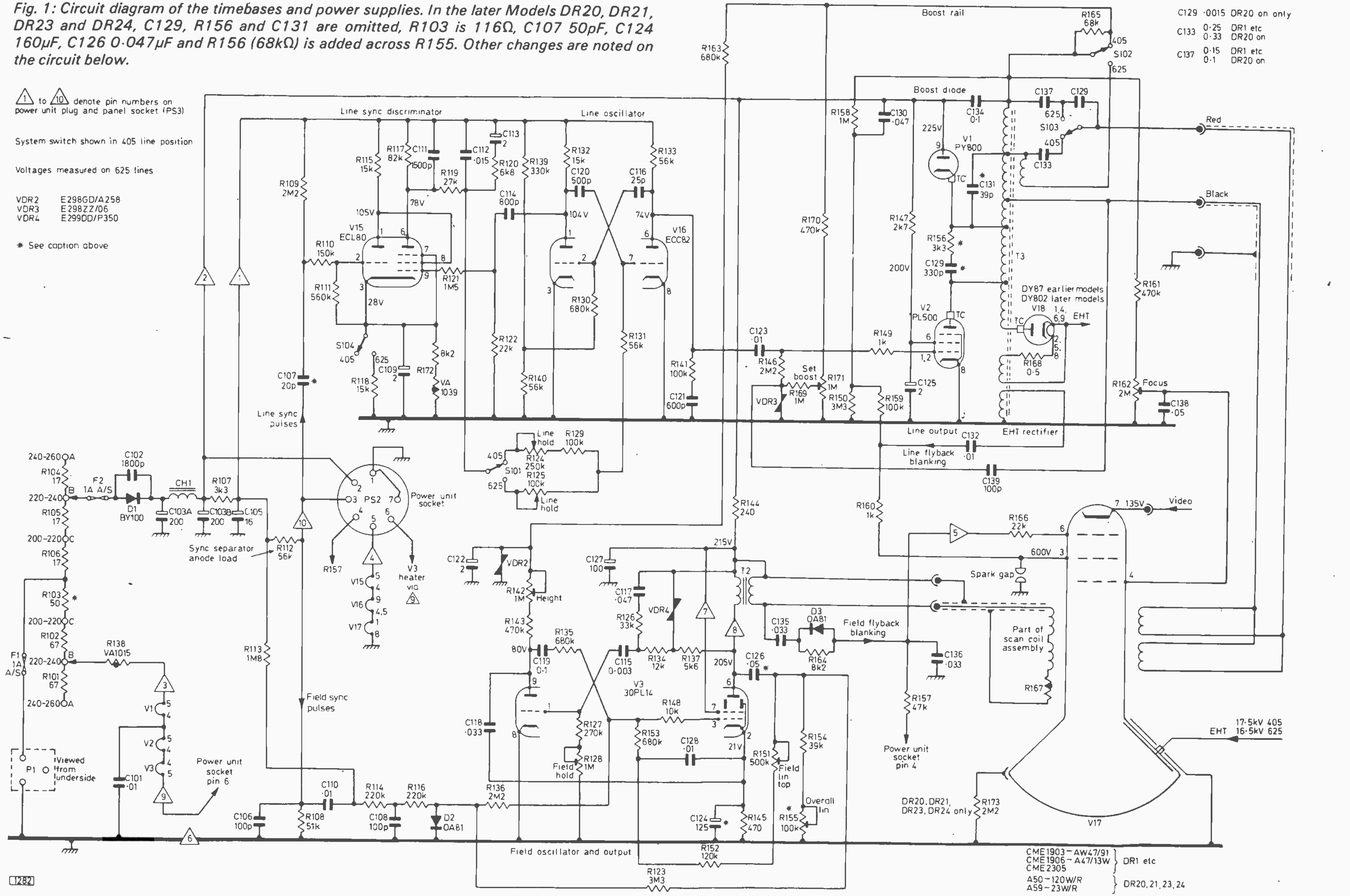
Line Timebase

The majority of faults seem to occur in the line timebase so it is appropriate to spend a little time discussing and clarifying these.

The line oscillator V16 (ECC82) is a simple multivibrator which is held in step by V15 (ECL80), the flywheel line sync discriminator. This circuit does not have the basic stability enjoyed by the more widely used sinewave oscillator and the necessity to adjust the line hold control from time to time should not be regarded as a fault.

Quite often however the adjustment required becomes more frequent and the picture may exhibit horizontal

Fig. 1: Circuit diagram of the timebases and power supplies. In the later Models DR20, DR21, DR23 and DR24, C129, R156 and C131 are omitted, R103 is 116Ω, C107 50pF, C124 160μF, C126 0·047μF and R156 (68kΩ) is added across R155. Other changes are noted on the circuit below.



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movement with ghostly streaks of picture content pulling across. This sort of hanky panky should direct attention to the ECL80 valve and the associated components, in particular R109 (2·2MΩ) and C109 (2μF).

The ECL80 can also be responsible for an unusual condition which is usually attributed to defective smoothing. This is when the picture is swaying from side to side in a rythmic manner. The clue is that the picture is not affected vertically, as would be the case if the main electrolytics were at fault (i.e. there is no rise and fall). The real cause is poor heater-cathode insulation in the ECL80, and a new valve will clear the effect.

The ECC82 is no mean hand at causing faults, usually confined to varying line hold or complete non-operation which of course results in severe overheating in the output stage.

It's in the output stage itself however that the majority of troubles occur. Apart from valve troubles the weak links are the resistors associated with the width control (mainly R170 470kΩ which changes value and damages the control), the boost line capacitor C134, and the line output transformer which develops shorted turns and poor contact to the plug in panel connections.

Some suspect resistors are close to the system switch – it is necessary to remove the panel in order to get at them.

The fault tracing drill is as follows.

Lack of Width

For lack of width first check the PL500 (PL504) and PY800 valves and the ECC82 if these are in order. Then check the value of R170 (470kΩ) and the condition of R171 (set boost control) which could have a dud spot or be otherwise damaged if R170 has changed value. Then check R169 and R146. When R146 goes really high it leaves the PL500 control grid floating and produces that strange effect like a rapidly varying hour glass (or wasp waist: what with waists and belly dancing when a ripple gets into the oscillator, these articles are becoming positively pornographic).

On rare occasions C139 (100pF high voltage) will short and possibly damage the v.d.r. in the width circuit (VDR3). This component can take a lot of punishment however. It is often suspected on account of its appearance when the grey unpainted type is used. In these models the E298ZZ/06 type is mainly used – these are coloured. The paint can still bubble up however without the component losing its effectiveness.

If width is still lacking when the valves and components have been checked there looms large the possibility (probability) that the line output transformer has shorted turns. There is not much difficulty in replacing this if the bottom sockets have not been eroded. Quite often however a clean up job has to be done on these.

No EHT

No e.h.t. is the condition most likely to be met and in order to save a lot of time a definite checking procedure must be followed. The sound is assumed to be in order – if it isn't the fault is elsewhere (probably the h.t. supply).

First remove the screen from the line output section (two bolts at the rear and slides at the left side) to reveal the transformer and valves. Look at the PL500 to see if it is overheating. If it is, note the degree. If a dull red, only just visible, the line drive may be present and the fault is probably in the output stage. A check at the junction of C123/R146/R149 should show a negative voltage of something over −25V (this is a low figure and takes into consideration the damping effect of the overheated PL500). If this voltage is absent there is no line drive and the PL500 will be far more overheated – in an unmistakable manner. This would direct attention to the ECC82 and its circuitry.

Assuming that there is some line drive however the next move is to remove the PY800's top cap. If this brings some life back to the stage, change the boost capacitor C134 (0·1μF, 1kV) as this will be found to have shorted. If taking the top cap off the PY800 merely stops the PL500 from overheating but warms up R147 (screen feed now taking full wack) put the top cap back on and remove the top cap of the DY87 (or remove the e.h.t. cap from the side of the tube). Either action will remove the effect of a shorted DY87. If everything now comes to violent life you are lucky and only the DY87 needs to be replaced.

If there is no difference, fit new valves in the PL500 and PY800 positions. If the same conditions are still present unplug the scan coils to clear these of suspicion. Once in a while the coils will be found at fault but disconnecting them will usually make no difference – the e.h.t. cap should be off the side of the tube however just in case the coils are at fault, since the sudden return of the undeflected e.h.t. would cause a nasty burn in the centre of the screen.

Having checked all these points and assuming that there are no other signs of overheating – such as R161 cooking due to a defective focus control (R162), or C139 fizzing around – one has to conclude that the line output transformer is defective. Mind you, if you were lucky enough to have a spare around in the first place it would have been a matter of minutes to try it, but who has the right one at the right time?

Now consider the case where the PL500 is badly overheating to denote lack of line drive. Obviously this indicates a fault in the oscillator stage and since this is a simple circuit there should be no trouble in locating the defect. Usually it is nothing more than a faulty ECC82 valve. There are times when this is not so however and the voltages may be found to be either very wrong or absent altogether. Approximately correct voltages are 100V at pin 1 and 75V at pin 6. If these voltages are low, check the cross-coupling capacitors C116 and C120. Whilst the anode load resistors R132 and R133 could have changed value, this doesn't often happen. Total absence of voltage at either end of these resistors should direct attention to the feed from R107, which can become open-circuit for no external reason or be damaged by C105 shorting (which is unlikely).

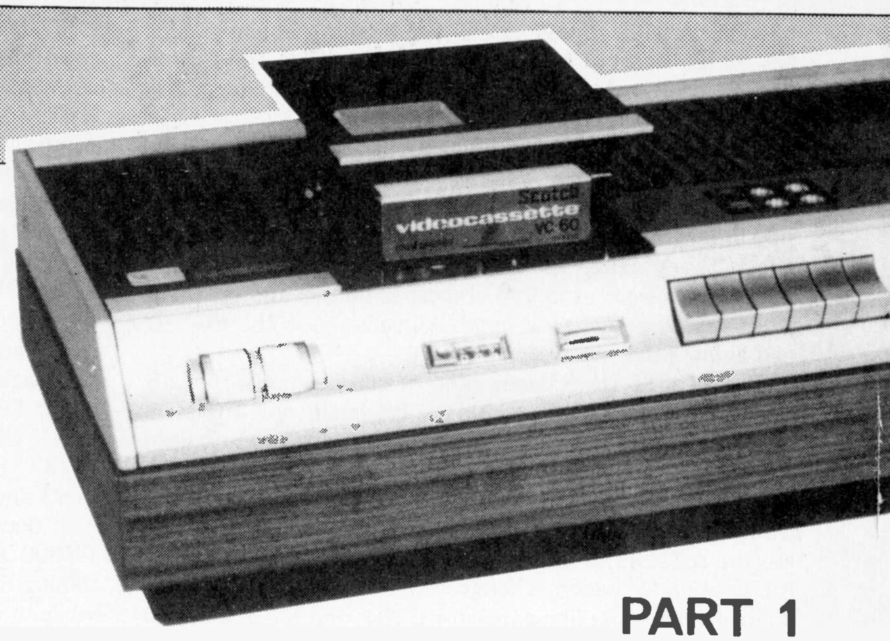
If the PL500 is cool check R147 and if necessary C125. This situation seldom arises however.

Line Hold Troubles

Faulty line hold is a trouble often experienced. The defect falls into two main categories. First faults in the oscillator stage, where the ECC82 or an associated component can be defective: apart from the ECC82 the components to suspect are R139 (goes high) or the cross-couplers previously mentioned. The other faults that can upset the smooth running of the oscillator lie in the discriminator stage. The ECL80 can be defective and should be checked first (after the ECC82). Then check resistor R109 and the two electrolytics C113 and C109. Several other components could be at fault, but we haven't found this to be the case.

CONTINUED NEXT MONTH

THE PHILIPS



M. P. RILEY

PART 1

IN the last two issues of *Television* the basic principles of helical scan videotape recorders have been outlined together with some of the more unusual techniques employed. In this and next month's articles we will concentrate on one machine; the Philips Video Cassette Recorder. This particular VTR has been chosen for several reasons, the most important being that it is the only video cassette recorder on the market at the time of writing that falls within the domestic price range. It should be noted at this point that with the introduction of VAT at 25%, the price of a VCR is over £500, and whether the consumer thinks that this is value for money remains to be seen.

Many other features of the machine make it an obvious choice for more detailed examination. A built-in tuner and i.f. strip enable 'off air' programmes to be recorded without the need for a separate colour receiver. A time switch is incorporated so that material can be recorded while the operator is away, and the cassette format makes the VCR very easy to use. In fact it has fewer controls than some audio cassette recorders.

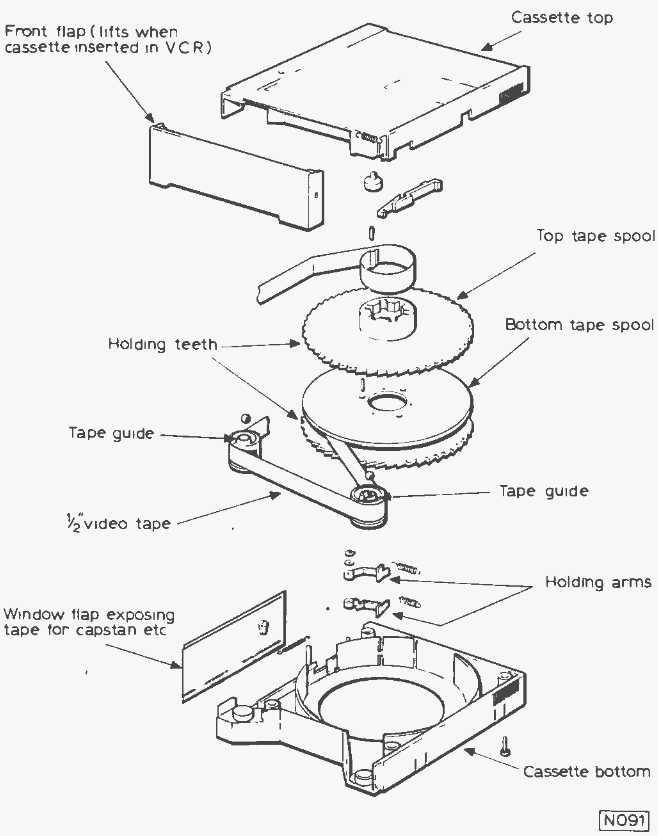


Fig. 1: Constructional details of the video cassette.

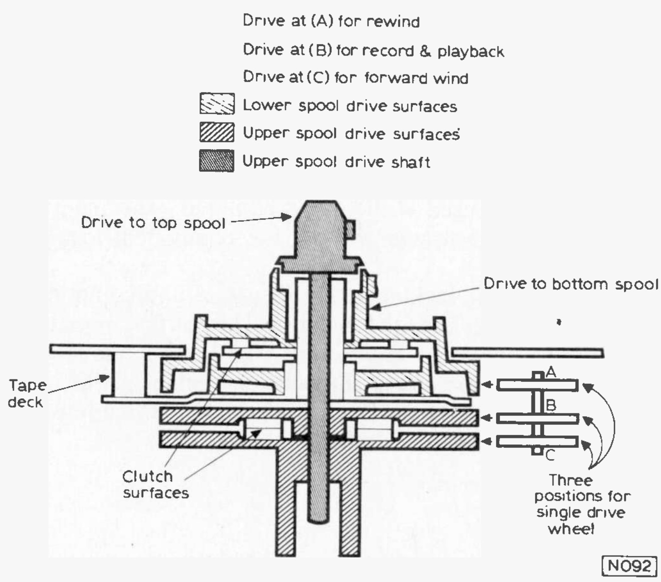
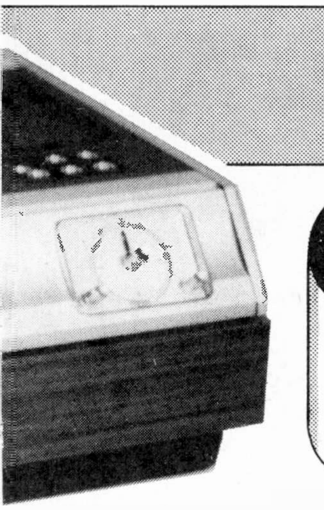


Fig. 2: Principle of the tape spool drive mechanism.

VIDEO CASSETTE RECORDER



The cassette format

The half inch video tape is housed in a cassette (Fig. 1) that stores the two spools of tape one on top of the other; the tape passing diagonally from the top spool to the bottom. This method of housing the tape in the cassette gives rise to a rather unusual method of providing drive to the two spools for forward and reverse winding of the tape, and the torque for record and playback. Simplified details of the drive system are shown in Fig. 2, where it can be seen that the two drive spindles are arranged in the same way as the control shafts on a dual concentric potentiometer, the centre spindle engaging in slots in the top spool of tape and the outer spindle driving the lower spool. Each spool has a large number of teeth cut into its outer rim which engage with small arms, preventing the spools from turning when the cassette is removed from the machine. This action stops the tape from spilling until the cassette is loaded in the VCR, whereupon the arms disengage enabling the spools to turn freely.

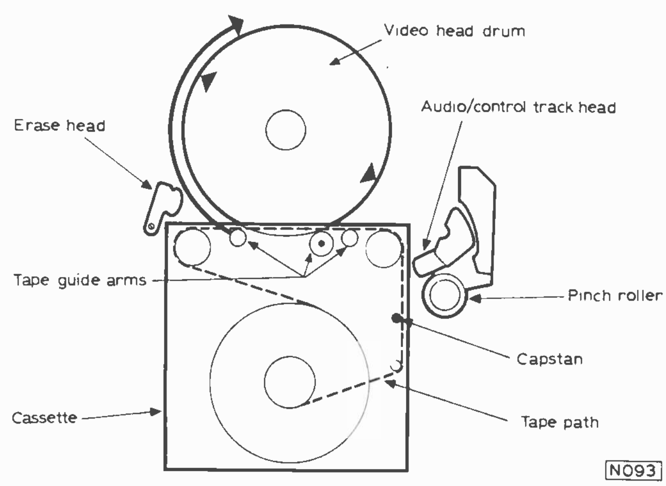


Fig. 3: Tape path with the machine turned off. The dashed line indicates the route of the tape.

Tape threading

A small window in the side of the cassette opens, exposing the tape, as the cassette is loaded into the machine. This length of tape is then presented to the audio and control track head stack, the capstan and the pinch roller, Fig. 3. The tape path is shown by the dotted line and it can be seen that the capstan and guide-arm assemblies are behind the backing of the tape. When the VCR is switched on the guide arm moves in the direction shown by the large arrow, pulling the tape out of the cassette and wrapping it around the head drum producing the familiar 180° half wrap. Fig. 4 shows the tape laced in the machine with the tape transport in the play or record modes. The pinch roller and audio/control track head assemblies have now moved forward to provide the required drive to the tape.

The video signal is recorded on the tape in the conventional diagonal manner. The main audio track is recorded along the lower edge of the tape and there is provision on some versions of the VCR to record a second audio track along the top edge. The control track is situated just below the second audio track with a guard band between the two. The complete tape format is shown in Fig. 5.

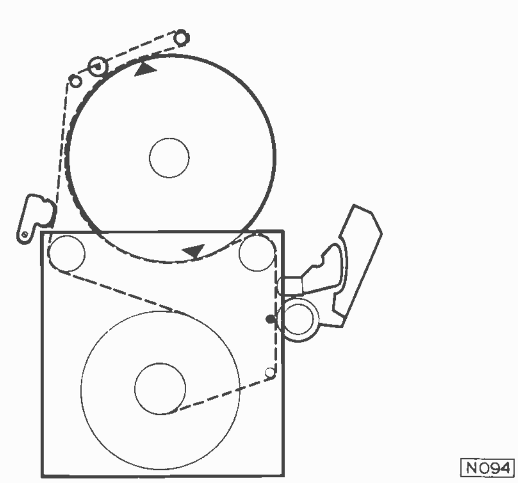


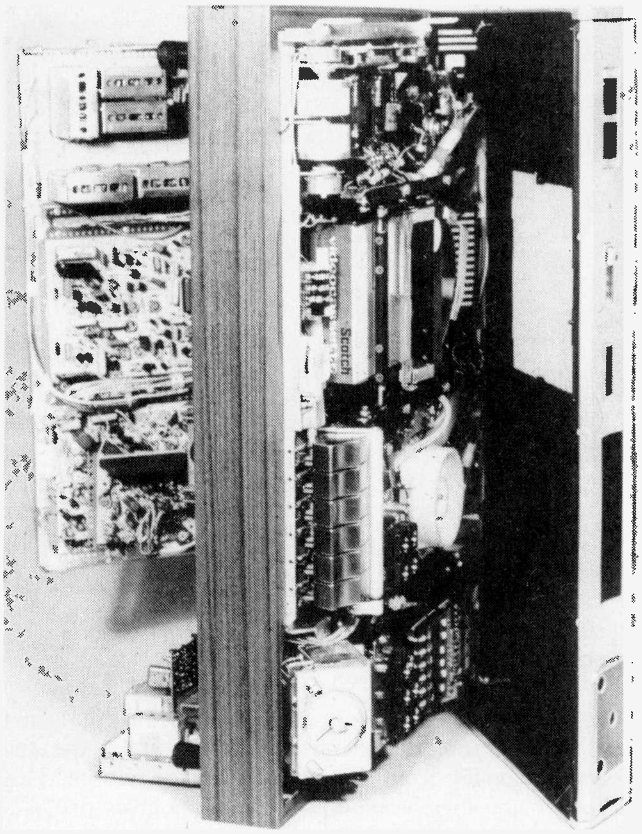
Fig. 4: Tape path with the machine turned on. A loop of tape has been drawn out of the cassette by the tape guide arms and wrapped around the video head drum.

The Record electronics

It is impossible to give a circuit description of a machine that uses 136 transistors, 67 diodes and 4 i.c.s in the limited space of two magazine articles; however a detailed examination of the techniques employed and the signal path through the VCR is possible. The reader will gather from the large number of transistors employed in relation to the very small number of integrated circuits that the production of videotape recorders for use in the home is very much in its infancy. The cost, size and electronic complexity of the VCR can only be reduced with the adoption of i.c. circuit techniques; but with the rather uncertain future of the market at this time manufacturers seem to be playing safe by using well-tried and easily available devices rather than invest in new custom-made i.c.s.

The VCR can be logically divided into sub-sections, but if this was attempted for our purposes life would become rather confusing! I feel the more conventional method of starting at the beginning and finishing at the end will be an easier way to tackle the problem. The accompanying photograph gives you an idea of what lies ahead. Are you sitting comfortably?

There are three main electronic modes in which the VCR operates: these are Record, Play and E to E modes. The E to E mode is used when the machine has been stopped but part of the video electronics is still in use, so as to provide an output to indicate that the VCR is receiving information. The E to E mode is the simplest of the three and uses familiar colour TV principles making a foundation on which we can build later.



This photograph of the VCR opened up for servicing gives some idea of the internal complexity.

The E to E mode

Tuner and a.f.c.

The u.h.f. aerial input applied to the VCR is first amplified in a wideband amplifier contained in module U504 (see Fig. 6). The output of this amplifier is fed to a splitter which in turn feeds the u.h.f./v.h.f. tuner unit and a second wideband amplifier. This second aerial amplifier then provides the main signal feed to the colour TV receiver via a second splitter which combines the output of the VCR with the amplified 'off air' signal feed. The v.h.f. (don't forget that the VCR is used throughout the European Economic Community which uses v.h.f. 625-line transmissions) and u.h.f. tuner units incorporate conventional electronic tuning with a rather interesting a.f.c. system known as PAFT. PAFT stands for Phase Dependent Automatic Fine Tuning, which adjusts the tuning control voltage to give maximum rejection at 33·5MHz instead of the widely used maximum gain at 39·5MHz. An a.f.c. system which tunes for maximum rejection at the sound carrier frequency provides a much more accurate control voltage for the tuner, and as the VCR is designed to operate unattended on a timer, tuning must be very accurate and stable if good quality recordings are to be made.

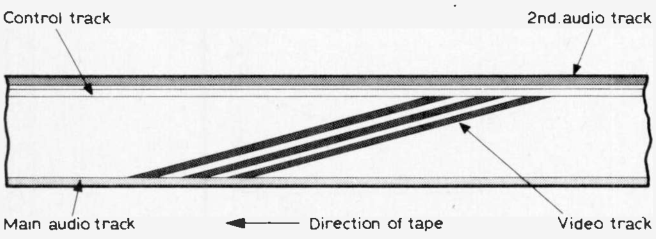


Fig. 5: The cassette tape format.

Two 6MHz sound i.f. signals are phase compared; one is from the sound i.f. amplifier and the other from the output of the luminance delay line. The latter signal has undergone a large amount of attenuation at 33·5MHz due to the rejectors in the i.f. amplifier, but the signal derived from the sound i.f. stage has had wideband amplification. Should the tuning frequency drift then the signal presented to the 33·5MHz rejector in the luminance i.f. amplifier will change, causing a phase shift in the signal leaving the rejector, and hence a change in phase of the 6MHz intercarrier sound produced at the luminance detector. The i.f. signal applied to the sound detector does not undergo any attenuation at 33·5MHz and therefore its phase will not be affected by the change in frequency of the signal.

The intercarrier signal from the sound i.f. amplifier is used as the chopping waveform for a synchronous phase detector U514, and the output of the luminance detector is used as the error signal. Any phase difference between these two signals is detected and the resulting error signal is smoothed and applied in series with the tuning voltage to correct for the drift in oscillator frequency. It is easy to see why this particular method of a.f.c. correction is not employed in the conventional colour receiver, and a comparison of accuracy between the two systems is very difficult to produce.

Luminance and Sound circuits

Amplification of the i.f. signal at the output of the tuner is carried out in three stages by the amplifiers U506, U507, and

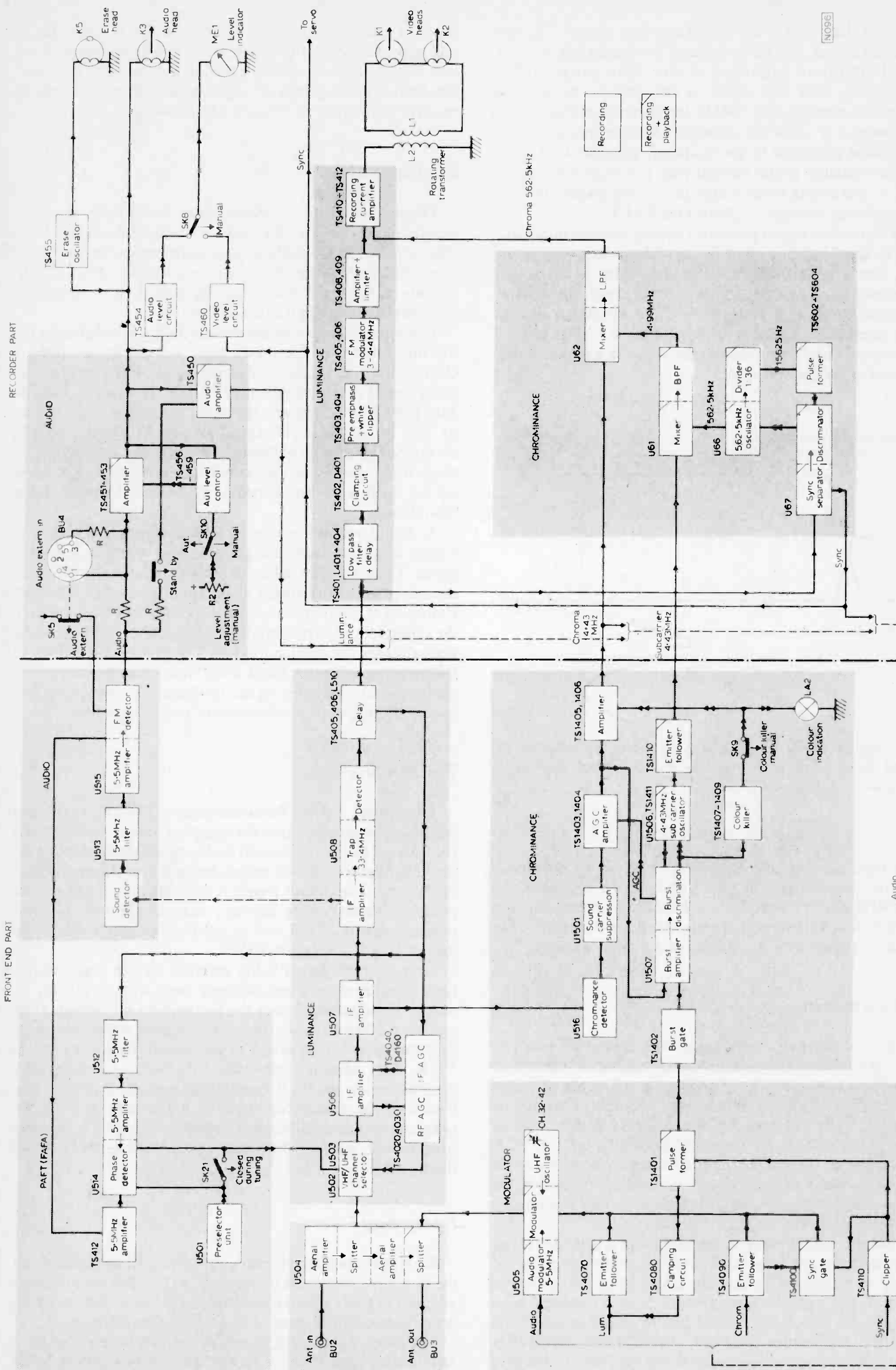


Fig. 6: Block diagram of the signal circuits in the Recording and E to E modes.

U508; module U508 also contains the sound rejector mentioned earlier, and the sound and luminance detectors. A take-off point is provided at the third stage of i.f. amplification, and this signal is fed directly to an a.m. detector to produce the 6MHz intercarrier sound signal. After passing through the bandpass filter in module U513 this signal is amplified by the sound i.f. amplifier U515 and then demodulated in the normal way to produce the audio signal. At the output of the sound i.f. amplifier a 6MHz take-off provides the reference signal for the PAFT.

The luminance signal produced by the detector in module U508 is amplified and then fed to three points within the VCR. The first is the luminance delay line (1μs) which compensates for the delay in the chroma processing stages, the second output is fed to module U512 which extracts the 6MHz intercarrier sound error signal for the PAFT, and the third output is used to produce a mean level a.g.c. voltage for the first i.f. amplifier and tuner.

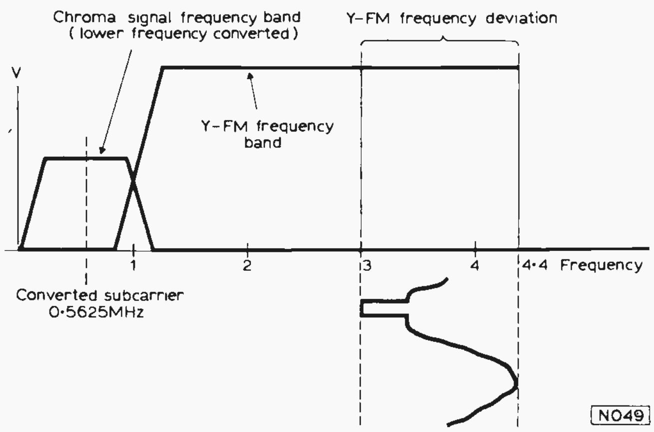


Fig. 7: Signal frequency spectrum of the VCR, showing the chroma information occupying the gap below the luminance f.m. signal.

We have now regained the luminance and sound signals from our transmission, we have yet to produce the 4·433MHz chroma signal and a mixed sync signal which is used to produce clamp pulses and servo drive waveforms. Let us look first of all at the production of the chroma signal.

Chroma circuits

Unlike the conventional decoder in a colour TV receiver, the VCR has only to produce the chrominance signal and need not go to the lengths of producing red, green and blue signals. This situation arises first because it would be impossible to fit the three wideband signals into the limited bandwidth available on the tape. Secondly, as the VCR produces a u.h.f. output to feed directly to the colour receiver's aerial socket, it would be pointless to decode the information and then have to recode it so that a domestic receiver could accept the signal from the VCR.

A 35MHz chrominance i.f. take-off point is provided at the output of the i.f. amplifier module U507, and this signal is fed directly to a detector in module U516. Any 6MHz sound present in the detected chrominance is then removed by a series rejector in module U1501 before amplification of the signal by transistors TS1403, 1404, 1405 and 1406. Automatic chrominance control is incorporated in the first stage of amplification using the conventional technique of half-wave rectifying the colour burst and using the resultant d.c. voltage to control the gain of the chroma amplifier. Production of the subcarrier signal again follows well-known receiver techniques and needs no explanation.

Sync pulse feeds

The output of the luminance delay line is split into three separate feeds, one of which goes to the sync separator U67. The output of this module is fed to a chroma processing stage (described later under the record mode), the tape servo to provide a reference for recording, and to a sync clipper module incorporating transistor TS4110.

This latter stage is a simple emitter-follower which clips the top and bottom of the mixed sync waveform providing a clean, noise-free signal of constant amplitude. The positive-going mixed sync output from TS4110 is then fed to the sync gate TS4100 which inverts the signal and adds it to the output of the luminance emitter-follower TS4070 and the chrominance emitter-follower TS4090. By combining all these three signals in the correct proportions a composite colour video waveform is produced which is then fed to the modulator.

A second output from the sync clipper feeds a pulse former circuit which provides pulses coincident with the line back porch. These are then fed to the burst gate in the chrominance decoder, and to the clamp at the input of module TS4070. Clamping at this point takes place during the line back porch, the clamp reference potential being black level. This clamping action biases the emitter-follower TS4070 so that cut-off of the transistor occurs at black level. Hence the line sync pulses are removed from the signal producing a non-composite luminance output to which new sync pulses are added.

The Modulator

The output signals from transistors TS4100, 4090 and 4070 are combined to form the complete colour signal. This is then added to the modulated audio signal derived from the f.m. modulator in U505 before being fed to the main u.h.f. modulator. The output frequency of this modulator can be preset to lie anywhere between channels 32 and 42, thus ensuring that the VCR can be used without interfering with the local u.h.f. TV transmissions.

Now that the signal being received by the machine has been processed and remodulated onto a new carrier, its output is recombined with the incoming u.h.f. signals from module U504 and fed to the colour receiver which has one of its channel selectors tuned to the output frequency of the VCR. The user is now able to select any incoming programme on the VCR tuner, transpose its frequency, and feed it to the colour receiver. He is also able to view the programme which is being recorded, or tune to a separate transmission without disturbing the recording operation of the machine.

Recording

When the machine is recording a selected programme all the functions described under the E to E mode take place in addition to those about to be explained. Let us just recap on what the machine is required to do during the record mode.

The audio signal must be processed in the same way as in an audio tape recorder, i.e. be equalised, added to an h.f. bias signal and then applied to the audio record head. The video signal must be passed through an h.f. filter, clamp, and then be frequency modulated before being applied to the video record head. The chrominance signal has to be processed and then added to the luminance f.m. signal.

The Chroma signal

As the VCR has a bandwidth of only 2·7MHz the chrominance information must be processed in such a way as to lie in the passband of the machine. It can be seen from Fig. 7 that this is achieved by transposing its frequency from 4·433MHz down to 562·5kHz, fitting below the spectrum of the luminance f.m. signal. During the playback of the signal the chroma is converted up in frequency, back to its original 4·433MHz. Incorporated in this system of transposing the chrominance frequency is a method of automatically compensating for changes in chroma phase caused by variations in head to tape speed during recording and playback. The system works as follows.

Line sync pulses from the sync separator module U67 are derived from the signal to be recorded, and used as a reference signal for the phase comparator also in module U67. The output from the comparator is used to lock an oscillator running at 562·5kHz (36 times line frequency). To complete the phase-locked loop the oscillator output is divided by 36 to produce a line frequency feedback signal for the phase comparator.

We now have an oscillator running at 562·5kHz which is directly locked to the line sync information contained in the signal to be recorded. The output of the oscillator is mixed with subcarrier derived from a crystal oscillator situated in the chroma decoder and locked to the colour burst of the incoming signal. A band-pass filter incorporated in U61 with the mixer passes the additive products of the mixed signal to produce a 4·99MHz sine wave. This second frequency is now directly locked to (a) the line sync information and (b) the subcarrier frequency of the video signal to be recorded. Any change in frequency or phase of (a) or (b) will produce a change in the frequency or phase of the 4·99MHz signal from U61.

A second mixer in U62 takes the output of the chroma decoder previously described and the 4·99MHz signal from U61 and mixes the two signals together. A low-pass filter at the output of the mixer passes the subtractive products to produce the final 562·5kHz. This transposed chrominance signal is derived directly from (1) line sync (2) subcarrier and (3) the chrominance signal. Any change in phase of these three signals will result in a phase change of the transposed chroma frequency. The table below shows the mathematical sequence used to produce the 562·5kHz chrominance.

Line Sync = 15·625kHz
36 × line sync = 562·5kHz
Subcarrier = 4·43361875MHz
Subcarrier + 36 times line frequency = 4·9961187MHz
4·9961187MHz − Chrominance frequency = 562·5kHz

The Luminance signal

The luminance signal is processed in almost exactly the same way as that of the Sony VTR described in last month's article. The signal from the luminance delay line in the receiver section of the VCR is fed directly to a low-pass filter TS401 where all the frequencies above the passband of the machine are removed. The signal is then black-level clamped to set the carrier frequency of the modulator, and white clipped to prevent over-deviation. After the signal has been pre-emphasised it is modulated on to a 3MHz carrier which is deviated up to 4·4MHz at peak white. The modulated signal is then limited by a simple two-stage clipper and amplified before being applied via a rotary transformer to the record heads. In the record current amplifier the transposed chrominance signal is added to the f.m. luminance signal. Fig. 8 shows the way in which the f.m. signal acts as the h.f. bias for the lower frequency chroma information, thus enabling both signals to be recorded at the same time with minimum mutual interference.

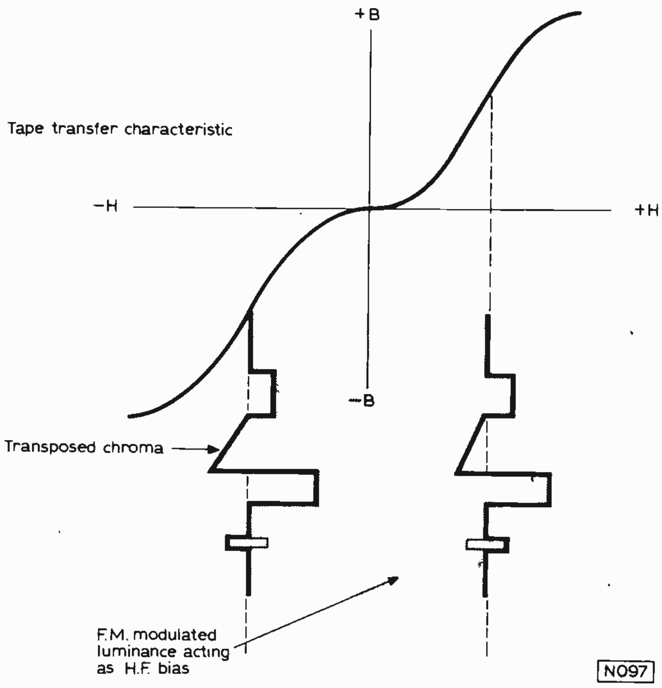


Fig. 8: The f.m. luminance signal acts as h.f. bias for the lower frequency chrominance signal on recording.

The Audio signal

Audio recording techniques are very simple when compared to the electronics of the rest of the machine. The output from the f.m. detector U515 is fed directly to an amplifier providing pre-emphasis and audio record level control. The operator has a choice of manual or automatic control of the audio signal, but the video signal record level is preset by the a.g.c. system in the luminance i.f. amplifier and therefore is completely automatic.

A 60kHz bias signal derived from the erase oscillator TS455 is added to the audio before it is applied to the record head K3. A separate audio amplifier TS450 provides the signal for the 6MHz f.m. modulator in U505. The output of two simple level circuits TS454 and TS460 can be switched to a meter to enable the operator to measure the level of either signal being recorded.

Next month

In next month's issue, we will examine the playback system of the VCR together with the operation of the servo system in the Record and Playback modes.

Improved Performance from the "Television" Colour Receiver

F. Greene

A 26in version of the *Television* colour receiver, using a Pye i.f. strip and the stabilised power supply circuit described in the December 1973 issue (pages 80-2), has been in operation for some eighteen months. Performance has been satisfactory but it was felt that there was lack of contrast, giving poor viewing under high ambient lighting conditions. There were also stripes at the left-hand side of the screen.

Improving the Contrast

The contrast problem is due basically to inadequate luminance drive to the RGB board, and is also experienced with sets fitted with the original i.f. strip. The only way of overcoming the problem is to add a video amplifier between the luminance channel on the i.f. board and the luminance input to the RGB board. The requirements of the amplifier are quite stringent however – in particular it must be fast since the correct luminance delay has already been set by the luminance delay line on the i.f. panel.

The specification is as follows: voltage gain of two minimum; bandwidth 5MHz; input-output delay 10-20nsec (10^{-9}sec); rise/fall times 20-30nsec; high input impedance and low output impedance; operation from a 20V stabilised rail; output voltage swing of 6V peak-to-peak without the amplifier saturating (i.e. limiting).

Fast Amplifier Circuit

The circuit developed to meet these requirements is shown in Fig. 1. It consists of a two-stage amplifier (Tr1/Tr2) using current feedback to determine the gain, followed by an emitter-follower output buffer stage (Tr3). PNP and npn transistors were used to ease the biasing problem and eliminate interstage a.c. coupling: only the input, from the contrast control slider, is a.c. coupled, the luminance input circuit on the RGB board incorporating a coupling capacitor.

Using the component values specified the nominal gain of the amplifier is three. This guarantees the minimum gain requirement taking component variations and tolerances into account. The amplifier was constructed on 0·1in single-sided tracked Veroboard – apart from keeping lead lengths to the minimum the layout is not critical. The performance on bench testing was found to be as follows:

Conditions:

Supply	20V
Capacitive output load	25pF
Input voltage	2V peak-to-peak
Pulse repetition frequency	5MHz
Pulse width	100nsec
Input rise/fall times	20nsec

Performance:

Output voltage	5V peak-to-peak
Rising pulse edge delay	14nsec (50% points)
Falling pulse edge delay	13nsec (50% points)
Overshoot/undershoot/ringing	Negligible

The amplifier was thus found to meet the requirements. It was incorporated in the set between the wiper of the contrast control potentiometer (2E) and the luminance input on the RGB panel (3C), using coaxial cable for the signal connections, earthed at each end. Power was taken from the 20V supply on the RGB board (3A and 3J).

When installed the amplifier gave the desired improvement in performance, with more than enough contrast control range and satisfactory picture quality under high ambient lighting conditions. It has also been tried out in a set using the original i.f. board, with the same results.

Striations

The problem of vertical stripes at the left-hand side of the screen was found to be due to the 750V black-level clamp pulses on the RGB board being coupled into the 20V rail and causing ringing. This ringing is superimposed on the colour signals, amplified and fed to the c.r.t. to give the stripes observed. A marked improvement was obtained by using a high-quality solid tantalum electrolytic capacitor (6·8μF, 35V) to decouple the 20V rail – add from 3A to 3J. This reduced the amplitude of the ringing considerably, making the stripes much less noticeable. ■

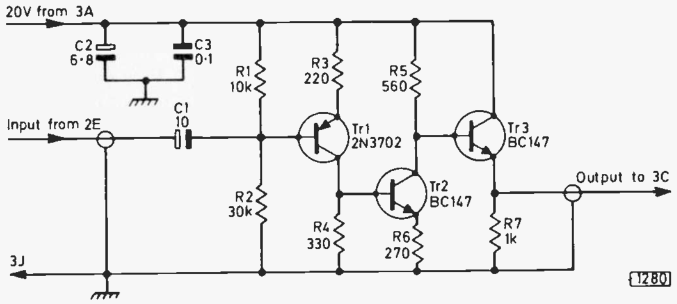


Fig. 1: Fast video amplifier circuit. Use a 6·8µF solid tantalum capacitor (C2) on the board as well as adding one on the RGB board – see text.

★ Components list

R1	10kΩ	C1	10µF 20V solid tantalum
R2	30kΩ	C2	6·8µF 35V solid tantalum
R3	220Ω	C3	0·1µF 100V ceramic
R4	330Ω		
R5	560Ω		
R6	270Ω		
R7	1kΩ	Tr1	2N3702
All resistors 10%,		Tr2	BC107 or BC147
½W, type TR4		Tr3	BC107 or BC147

SWITCH-MODE POWER SUPPLIES

E. TRUNDLE

UNTIL a few years ago the power supply was a relatively insignificant part of a tv receiver, often consisting of only a handful of components. There was the brute force arrangement, with a large choke and smoothing capacitor providing a single h.t. rail from which the entire set was powered. Slightly more civilised is the multi-filter circuit, in which several *RC* filters smooth and isolate several different h.t. lines which feed various sections of the receiver. Valves are not fussy devices so far as h.t. supplies are concerned: in particular the all important line output stage can be stabilised by means of a v.d.r. circuit.

The valve heaters represent a waste of energy, the inevitable heat being added to by the customary "hairy" mains dropper. In early monochrome sets over 100W of heat was usually dissipated within the cabinet, while hybrid colour sets could achieve 300W! The problem could have been resolved, but the old bogey of cost ensured the survival of the dropper for many years.

Development of Solid-State TV Chassis

The advent in 1967 of the first fully transistorised colour chassis (Thorn 2000) resulted in power supply circuitry being rethought. The first colour receiver line output transistors were low-voltage devices requiring an h.t. line of around 60V. As with all transistor line output stages the transistor operates in true class C, and for good e.h.t. regulation – and stable width – a stabilised power supply is required to cope with the high and variable current demand. In the 2000 chassis a double-wound mains transformer was used, with separate series regulators of conventional design feeding the line and field timebases. This is a good but expensive system. The subsequent single-standard Thorn 3000 chassis retained low-voltage transistors but used a switch-mode regulated power supply, the famed chopper circuit.

As high-voltage deflection transistors became available the norm for solid-state colour receiver h.t. lines became 160-200V. This eased the current requirements, but the need for efficiency and stabilisation remained. A different type of switch-mode power supply, based on the use of a thyristor (silicon controlled rectifier), was developed to meet this need. More recently a number of other techniques have been developed, culminating in the Syclops circuit used in the Thorn 9000 chassis – a description of the operation of this was given in the August issue.

Switch-Mode Principle

Imagine you are using a 100W bulb to light a small room. If you wanted less light than that given off by the bulb several techniques could be used to reduce the light. You might buy a transformer to reduce the voltage applied to the bulb. This would be expensive and bulky however. You might buy a large resistor and wire it in series with the bulb. But this would be wasteful and crude. If you devised a system of switching the bulb on and off at high frequency, no power would be wasted. The ratio of the bulb's on time to its off time (the mark-space ratio) would determine the illumination provided by the bulb and, more to the point, the size of the bill at the end of the quarter! This basically is the principle of the switch-mode power supply. The analogy is by no means exact however, since the bulb's current requirement does not vary and, provided the switching or chopping rate is sufficiently high, no energy reservoir is required between the switch and the load (the bulb).

Thyristor Stabilised Supplies

Nearly all current colour receivers use a form of switch-mode power supply. The most common circuit is the thyristor one, so we will look at this first. The thyristor may directly rectify the incoming mains supply, or it may be fed by a separate full-wave rectifier. In either case the thyristor's mode of operation is the same.

Rank Circuit

An example of the first approach is the circuit used in the Rank 90° colour chassis which was introduced in 1969. Fig. 1 shows the circuit. The thyristor 8THY1 can conduct only on positive half-cycles of the mains input waveform and only when its gate has been made positive with respect to its cathode. It is a characteristic of the thyristor that once it has been triggered at its gate it will continue to conduct until its anode voltage drops below the voltage at its cathode – regardless of the conditions at its gate. If we can arrange therefore to apply a positive pulse to the gate at some point during the latter half of the positive half-cycle of the mains input, the thyristor will fire and continue to conduct until the mains waveform drives its anode voltage below the potential at its cathode – thus reverse biasing it.

The thyristor gate triggering voltage is derived from the mains input sinewave via the potential divider 8R6, 8R7 and 8RV1. Its timing is incorrect however, so after amplification and clipping by 8VT1 a delay is introduced by the phase-shift network 8R10, 8R20 and 8C7. The BR100 diac 8D3 is a bidirectional device which conducts at a point called its breakover voltage. When this is exceeded, it conducts and conveys a positive triggering pulse via 8C8 to the gate of the thyristor which thus fires.

The zener diode in 8VT1's emitter circuit compensates for temperature drift, and the initial working point of the circuit is set by the "set e.h.t." control 8RV1. Compensation for mains voltage variations is effected directly by 8VT1 since its base current is determined by the mains voltage.

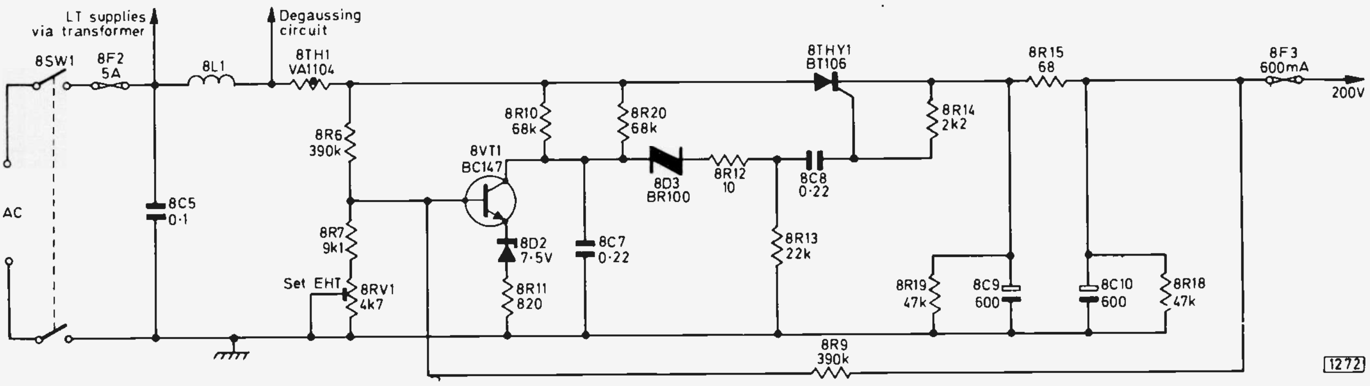


Fig. 1: Thyristor stabilised power supply circuit used in the Rank A823AV chassis. Thyristor 8THY1 is switched on during the latter half of each positive-going half cycle of the mains input. The trigger pulse is provided by diac 8D3, under the control of 8VT1 which compensates for variations in the mains input and for variations in the load, the former action occurring since its base is fed with the mains input, the latter as a result of the feedback via 8R9. The timing of the trigger pulse is controlled by 8VT1 with 8C7/8R10/8R20.

The all important h.t. line stabilisation is achieved by applying feedback to the base of 8VT1 via 8R9. If due to increased current demand the h.t. voltage falls, 8VT1's base current also falls, reducing its conduction: consequently 8C7 charges more rapidly via 8R10/8R20, the breakover voltage of 8D3 is reached sooner and 8THY1 is fired earlier in the cycle, increasing the output voltage to offset the initial fall.

A conventional filter – 8C9/8R15/8C10 – removes the ripple on the output line. The arrangement is relatively simple, but effective. The alternative approach used in chassis such as the Pye 713 and Philips 320 (monochrome, this one) is to include a separate full-wave bridge rectifier between the mains input and the thyristor. In consequence the anode of the thyristor is fed with a train of 100Hz positive-going half-cycles, greatly assisting in the smoothing downstream from the thyristor. The circuit's operating principle remains the same however. You may also find a single half-wave rectifier in series with the thyristor, on the mains side: this is simply to provide the thyristor with a degree of protection against transients on the mains input.

It is a common fallacy that the thyristor continues to conduct until the mains waveform drops to zero. As the thyristor cuts off when its anode voltage falls below its cathode voltage however this cannot be – see Fig. 2. The relatively short time interval between $t1$ and $t2$ is called the conduction angle and is measured in degrees of the mains cycle (360° occupies 20msec with a 50Hz mains supply). During the brief interval when the thyristor is conducting the entire energy required by the receiver for the whole period must be passed into the reservoir. The peak current through the thyristor is thus several times the h.t. current flowing through 8F3 – see Fig. 2(c).

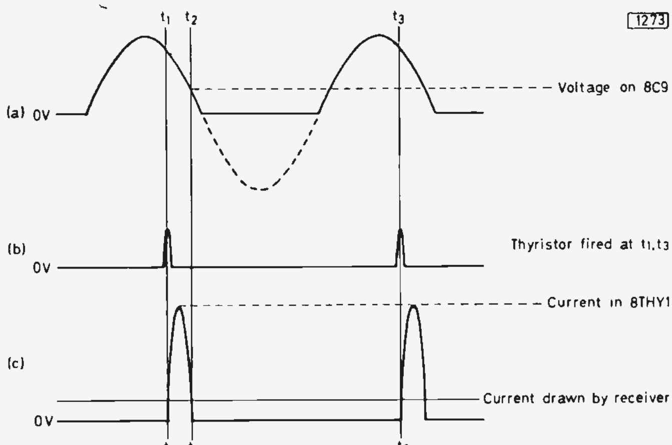


Fig. 2: (a) Duty cycle, or conduction angle, of thyristor 8THY1. (b) Trigger pulses from the diac fire the thyristor at times t1, t3 etc. (c) During the time t1 to t2 the reservoir capacitor 8C9 has to be charged sufficiently to be able to supply energy to the receiver until time t3.

In all sets using switch-mode power supplies protection is required against over-voltages due to a fault or mis-adjustment of the regulating mechanism (see article in the August 1975 issue). In the Rank chassis in question a voltage sensing arrangement in the line generator circuit shuts down the line output stage in the event of the h.t. voltage rising 10% above normal, thus preventing damage.

Many chassis use thyristor power supply circuits, and inevitably there are variations in detail.

Chopper Circuits

The chopper technique is by no means new, having been used for many years in industrial instruments and professional equipment. It first burst upon an astonished retail world however in the Thorn 3000 chassis. Sony used a broadly similar design in their KV1300UB receiver, and the Berry Vision solid-state chassis uses the same basic arrangement. The idea is that a transistor in series with the supply – the chopper transistor – is either fully saturated or cut off, thus dissipating very little power. Regulation is effected by varying the ratio of its on/off times. The chopping occurs at line frequency. The circuit has been described in detail before in this magazine, for example in the September 1974 issue (pages 514-7), so we do not propose to repeat all this.

As high-voltage transistors have become more commonplace in current designs, so the chopper power supply is being abandoned in favour mainly of thyristor designs. There are nevertheless many thousands of sets with chopper supplies in use, and they will require servicing for many years to come. There are other approaches to h.t. regulation however.

Blocking Oscillator Circuit

In their 110° colour chassis for example Tandberg use a novel form of switch-mode supply which could become more widespread in future. The circuit is shown in Fig. 3. The incoming mains is rectified by the full-wave bridge rectifier D976-9, the resulting –280V output being smoothed by C977 and used to power the blocking oscillator Q977 which supplies power to the whole of the receiver except for the c.r.t. heaters. The primary winding of the blocking oscillator transformer is winding a-d which forms Q977's collector load. The feedback winding is i-h, which is connected to the

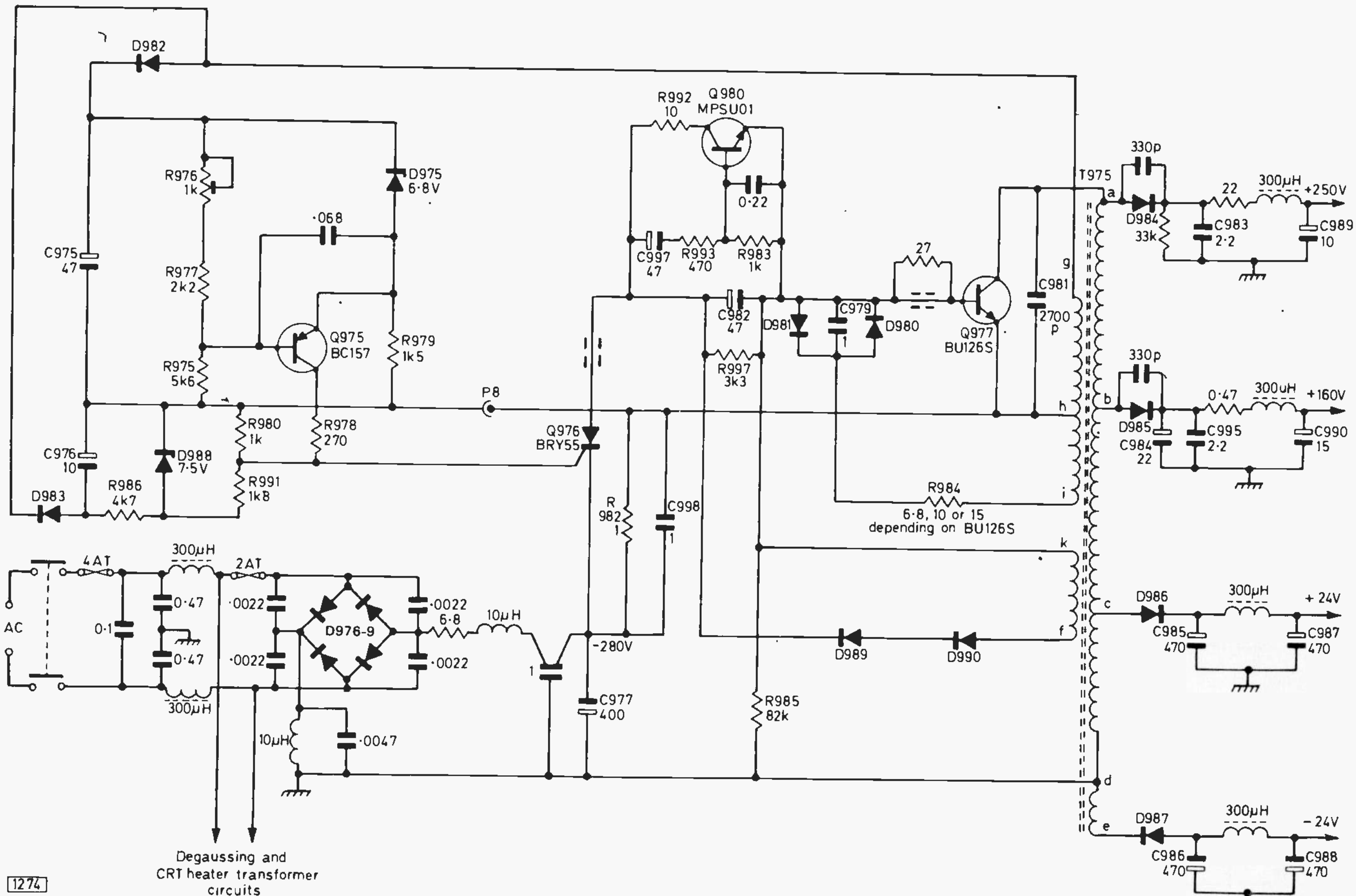


Fig. 3: Blocking oscillator switch-mode power supply circuit used in Tandberg 110° colour sets. Warning to Australian readers: a very similar circuit is used in the EMI (Australia) C211 110° colour chassis!

base of Q977 via the limiter resistor R984, capacitor C979 and the speed-up diodes D980/D981. Q977 is either fully saturated or cut off, so its dissipation is low. The output is a squarewave of varying mark-space ratio – depending on the frequency, which is varied to provide the regulation. The squarewave output is rectified by diodes D984/D987 and filtered to provide the various supply lines required by the receiver. The oscillator's high basic frequency (> 25kHz) greatly eases the filtering and accounts for the low values of the smoothing capacitors. The transformer T975 itself is a surprisingly small ferrite-cored device.

Stabilisation

The voltage appearing across winding g-h is rectified by D982, with C975 as its reservoir. This voltage (approximately 24V) is proportional to the unit's output voltage and sets the base current of Q975 whose emitter voltage is stabilised by zener diode D975. The conduction of Q975 is thus governed by the unit's output voltage. As this increases, the collector of Q975 moves in a positive direction, taking the gate of thyristor Q976 with it.

The regulator's "earth" line is point P8, at Q977's emitter, but as a result of the presence of R982 there is a sawtooth ripple voltage present here. The amplitude of the sawtooth is proportional to Q977's emitter current. This sawtooth appears at the gate of thyristor Q976, which fires on the peaks of the sawtooth voltage.

As its gate moves positively, due to the action of Q975, so a lower amplitude sawtooth voltage – corresponding to less current in Q977 – is required to fire the thyristor. Each time Q976 fires it passes a negative pulse from the –280V line via C982 to the base of Q977, cutting it off early. The output voltage is thus stabilised against mains voltage and load current variations. Capacitor C982 is charged to about 4V by D989 and D990 from winding k-f on the transformer: this holds the anode of the thyristor at the correct voltage.

Kick-Start Circuit

At switch on the reservoir/smoothing capacitors C983-C990 present a heavy load to the transformer on the positive half-cycles of its output, due to the charging current. Thus C975 will not charge fully via D982, and the regulator transistor Q975 will not conduct. The negative half-cycles are not loaded however, and as a result C976 is charged to about –30V by diode D983. This voltage is stabilised at –7·5V by zener diode D988. The potential divider R980, R991 supplies –3V to the gate of thyristor Q976. This means that the current in Q977 must be very high (3·7A) before the voltage developed across R982 becomes high enough to fire the thyristor and cut Q977 off. The feedback voltage from point i on the transformer is still too small at switch on (due to the loading effect of the charging filter capacitors) to maintain oscillation however. Thus we need a starting mechanism to get the circuit going.

At switch on the charge on C982 increases because winding k-f is so phased that diodes D989 and D990 conduct on the "unloaded" half-cycles of the output. C997 therefore charges through the base-emitter junction of Q980. As a result Q980 conducts, tending to discharge C982, which is already being drained by the conducting thyristor Q976. The net result is that the charge on C982 becomes too low to maintain the thyristor in conduction. The thyristor is thus held "off" until C997 has charged and Q980 cuts off. This takes about 100msec, by which time

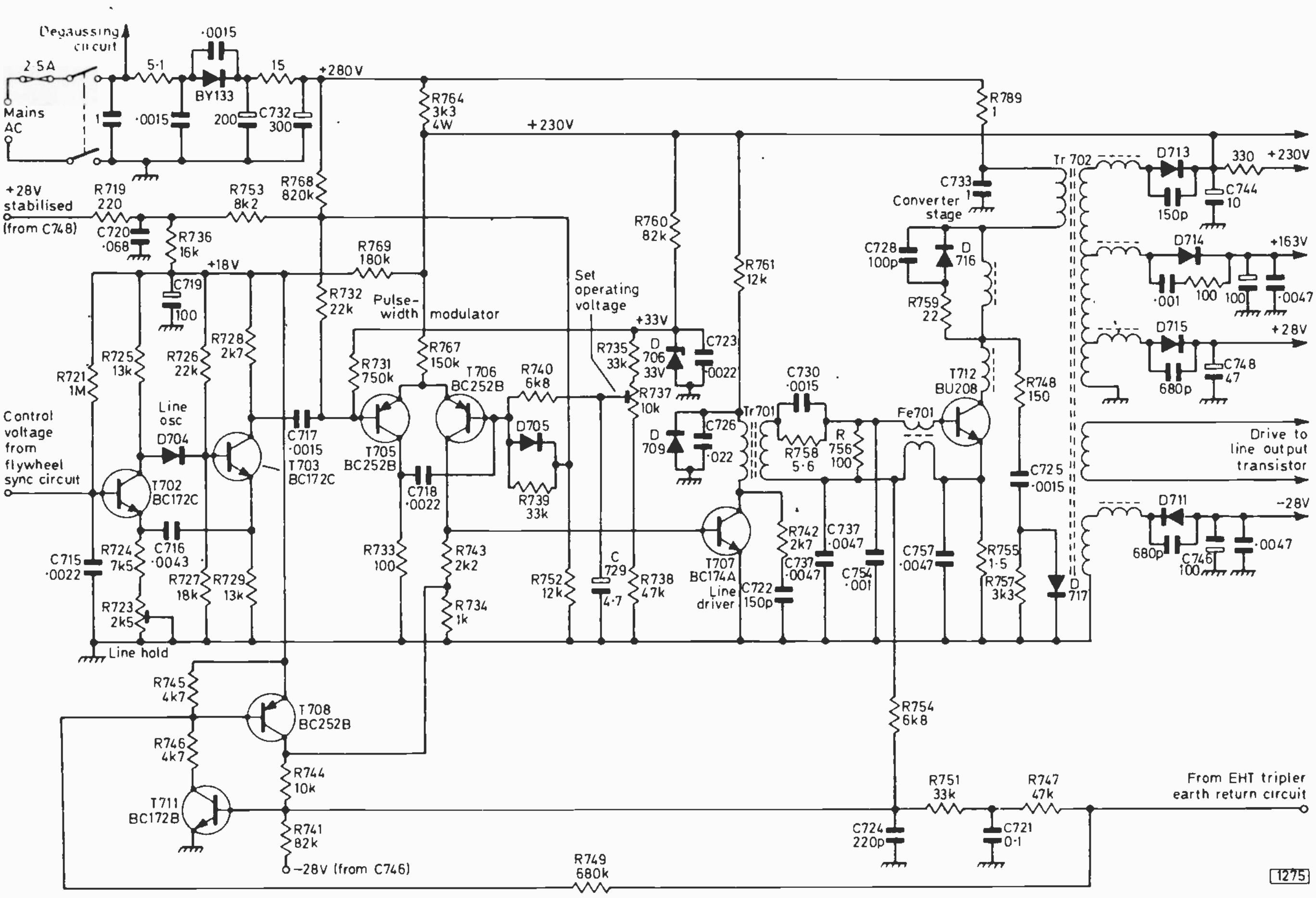


Fig. 4: Power supply regulation in the ITT FT110 chassis is effected by varying the mark-space ratio of the waveform from the line oscillator. This varies the conduction periods of the converter stage between the line driver and the line output stage. Rectifiers fed from taps on the converter transformer Tr702 consequently provide regulated outputs. When servicing the line oscillator/switch-mode power supply board it is important to ensure that C732 is completely discharged before attempting to remove or plug in the board.

the output filter capacitors have charged and the excessive load has thus been removed. The circuit then operates normally.

Overload Protection

If a heavy load is presented to any of the outputs from the unit (a short-circuit line output transistor for example) the regulator will function as described above but without Q980 conducting. C982 will eventually discharge through the thyristor, cutting it off and allowing Q977 to conduct briefly. C982 will rapidly charge again, switching the thyristor on for a long period until the charge on C982 has once more leaked away. The mark-space ratio of the blocking oscillator's output waveform thus becomes high, reducing the average current to a safe level. The repetition frequency in fact falls to about 1kHz, and a characteristic buzz is heard from the oscillator transformer. These conditions are maintained (even if the load is removed) until the set is switched off for a few seconds and then switched on again, allowing the quick-start circuit Q980 to operate once more.

ITT FT100 Circuit

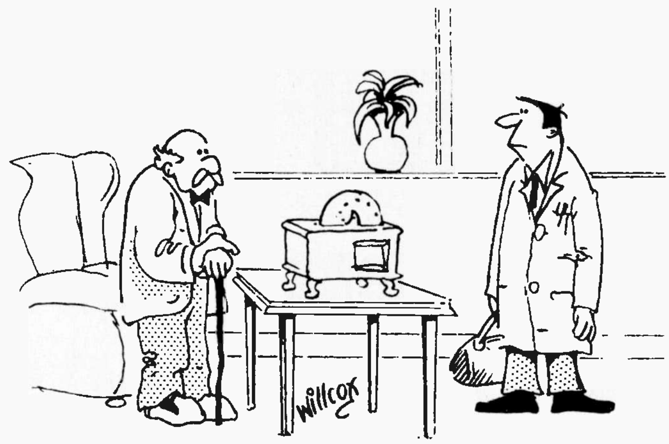
The regulator circuit used in the ITT 110° Model FT110 is another example of the switch-mode technique and, like the chopper circuit used in the Thorn 3000 chassis, operates at line frequency. In this case the regulator is part of the line timebase, which is logical since both functions are being carried out at the same frequency. There are five basic sections of the line timebase: the oscillator, followed by a pulse-width modulator which varies the mark-space ratio of the oscillator's output waveform, the line driver stage, a converter stage which provides the regulated outputs and also drives the line output stage itself.

The circuit is shown in Fig. 4. The line oscillator is – unusually – a multivibrator consisting of T702 and T703, the frequency being determined by the time-constant of C716, R724 and R723. There are two power supply feeds, one from the 28V supply via R719 and R736, and a start-up feed from the 280V (unregulated) line via R764 and R769.

Pulse-Width Modulator

The output is coupled by C717 to the pulse-width modulator, a monostable multivibrator consisting of T705 and T706. This is triggered on by the line pulse at the base of T705 and remains on for a period determined by the rate at which C718 discharges into the base of T706. The discharge rate of this capacitor is governed by the conduction of the transistors, which in turn depends on the 28V line voltage applied via R719, R753 and R732 to the base of T705. The result is a feedback loop, the power supply output voltage being monitored and translated into a mark-space ratio variation of the current pulses flowing through T706. The action here is similar to that of the monostable circuit in the Thorn 3000 chassis. Variations in the mains voltage and hum ripple on the unregulated 280V line are compensated for by the link from this line via R768 to the base of T705. The operating point of the circuit is set by the set h.t. control R737, the supply to this being stabilised by the zener diode D706 – if this diode is faulty it will not be possible to set the h.t. correctly, the likely result being a small picture.

When the set is first switched on there will be no 28V supply and the drive pulses to T705 will be low. Current flows via R752, D705, R740, R737, R735, R760 and R764 to the 280V rail, the voltage thus established across R752 compensating for the lack of current through R735, enabling the circuit to start. When the 28V line has risen sufficiently D705 will be reverse biased and normal operation will start.



"Can you convert it to colour?"

Converter Stage

The squarewave current flowing in T706 passes through the base-emitter junction of the driver transistor T707. The following converter output stage (T712) operates in precisely the same manner as a conventional line output circuit, with the ferrite transformer Tr702 providing various output voltages for use in different sections of the receiver. A separate winding on this transformer drives the line output transistor itself. Both the converter and the line output stage use a BU208 transistor.

Overload Protection

As usual, protection is provided, consisting here of the transistors T708 and T711. If a fault condition results in the secondary winding(s) on transformer Tr702 becoming excessively loaded the current in T712 will increase. The resulting increased voltage across its emitter resistor R755 is fed via R754 to the base of T711, driving it into conduction. This in turn switches T708 on, and the two transistors lock on regardless of the voltage across R755. In this condition the driver transistor T707 is held conducting by the current flowing via R743. The converter stage shuts down due to the absence of drive, and all its output voltages fall.

An additional result of T708 conducting heavily is that the line oscillator's supply voltage falls, since C719 discharges. When this voltage falls sufficiently T708 can no longer hold T711 on and the two transistors switch off again. The whole cycle repeats at about 400msec intervals until the overload is removed.

During channel changing the c.r.t. beam current rises to maximum: the feed from the e.h.t. tripler circuit via R747 prevents the circuit tripping in these circumstances. In the event of a c.r.t. flashover a negative pulse is applied from the e.h.t. tripler circuit via R749 to the base of T708 to operate the trip.

Servicing

From the servicing point of view switch-mode power supply arrangements are certainly more difficult to deal with than conventional circuits. There is always the danger of short-circuits or incorrect operating conditions causing an over-voltage, with disastrous results. Under no circumstances should any protection device be over-ridden or disabled. In the Thorn 3000 chassis for instance repeated tripping of the mains cut-out is often due to the over-voltage crowbar trip thyristor W621 being leaky. If this is suspected, W621 must be replaced: don't disconnect the crowbar thyristor and switch on since an over-voltage may be legitimately firing it.

Another point to remember is that transistor switches are designed to operate very rapidly in order to minimise the dissipation within them. Do not therefore connect any instrument – an oscilloscope with straight-through probe for example – whose input capacitance is likely to slow the rise time of the switching waveform. Examples of vulnerable points are the base of the chopper transistor VT604 in the Thorn 3000 chassis and the base of the blocking oscillator transistor Q977 in the Tandberg circuit described earlier.

Dummy-Load Testing

The risk of damage when working on switch-mode circuits can be eliminated by disconnecting the power supply unit's output line(s) and simulating the load by using a resistor to absorb the energy. Taking the Thorn 3000 chassis as an example, we need to draw about 1·5A at 60V from the chopper circuit. This suggests a 40Ω, 100W resistor – best made up from a firebar element. A standard 240V, 1kW element has a resistance of about 60Ω.

A more elegant (and more expensive) way of testing is to use a variac. The mains can then be slowly "wound up" while the output currents and voltages are monitored.

One disadvantage of the auto protection used in the Tandberg circuit is that fault diagnosis is made more difficult since the set has to be switched off and on again to reset the trip. This allows only a few milliseconds in which to diagnose the fault! The dummy-load or variac dodges can be very useful here. If in doubt, a cold check on all the semiconductor devices in the power supply circuit will often reveal the culprit.

In the ITT FT110 and similar designs where the circuit "pulses" during overload conditions – the Thorn 9000 Syclops circuit is another example – cold d.c. checks for leakage in vulnerable components should be made. If this doesn't resolve the problem, progressive load shedding by disconnecting supply lines until normal operation returns should reveal the fault area.

Conclusion

Switch-mode power supplies are certainly here to stay, and as the transformer manufacturers and the purveyors of large wire-wound resistors slowly go broke we must attack power units with an oscilloscope probe rather than a neon screwdriver! The writer vaguely remembers a strange glass device (PY32 or something) which apparently once formed the heart of a TV set's power supply. May it rest in peace!

CEEFAX/ORACLE

reception techniques

Steve A. MONEY T. Eng. (CEI)

PART 4

BOTH television and the cinema film depend upon the phenomenon of persistence of vision in the human eye to create the illusion of moving pictures. If the film in the cinema is projected too slowly an intolerable flicker effect is produced. To avoid this effect in television the screen is scanned fifty times a second. The broadcast television signal contains all of the resulting video information, which after suitable processing is applied directly to a cathode ray tube to reproduce the required picture.

In the case of the teletext signals however things are not as straightforward. The data for a selected page of teletext information is transmitted as a short burst of signals about once every thirty seconds or so depending upon the number of pages in the magazine being broadcast. To present a stable display on the screen we need once again to apply a video signal to the picture tube at the rate of fifty scans per second. In order to produce this continuous video signal for the display the received data, having been captured and decoded, must be stored in some form of memory device.

Page memory

Unlike a normal television picture the display of a page of teletext data follows a rigidly defined layout in which there are 24 rows each containing 40 spaces where the characters or symbols may be displayed. Each of these spaces can contain any one of 150 possible patterns, 96 being alphanumeric symbols whilst the other 64 are used for graphics. For each space a seven-bit binary coded number defines which one of the possible patterns is shown in that space. In a typical displayed page many of the 960 character positions will just be blank spaces but a code number is still required for each of them to tell the display control circuits to leave the space blank. For a complete page of data there will be 960 words of seven bits each, giving a total of 6720 bits of data which must be stored in the page memory of the decoder.

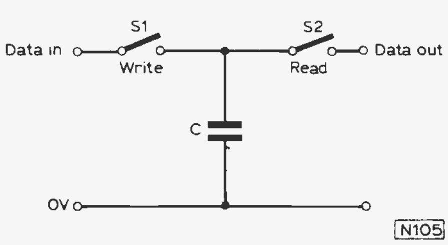


Fig. 17: A capacitor memory cell.

Most decoders will have a memory which holds a single page of data but some more sophisticated models may have a number of memories so that several pages or perhaps the complete magazine may be stored at one time. This would enable the viewer to have an immediate display of a different page, whereas a viewer with a simple decoder might have to wait up to half a minute before his newly selected page appears on the screen. For the moment we shall deal with the single page memory since the extra pages of memory will be identical circuits.

Now let us look at the requirements for a single page memory. Basically it consists of an array of 960 electronic 'pigeonholes' each of which is used to hold a code defining the pattern to be displayed at one of the character positions on the screen. Normally each of these pigeonholes would contain a seven-bit word, but for simplicity let us assume for the moment that the symbol in the character space can be defined by a single data bit. This bit may be either 1 or 0 and will correspond to a space which is either white (1) or black (0).

Each memory cell corresponds to one particular space in the display on the screen. As each piece of data comes from the receiver it must be written into the appropriate cell in the array. Similarly as each space is scanned on the display the corresponding cell must be interrogated and its contents read out so that the correct symbol is shown on the screen. To achieve this an addressing system is needed to obtain access to the data stored in the array.

The two main types of storage system in common use are defined by the method used to obtain access to the data stored in the array. These two types are known as the Random Access Memory (RAM) and the Sequential Access Memory. We shall start by examining the action of the RAM which is the type commonly used for computer systems.

Dynamic memory cell

Perhaps the simplest form of storage element is a capacitor. If the capacitor is charged and then disconnected from the circuit it should, in theory, retain its charge for ever. Fig. 17 shows how such a simple capacitor cell can be produced. Let us assume that when the capacitor C is charged to some voltage V the cell is in the 1 state and when the capacitor is discharged a 0 state exists. Suppose we wish to write a data bit into the memory cell. Switch S1 is closed and connects the capacitor C directly to the input data line. Whilst S1 remains closed capacitor C will charge or discharge until its voltage is the same as that on the data input. If switch S1 is then opened the capacitor will retain this voltage state since there is no path for current to flow into or out of the capacitor. To read data out of the cell the second switch S2 is closed and connects the capacitor to the output data line.

Unfortunately a large array of discrete capacitors and mechanical switches is not a very practical proposition for a teletext page memory when we consider that there must be more than 6000 cells in the complete array. The switches can however be replaced by field effect transistors so that the whole array of cells can be fabricated on an integrated circuit chip. A typical cell arrangement will be as shown in Fig. 18. This is the basic structure of the cells used in the Intel type 1103 random access memory device which has a total of 1024 such cells. All of these cells plus some additional control circuits are packed on to a tiny chip of silicon roughly 3 mm ($\frac{1}{8}$ in) square. A photograph of the chip, taken through a microscope, shows the regular pattern of the array of memory cells and the complexity of the circuit.

Let us consider the action of a transistor-capacitor memory cell. Suppose we wish to write a data bit into the cell shown in Fig. 18. First of all a voltage is applied to the Write Select input. This biases the gate of Tr1 relative to its source electrode causing the transistor to conduct. When conducting fully transistor Tr1 exhibits a very low resistance between its source and drain terminals, thus connecting capacitor C directly to the input data line. The capacitor will then charge or discharge until it has the same voltage level as the input data signal. When the Write Select signal is removed Tr1 turns off effectively disconnecting the capacitor from the input. The voltage across the capacitor should now remain steady for a time if no further Write Select signals are applied.

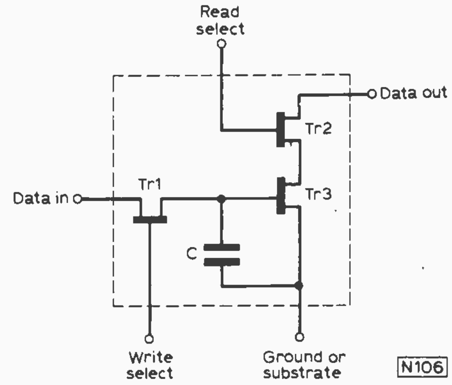
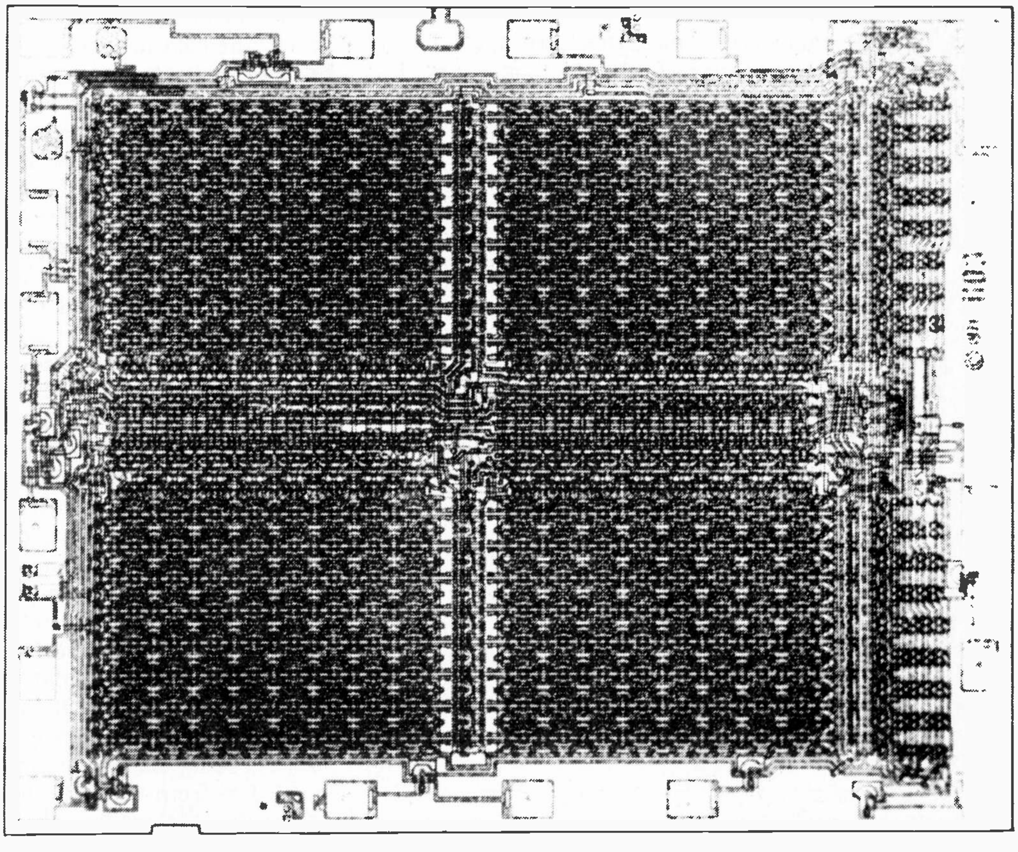


Fig. 18: A dynamic memory cell.

Transistor Tr3 acts as a source follower stage which is the f.e.t. equivalent of a valve cathode follower. It presents a very high input impedance across the capacitor whilst having a relatively low output impedance to enable it to drive the output circuits. Transistor Tr2 acts as a switch to connect the source of Tr3 through to the Data Out line when a control voltage is applied to the Read Select input. To read out the data from the cell all we have to do is apply a control signal to the Read Select input to turn on Tr2, whereupon the voltage across the capacitor will appear at the output and can drive a load without seriously affecting the state of the capacitor.

Selecting the cell

When there is a large number of cells in the memory array we shall need some simple method of selecting one particular cell from the array, either to read data from it, or to write data into it. To simplify the wiring, all of the data inputs of the cells could be fed from a common data input line and all of the data outputs could feed into a common output line. If the cells are effectively in a single row then each cell will need a separate pair of wires for its Read and



Chip layout of the Intel 1103 RAM, as viewed through a microscope.

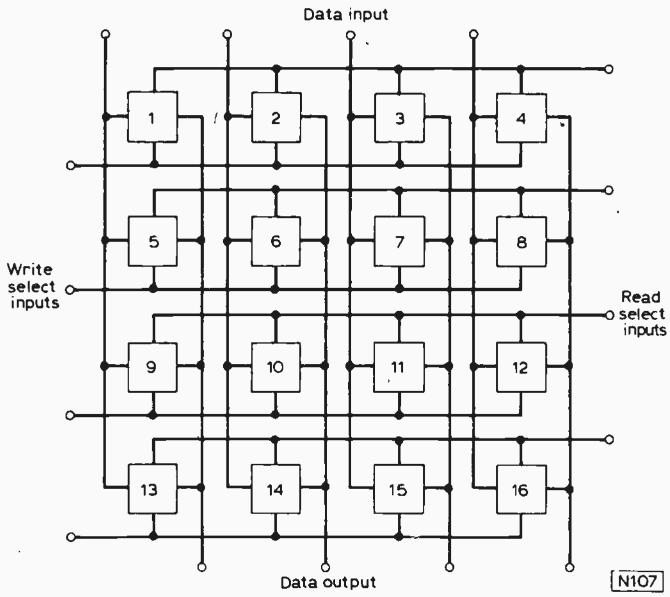


Fig. 19: Connection arrangements for a 16-bit memory array.

Write Select inputs. For an array with 1000 cells this would mean that there would be over 2000 lead-out wires from the array which is obviously not a practical proposition for an integrated circuit device.

The number of leads required and the complexity of the interconnection wiring on the chip can be reduced if the cells are arranged in a two-dimensional matrix as shown in Fig. 19. Here the 16 cells have been arranged to form a 4 × 4 matrix. For a 256-bit array there will be 16 × 16 cells and 1024 bits would need an array of 32 × 32 cells. The input data lines of the cells in each column are tied together in a group and the outputs are similarly grouped. Read Select lines across each row of cells are fed from a common input and similarly the Write Select lines are also joined together across each row. Thus by activating one of the Read Select inputs the whole row of cells associated with that input are selected. In the same way data signals are applied to or taken from a complete column of cells at a time.

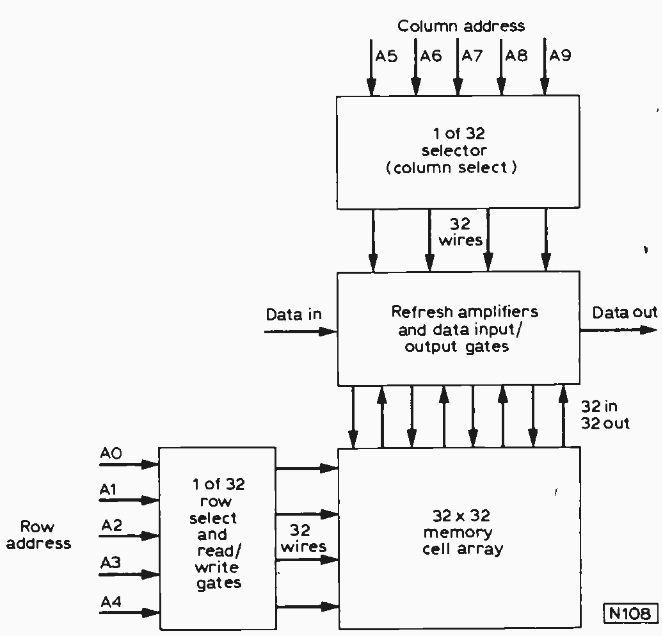


Fig. 20: Overall block diagram of a complete memory i.c.

To select one particular cell from the array we merely have to select the row and column that cross at the desired cell. Suppose we wish to write into cell number 7 in the array shown in Fig. 19. First a Write Select input is applied to the cells in row 2 and then the data input is connected to the cells in column 3. Although the data is applied to all of the cells in the column only cell number 7 has its Write Select activated so it will be the only cell in the column to have data written into it. To read from a cell a similar procedure is adopted using the Read Select and data output lines to determine which cell is selected. To facilitate the switching of the input and output data signals two additional rows of transistor gates are added to the basic array of memory cells.

Currently available memory devices have additional transistor switches and control circuits included on the chip to control the cell selection process. Usually the selected cell is defined by a binary coded address input. For a 1024-bit memory like the Intel 1103 this address code consists of ten bits. Five bits are used to select one of the 32 rows and the other five bits select one of the 32 columns of the array. An overall block diagram of a complete memory integrated circuit is roughly as shown in Fig. 20.

Refreshing the data

Up to now we have assumed a perfect memory cell in which the capacitor, once charged, will retain its voltage level indefinitely unless a further write operation is carried out. In practice it is not possible to produce such a perfect cell in an integrated circuit. Because of the small size of the silicon chip the capacitors that can be produced are of quite low capacitance value whilst at the same time there will be leakage paths on the silicon chip which will allow the charge on the capacitor to leak slowly away. After a short time, usually in the order of milliseconds, the data stored in the capacitor will have been lost unless some action is taken to retain it. For teletext use we need a storage time of about thirty seconds so a method of restoring the data is needed.

To maintain the stored information in a dynamic type cell array the data in each cell needs to be 'refreshed' from time to time. A 'refresh' operation involves reading the data from the cell and then immediately writing it in again. In this way the charge on the cell capacitor can be restored to the level it had after the data was first put in. Thus the data is restored after each refresh cycle and may be retained in the cell indefinitely. The refresh cycle must of course be carried out before the charge on the capacitor has fallen to a level at which the data is lost or unreliable and for most dynamic memories this involves refreshing each cell at least once every two or three milliseconds.

If every cell were selected individually to refresh it, the number of refresh cycles needed would be too great for practical use so in most memories a whole row of the array is refreshed at at time. Thus for a 1024-cell array only 32 refresh cycles would be needed instead of 1024. To simplify external circuitry, refresh cycles are carried out automatically every time data is read out from one of the cells in a row. As shown in Fig. 20 the output data from the selected row is fed through a set of refresh amplifiers and then passed via the input gates so that it can be automatically written back into the selected row of cells.

To refresh all of the data stored in the memory we simply have to select each of the rows of cells in the array in turn and carry out a Read operation. When the page of teletext data is being displayed on the screen it will be necessary to read data from 40 memory cells in sequence to produce the characters for one line of the display. If we arrange that the characters are stored in successive rows of the memory array then the whole array can be refreshed as each line of characters is read out. Since there are 24 lines of characters per frame the data in the memory array will automatically be refreshed every millisecond which meets the requirements of current types of dynamic memory.

Timing

For a dynamic type memory system the timing of the input and control signals can be relatively critical. In Fig. 21 is shown the timing sequence for a Write cycle with an 1103 type memory device.

First a Precharge signal is applied which is used to reset the internal circuits of the chip and prepare it for a Read or Write cycle. After this the Address code is set up on the address inputs to select the cell which is to be written into. A third signal is Cenable (Chip enable) which is used to select the chip if more than one memory device is used to make up a larger memory array.

The Precharge pulse is now removed and after the input data has become stable the Read/Write line is set to Write, when the data will be written into the selected cell. During the Write pulse the Address, Cenable and Data inputs must remain steady but after the end of the Write pulse the address can be changed ready to select the next cell to be dealt with.

A similar sequence of events takes place during a Read cycle as shown in Fig. 22. Here the Read/Write line remains in the Read condition throughout the cycle. After a short delay time data will appear at the output and will remain valid until either the Address or Cenable inputs change.

Intel Corporation have introduced an updated version of the 1103 which is known as the 1103A. This device does not require a Precharge signal which makes the timing sequence much simpler. In all other respects the 1103A is a direct replacement for the 1103, the Precharge input pin having no internal connection.

Some dynamic memories make use of multiphase clock signals but in general these types are now considered to be obsolete. Most memory systems with dynamic devices are likely to follow the general pattern of the 1103 type. Typical Read or Write cycle time periods for dynamic memories are from 300 nanoseconds to a microsecond.

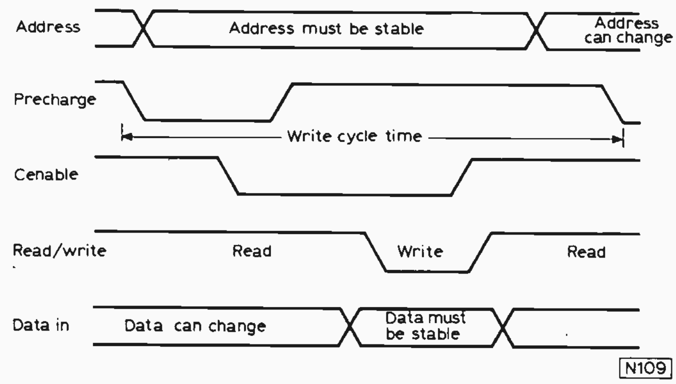


Fig. 21: Timing sequence for the Write cycle of the 1103 memory.

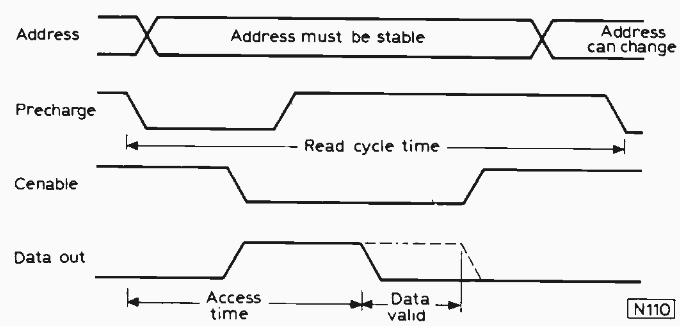


Fig. 22: Timing sequence for the Read cycle of the 1103 memory.

Static memories

One of the major drawbacks of the dynamic type memory device is the need to refresh continually the data stored in its cells. An alternative approach to building a memory array is to use static cells instead of the dynamic type. A static cell contains a somewhat more complex circuit as shown in Fig. 23. Here two transistors, Tr2 and Tr3, form a flipflop circuit having two stable states. Transistors Tr1 and Tr4 act as switches which allow the cell to be connected to the two data lines operating in antiphase. When the Select line is energised transistors Tr1 and Tr4 turn on and connect the cell directly to the data lines.

To write data into the static cell the two data lines are driven from the input data signal so that when the cell is selected it is forced to take up the same logic state as the input data. The cell will retain this state indefinitely unless a further write operation is carried out.

When data is to be read out from the cell the input data is disconnected and the two data lines are used to drive the output stage of the memory. Now when the cell is joined to the data lines by applying a select signal the data stored will be passed to the output stage but the state of the cell itself will be unaffected.

As in the dynamic memory the static cells form an array of rows and columns and the addressing process is virtually the same. Read and Write sequences follow the same pattern except that in the static memory there is no Precharge signal and no refreshing is carried out.

A typical static RAM is the 2102 type produced by Intel, which has 1024 cells and operates with a read or write cycle time of less than a microsecond.

A practical page memory needs to store seven-bit data words whereas each memory chip is generally capable of handling only one bit. Fig. 24 shows how a complete page memory is built up using 2102 type memory devices. Here each of the seven data bits is fed into a separate memory chip but all of the 2102 devices are driven in parallel on the address and read/write control lines. Thus the same cell in

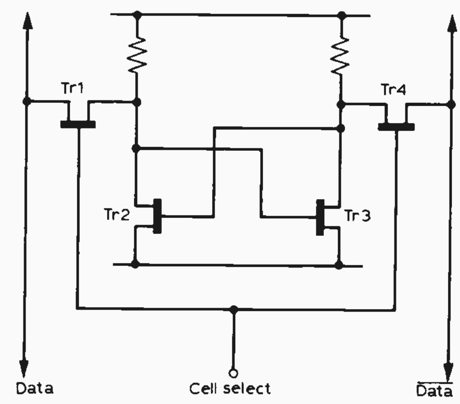


Fig. 23: A typical static memory cell.

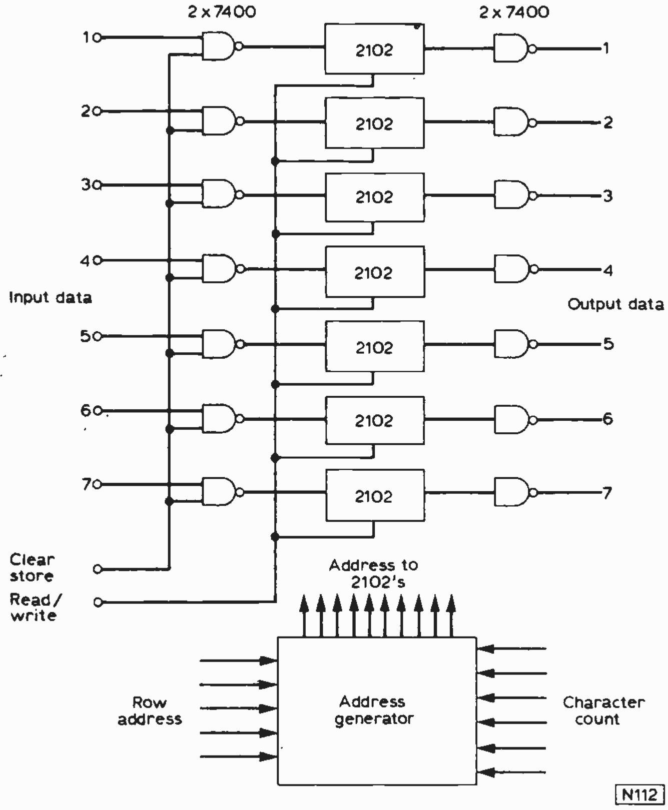


Fig. 24: Block diagram of a Page memory using Intel 2102 RAMs.

all seven chips is selected and the seven-bit data word can be transferred into or out of the memory in one parallel bite. Gates are included in the data input lines so that the whole memory can be cleared of data if desired and a further set of gates at the output allows the memory to drive the following logic circuits in the decoder.

Address generation

It would be very convenient if the array of cells in the memory had a 40 × 24 layout to match the 40-character by 24-line display format of the page of text.

The address code for such a memory array may be split conveniently into two parts, one consisting of five bits which select the row of cells, and the second comprising six bits which select one of the 40 characters in the row. When information is being written into the store the cells along a row must be selected in sequence as the data for each character arrives so that the data is written into its proper position along the row. To do this a counter, which is set to zero at the start of the line of characters, is incremented each time data for a character is received. The counter will therefore count up from 0 to 39 as the line of characters is received and its output can be used to select the cells in the row in sequence as required.

After the first line of characters has been stored the row address of the memory must be increased by one to select the next row of cells. This can easily be done by using the received Row Address code of the data to drive the row address of the memory.

When data is being displayed a similar arrangement is used. Once again a character counter selects the position along the memory row whilst the row address is derived from the display control electronics as it scans the lines of characters on the displayed text.

At the present time specially designed memory devices to match the teletext format are not available. In order to produce integrated circuits economically they need to be manufactured in vast quantities, hence it is unlikely that special teletext memory devices will become available until the set makers start mass producing teletext decoders. In the meantime the readily available memory devices are all aimed at computer and data processing applications. Usually these types have a binary number of cells, often in a square array, and common sizes are 256, 1024 and 4096-bit arrays. Some manufacturers also produce 512 and 2048-bit memories. For a teletext page memory a 1024-bit array device is most convenient and since this is a popular size prices tend to be quite low.

Unfortunately the addressing arrangements for a 1024-bit array are not directly compatible with the teletext page format. An address generation circuit is therefore needed to convert the character count and row address signals into a simple binary code address for application to the memory devices.

Suppose that we are writing the first line of symbols into the memory. The character count signal can be applied to the first six bits of the memory address so that as the 40 characters in the line arrive they are loaded into the first 40 cells in the memory array. For the next line of characters however we need to add 40 to the output of the character counter so that the data is loaded into cells 41 to 80 in the memory array. For each successive row of characters a further 40 must be added to the count signal so that the data progressively fills the memory. Thus to produce the address for the memory device we need to add forty times the row address of the line of characters to the character

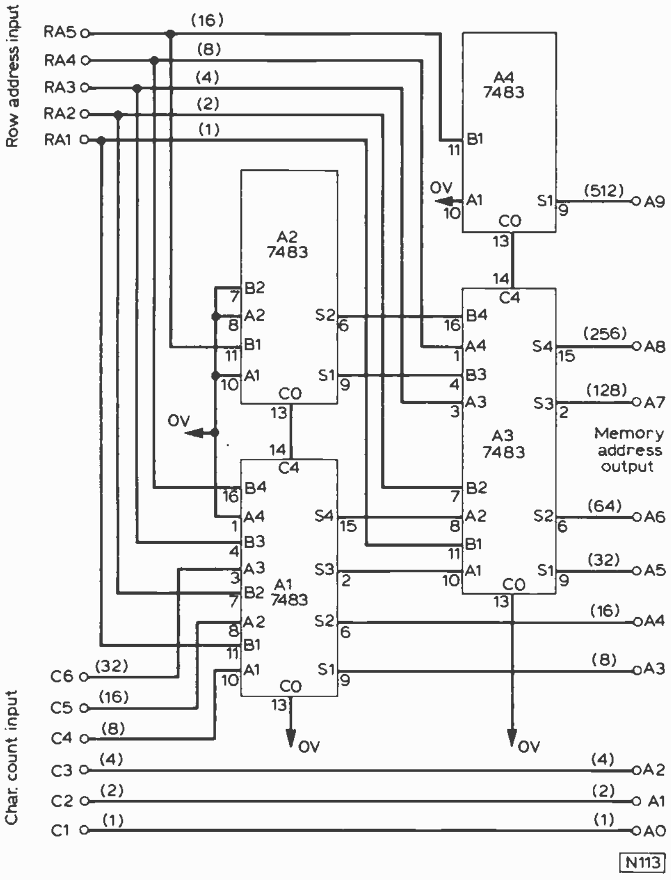


Fig. 25: An address generator circuit.

count along the line. This can be carried out by using the circuit shown in Fig. 25.

Here 7483 type binary adder devices are used. These devices will accept two four-bit binary numbers at their inputs and produce a binary number at the output which is equal to the sum of the two input numbers. In this circuit two stages of addition are used. The first three bits of the character count (of weights '1', '2', and '4') are passed straight through to the memory address lines since this part of the address remains unaffected if 40 or a multiple of 40 is added to the total address.

In adders A1 and A2 the row address is added to the character count but the row address units are effectively added to the 8 level of the character count so that a unit change in the row address gives a change of eight in the final output address. Thus we have effectively multiplied the row address by eight and added it to the character count. To give a total multiplication by 40 we need to add in a further 32 times the row address and this is done in the second stage of addition using adders A3 and A4.

Here the units of the row address are added in to the 32 level of the output address, so that for a change of one in the row address the output address changes by 32. As a result the final output address will represent the basic character count plus 40 times (32+8) the row address input, which will ensure that the character data will be stored into successive locations throughout the 1024-cell array.

In next month's article we shall take a look at the alternative approach to a page memory using sequential access type memories.

LONG-DISTANCE TELEVISION

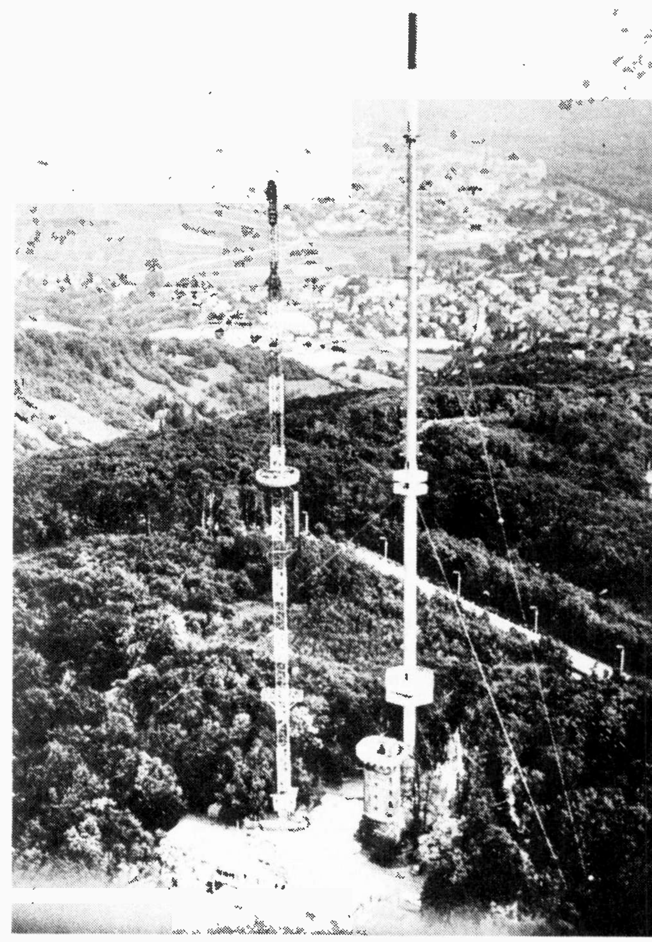
ROGER BUNNEY

WITH July there has been a slowing down in Sporadic E conditions. There were some excellent openings during the early part of the month but towards the end of the second week the trend was to fewer stations and less intense openings. Nevertheless several excellent openings were logged, with the added bonus of enhanced Tropospheric conditions in Band III and at u.h.f. on July 5th. My own log is as follows:

1/7/75	DFF (East Germany) ch. E4; SR (Sweden) E3 – both MS (Meteor Scatter reception); TSS (USSR) R1, 2; CST (Czechoslovakia) R 1: RAI (Italy) IA – all SpE.
2/7/75	TSS R1 – SpE.
3/7/75	TSS R1; CST R1; MT (Hungary) R1; RTVE (Spain) E2, 3, 4; JRT (Yugoslavia) E3, 4; RAI IA; NRK (Norway) E2; TDF (France) E2 – all SpE. DFF E4 – MS.
4/7/75	MT R1, 2; SR E2, 3; NRK E2, 3; YLE (Finland) E3; JRT E3; RTVE E2, 4; RTP (Portugal) E2; WG (West Germany) E2 – all SpE. DFF E4 – MS.
5/7/75	TSS R1, 2; RTVE E3; NRK E2; RUV (Iceland) E4 – all SpE. Also good Tropospheric reception from Holland, Belgium and West Germany at v.h.f. and u.h.f.
6/7/75	RTVE E3 – SpE.
7/7/75	DFF E4 – MS.
8/7/75	RTVE E2, 3, 4 – SpE.
9/7/75	TSS R1; RAI IB; plus unidentified signals – all SpE: Switzerland E2; RTVE E2; DFF E4 – all MS.
10/7/75	TSS R1; TVR (Rumania) R2; RAI IA, B; RTVE E2, 3, 4 – all SpE.
11/7/75	SR E2 – SpE; RAI IB – MS.
12/7/75	RTVE E2, 4 – SpE; DFF E4 – MS.
13/7/75	RTVE E2 – MS.
14/7/75	SR E2 – MS.
15/7/75	RAI IB – MS.
17/7/75	DFF E4; MT R1; RAI IB – all MS.
18/7/75	DFF E4 – MS.
19/7/75	RAI IA – SpE.
20/7/75	TSS R1 twice; RTVE E4 – SpE; TVP R1 – MS.
21/7/75	RTVE E2, 4; SR E2; RAI IB – SpE.
22/7/75	TSS R1, 2; RTVE E2 – SpE.
23/7/75	RTP E2 – MS.
24/7/75	RAI IB – MS; SR E2 – SpE.
25/7/75	TSS R1 twice, R2; TVR R2; plus unidentified signals – all SpE.
26/7/75	SR E2 – SpE; CST R1 – MS.
27/7/75	SR E2, 3 – SpE; TSS R1; TVP (Poland) R1 – both MS.

The SpE opening on July 3rd produced the TDF Bastia ch. F2 transmitter signal floating over the "local" TDF signal from Caen, North France. It was interesting that Caen was on 819 lines whilst Bastia was putting out 625-line test transmissions. The colour test card from the latter featured a "flashing" grid insertion at the top right-hand corner.

The Tropospheric opening during the early morning on the 5th produced several Dutch and West German transmitters at v.h.f.



The Vienna (Austria) transmitter mast has recently been replaced by ORF to improve the coverage. The new (right) and old (left) masts at Kahlenberg are shown here. The v.h.f. aerial structure was lifted one metre to 123m; the u.h.f. aerial structure was raised from 65m to 152m. The u.h.f. panels can just be seen below the circular platform of the old lattice structure.

Photo courtesy ORF.

and u.h.f. At 0835 a programme was noticed on ch. E46 – a weak signal. It was also noted at v.h.f. *between* chs. E5 and E6 – there were Dutch transmissions at the time on both channels, thus confirming the in-between signal. The Dutch transmitters were on test card: the programme seen appears to have been an educational one from WDR (West Germany). I can find no reason for the rather unusual frequency, betwixt channels E5 and E6, however. Can anyone help?

I was very pleased to receive a visit from Peter Vaarkamp (Holland) on the same day. He was spending several days on holiday in the UK, taking the opportunity to visit DXers, etc.

Matters Arising

In the June column we included some comments from Nigel Hanwell following his recent trip to Chicago. We have since received a letter from Morrie Goldman, who lives there, clarifying one or two points. He says that colour on the three v.h.f. network transmitters is excellent, while the previous comment that WCIU ch. A26, WFLD ch. A32 and WSNS ch. A44 colour output is better than network is surprising.

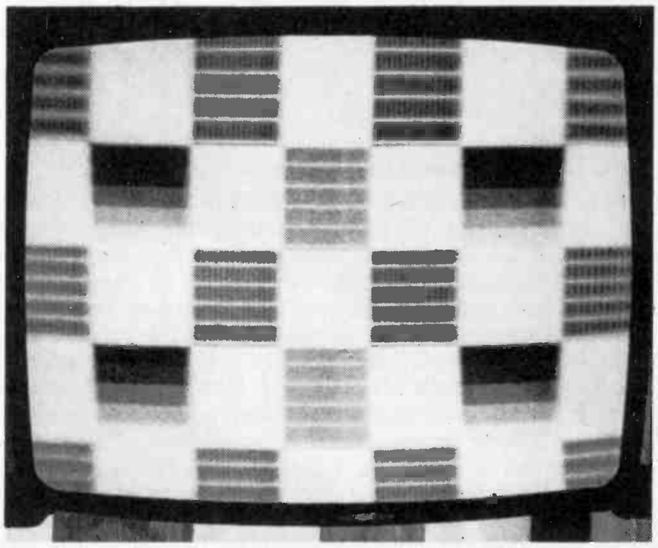
WCIU apparently has modest equipment and facilities and the colour is below network standard; WFLD has excellent equipment and the colour is equal to network standard; WSNS colour is at times below network standard but Morrie suggests that the quality could be improved by using better lighting techniques. The WMAQ transmitter is atop the John Hancock Building, along with WBBM ch. A2, WGN ch. A9, WFLD ch. A32 and WSNS ch. A44. The Sears Tower currently supports WLS ch. A7 and WTTW ch. A11. Following the construction of several 1,000ft buildings Chicago has been plagued by ghosting, but the transmissions from atop the Sears Tower Building (1,450ft) do not suffer. Those stations not atop Sears say that the expense of moving would be too great to justify. Morrie ends with the pertinent comment that the SpE season there has so far been poor.

The Telefunken T05 test card, transmitted by Dannenberg NDR-1.

News Items

Brunei: The colour TV service opened officially on July 9th, following on-air testing from March 1st. The service was established in just nine months, considered to be a world record where no previous TV service existed. The service is at present operating from temporary studio facilities in the Radio Brunei building. The northern part of the state is covered by a single transmitter: a second transmitter at Seria will cover the south. Marconi is to supply two 10kW v.h.f. transmitters for this latter station.

Jordan: The Jordanian TV service is reported to be using test card F with the identification "Jordan TV".


Checkerboard test pattern used by RTVE, RTP, Rhodesia and others. This photo was taken by Doug McFadyen (New Zealand) from a local transmission.

Transmitter Listings

West Germany: Visselhoevede NDR-1 ch. E7, 20kW e.r.p., vertical polarisation.

Cyprus: Sina Oros CBC-1 ch. E8 now closed.

France: Le Mans-Mayet ch. E21, 1,000kW; Boulogne-Mont Lanbert ch. E37, 60kW; Dunkerque-Mont des cats ch. E45, 200kW; Limoges ch. E53, 1,000kW. All these transmitters radiate TDF-3 with horizontal polarisation. Champagnole-le-Bulay TDF-2 ch. E61, 80kW (horizontal).

Rumania: Odorhei/Harghita ch. R5 50kW, Heniu ch. R3 up to 5kW, both with horizontal polarisation. The Gheorghieni ch. R5 transmitter is now closed.

TSS-1 (USSR) Riga caption. Photo courtesy HS Publications.

From Our Correspondents

Garry Smith (Derby) has pointed out that test pattern identifications have been changing somewhat this season. On the 5th he noted the CST electronic pattern with the "RS-KH" identification, the PM5544 test card with "SR Praha" and the Fubk pattern with "CST 02". He has also noted the "CST Bratislava" PM5544 pattern less side panels, and the RETMA card floating about on chs. R1 and R2. He suspects (as we do) that MTV (Hungary) is using this pattern again. Keith Hamer (Derby) has seen the old monochrome RTVE card with the identification "tve Valencia" floating over the new electronic RTVE card. This was on ch. E3. A new identification was observed at 1258 on the 10th, "TVE-1 Navacerrada Canal 2", on ch. E3.

The mystery ch. E3 ORF signal has again been seen, with the Telefunken T05 card, in various parts of the UK. ORF still comments that its only ch. E3 outlets are relays, but the situation is unusual since the signal seems to be received quite regularly. Clive Athowe (Norfolk) noted the signal, and during the period July 3-7th experienced good Tropospheric reception from N. Germany and Scandinavia. He received twenty Swedish u.h.f. stations. Highlights included a Danish ch. E11 relay – several 50W relays are listed on this channel – the Swedish Munnebostrand 400W transmitter on ch. E53 and another 400W relay on ch. E46.

Hugh Cocks has commented on strange signals received at his South Devon location. On July 2nd he noted his semi-local station Caradon Hill, but not from the usual, correct direction. He also received Heathfield, Hannington, Dover and Crystal Palace at high levels from a south easterly direction. All signals had a "ghostly" appearance and we are wondering whether they could have been "bounced" off the French coast. Can anyone throw any light on this?

F. Zarrario (Retford) has received Finland, Austria, Sweden, Spain, Switzerland, Norway and Yugoslavia during recent openings, using an old Bush Model TV62. His query regarding Grunten confirms that he received this W. German (Bavaria) transmitter as well.

John Lees (Hucclecote) has similarly had considerable success. He comments that a cold front seems to produce good reception. The "TB-CCCP" he mentions is from the USSR – it's a news programme.

George Ridgwell (Harold Wood) has modified a Thorn 950 chassis to switch between positive and negative video and has seen Tropospheric signals at u.h.f. from WG, NOS (Holland), Belgium and France. His SpE loggings include Norway, Spain and Italy.

Nigel Breward (Stoke-on-Trent) has been very active. On June 2nd he received no fewer than nine countries. He logged Budapest on both the EBU bar pattern (MTV-1 BUDAPEST identification) and the PM5544 card.

New TV Receiver Techniques

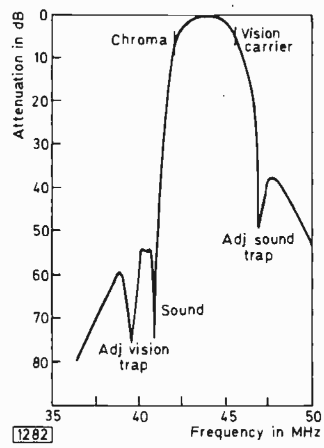
In recent editions of the *WTFDA Bulletin* Morrie S. Goldman has been discussing TV receiver developments, with particular reference to features that will give better DX reception. As with all signal reception, especially with weak and marginal field strengths, gain and noise figures are of the utmost importance, while with the number of channels likely to be present during good DX conditions in the relatively cramped TV frequency spectrum (for example the European Band I) selectivity and freedom from overloading/cross-modulation are similarly important. Morrie anticipates that varactor tuners will be used in most receivers at both v.h.f. and u.h.f., with higher *Q* varicap diodes and consequent higher gain with lower noise. The use of f.e.t.s and m.o.s.f.e.t.s in tuners will also add to the higher gain/lower noise performance and to improved high signal/lower cross-modulation capability.

Digital channel readout is likely to become popular as a result of reduced costs due to the economics of large scale production. One maker has developed a complete v.h.f./u.h.f. tuning package using light-emitting diodes to give the digital read-out. This is costed at $30, possibly falling to around $15 with higher production. Frequency generation is by means of a phase-locked loop. All this makes keyboard channel selection possible – though in the UK, with the normal requirement of selection of three-four channels, the present system of preset buttons is likely to remain in use. In the US however, the viewer will be able to punch out his required channel on a small keyboard – for example in selecting channel A34 he punches first 3 then 4. This is a disadvantage for the DXer since he will need to punch up each channel in turn: much better the continuous tuner which enables a quick check to be made over the whole band. Due to the phase-lock loop the tuner will always lock exactly to the channel, making it difficult to fine tune to improve adjacent channel rejection.

Improvements in tuner accuracy from those manufacturers producing rotary u.h.f. tuners have come as a result of the latest FCC regulations.

One manufacturer is experimenting with a varactor tuner whose tuning voltage is varied via an optical coupler. Light from a small bulb passes through a polarised disc which is mounted on the tuning shaft: the tuning voltage is obtained from a phototransistor which senses the incident light from the bulb via the polarised filter disc.

The i.f. amplifier provides the main gain and selectivity of course. Where signals are available on adjacent channels the i.f. response is critical – there must be a full channel bandwidth



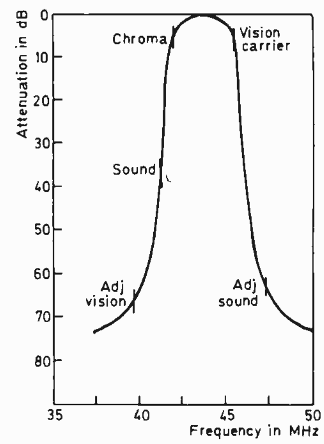


Fig. 1 (left): I.F. response of a typical modern US colour receiver using standard i.f. components.
Fig. 2 (right): I.F. response of the US Heathkit Model GR2000 which uses an LC i.f. filter.

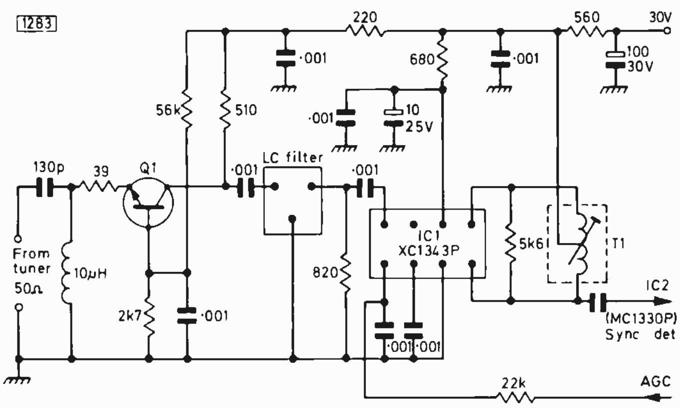


Fig. 3: Vision i.f. strip using an LC filter.

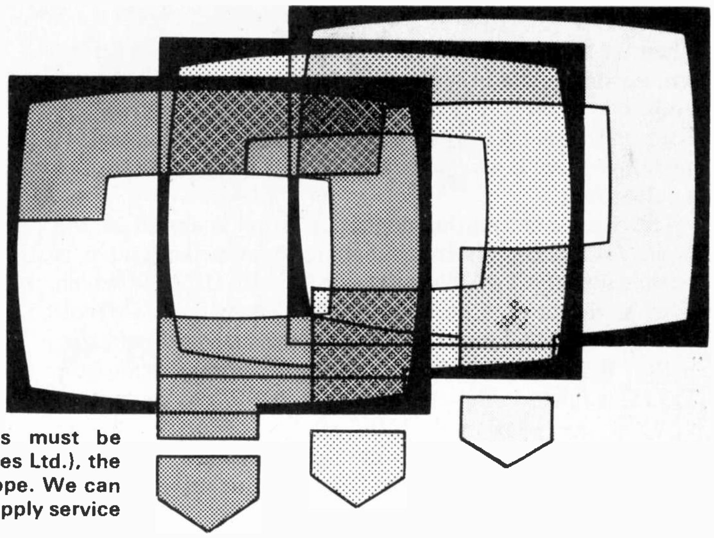
within 3dB for the vision and colour subcarrier, followed by a very deep notch in the response to avoid adjacent channel interference. The i.f. response curve of a modern US colour receiver using conventional i.f. transformers is shown in Fig. 1, while Fig. 2 shows the vastly improved selectivity of a receiver using an *LC* i.f. bandpass filter (Heathkit GR2000). The arrangement consists of a high *Q* bandpass filter with preamplifier and follow-up i.c. amplifier – see circuit shown in Fig. 3. The filter itself requires no alignment, the only adjustment being T1 which attenuates spurious signals from the i.c. and gives correct matching to the following stages.

Other manufacturers are looking elsewhere in the quest for improved selectivity. Research is proceeding into surface-wave filters (Mullard in the UK have done much work on this – see for example the note on page 402, July 1974). In this system the electromagnetic i.f. signal is converted into an ultrasonic one which passes through a piece of piezo-electric material, usually Lithium Niobate. The bandpass characteristic is determined by the design of the two transducers used – at the input and output, the latter converting the signal back to an electromagnetic one. A single unit is used between the tuner and the i.f. strip and the amount of alignment required is minimal. The cost of a surface-wave filter is expected to be around $2 once production has built up.

The *LC* filter used in the Heathkit set is about 5in long: the surface-wave filter will be about 1in long.

Reception in North America differs somewhat to that in Europe – for example US u.h.f. tuners do not usually have either a tuned or untuned r.f. amplifier. Nevertheless what goes on there is not without implication here. Our grateful thanks to Morrie Goldman (Chicago) and the WTFDA (Box 163, Deerfield, Illinois, 60015, USA) for permission to publish these comments.

Your PROBLEMS solved



Requests for advice in dealing with servicing problems must be accompanied by an 11p postal order (made out to IPC Magazines Ltd.), the query coupon from page 603 and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

DECCA CTV25

The fault with this set is loss of line hold. The picture is broken up into a horizontal basketweave pattern – multicoloured – which varies with change of scene. I have changed the line timebase valves and the flywheel sync diodes without improving matters. The line hold control is o.k.

We suggest you check the electrolytics in the line oscillator circuit – C320 (2μF) which decouples the slider of the line hold control and C324 (2μF) the cathode coupler – resistor R317 (47kΩ, 1W) in the reference pulse feedback path, the oscillator feedback capacitor C325 (820pF), and R421 (100kΩ) which is in series with the line hold control and is connected to one of the tagstrips underneath the line output chassis.

PHILIPS G22K520

There is an occasional intermittent fault on this set. The symptom is as follows. On switching the set on, instead of the brightness increasing to normal after about five to ten minutes' warm-up time the picture is only just visible though the sound normal. The brightness can be restored by advancing the c.r.t. first anode potentiometers and slightly increasing the contrast and brightness control settings. After a time which varies on different occasions the brightness returns to normal. Otherwise the picture is excellent.

This trouble is commonly caused by a faulty zener diode in the beam limiter circuit. The component concerned is D5582 on the line scan panel. We suggest you use a 1·3W type in place of the 400mW device fitted. (Philips G8 chassis.)

DECCA CS2230

When the set is switched on the whole picture has a reddish or magenta cast. This persists for five to ten minutes, then the picture corrects itself instantaneously. I am wondering what action to take over this initial lack of green drive.

First check around the green output transistor (TR216), looking for dry-joints etc. The miniature presets in the stage – VR317 which adjusts the drive and VR321 which sets the bias – are prone to trouble. If the fault persists either the transistor itself or IC2 (MC1327) is likely to be faulty. (Decca 30 series.)

FERGUSON 3816

There is neither sound nor vision on this set. At first the d.c. fuse kept blowing. By a process of elimination it was found that the fault lay in the line output section, somewhere after the boost diode – the boost voltage is down at 11·5V instead of 25V. By fitting a 5A fuse the set was kept going long enough to make some voltage and waveform checks. The line driver transistor base voltage was found to be correct, but at the collector although the waveform is the correct shape the amplitude is only about half what it should be, presumably due to the low boost voltage since this stage is fed from the boost rail. The h.t. voltages derived from the line output stage are very low – the c.r.t. first anode supply is only 15V instead of 300V while the video supply is 10V instead of 95V. The line driver and output transistors have been replaced without making any difference and all diodes and electrolytics in the area have also been checked.

Disconnect C108, the scan correction capacitor which feeds the scan coils. If the drain on the h.t. line is still heavy, suspect the line output transformer of having short-circuit turns. First however check by substitution the two capacitors in the collector circuit of the driver transistor – C101 and C102. (Thorn 1590 chassis.)

HMV 2715

The trouble with this set is foldover at the bottom of the raster – about 1in high.

First ensure that the h.t. line is at about 60V. Then check C429 (16μF) in the collector circuit of the field output transistor, the scan charging capacitors C427 (25μF) and C428 (10μF), the driver and output transistors VT423 (BC116A) and VT424 (BD116), and the scan coupling capacitor C762 (400μF) which is on the convergence panel. (Thorn 3500 chassis.)

PYE 40F

There is insufficient width to fill the screen – on the right-hand side – even with the width control set to maximum. The output stage valves seem to be overheating, though all the timebase valves have been replaced without making any improvement.

The most common cause of the trouble in this chassis is that the coupling capacitor C111 (0·47μF) between the line blocking oscillator and the control grid circuit of the line output valve is leaky.

GRUNDIG 1510GB

When the set is switched on the sound is o.k. but the screen remains dark. The brightness and contrast controls do not produce any effect and with the colour control at zero there is no monochrome picture. With the colour control at maximum there is a very dark picture which is negative and in colour only.

The trouble is that the luminance signal is absent on the display. Virtually all the luminance channel circuitry is contained in the TBA970 integrated circuit (IC365), which could be defective. Check for dry-joints or an open-circuit connection on the luminance delay line first however, and ensure that the BF459G luminance output transistor (Tr375) is functioning – there should be 0·6V at its emitter, 1·2V at its base and 170V at its collector. Before condemning the TBA970 ensure that the voltage at pin 8 is about 0·5V or less – this is the beam limiting input.

GEC 2010

We are puzzled by lack of e.h.t. on this set. The line output transformer and all valves in the line timebase have been replaced and the valve and c.r.t. voltages all read correct. A low whistle can be heard and this alters in pitch as the 405-line hold control is adjusted. The sound is o.k.

It seems that whilst the line timebase is operating the output is insufficient. The likelihood is a fault in the line oscillator circuit. We suggest you check the tuning capacitors C168 (0·0022μF) and C169 (0·003μF), the feedback coupling capacitor C170 (820pF) and the value of the common cathode resistor R122 (560Ω) in this stage. If all is o.k. here, check the coupling components between the line output valve and the transformer – choke L68 and capacitor C175 (0·47μF).

ITT CK602

There is a ¾in horizontal band of lighter colour right across the screen. This moves up the screen from bottom to top at approximately two second intervals. The fault does not worsen with time and in fact on occasions during an evening's viewing will clear completely for maybe several hours. It is always there however when the set is switched on. The moving line has slowed on occasions and once froze on the picture, but the norm is movement from bottom to top in two seconds.

There are several possible causes of this hum bar. These are, in order of likelihood, the l.t. supply series regulator transistor T46d (AD161), the l.t. bridge rectifier D52d, the l.t. reservoir capacitor C262d (500μF), C263d (10μF tantalum) which smooths the regulator reference voltage, and the regulator driver transistor T45d (BC170B). The use of freezer and a hair-dryer might help to narrow the field of search. (ITT CVC5 chassis.)

GEC C2136

When the set is switched on from cold there is field rolling: when warm the fault is field slip on camera and channel changes. There is also intermittent false field lock. Adjusting the field hold control makes the rolling worse and the slip better or vice versa.

We suggest you check the field sync pulse clipper/inverter transistor TR451 (BC147), the field hold control itself, and the silicon controlled switch field oscillator SCS451 (BR101). Make sure that the electrolytics in this area – C455 (47μF) which decouples the supply and C452 (4·7μF) which decouples the emitter of TR451 – are doing their job. (GEC C2110 series.)

BUSH CTV25

The trouble with this set is absence of green, and I suspect the decoder. The clown in the test card centre circle has a pink coat instead of a green one, though the reds and greens seem all right. I have checked voltages around the decoder circuit but everything here seems to be OK.

First ensure that monochrome reproduction is untinted: many sets of this age have worn tubes, recognisable by inability to achieve correct grey-scale tracking. Once you are satisfied on this point, check the G –Y colour-difference output/clamp valve 6V4 (PCL84) and the voltages and components in this stage. The trouble is unlikely to be in the decoder.

FERGUSON 3821

There is a loud click a few seconds after switching on; a similar click occurs twenty minutes or so after switching off and removing the mains plug. Replacing the HT2 smoothing electrolytic C38 cured the first click but the other still occurs. No spark can be seen and the set works normally otherwise.

We suggest you check the print on the board in the vicinity of the smoothing electrolytics, looking for hairline cracks or dry-joints, particularly in the earthing line. (Thorn 1500 chassis.)

PYE CT203

A new c.r.t. was fitted after the neck of the original one was accidentally broken. Following reconvergence a good picture was obtained but after switching off there are bright spots at the centre of the screen. All earthing strips seem to be in place and the beam limiter circuit has been checked over.

Switch-off spot suppression is not generally provided in colour sets. It is normal for the spots to persist for about ten seconds, defocusing and spreading out during this time. Most of the energy is dissipated in the shadowmask. (Pye 697 chassis.)

DECCA CTV19

There is severe but intermittent field jitter on this set, along with occasional line pulling which shows up in the form of S-shaped vertical lines. The bending can be straightened by adjusting the fine tuning, but the vision is then too far off station resulting in severe patterning. When the field jitter occurs it is just as severe when the contrast control is set to minimum. The faults do not show when a test card is being received. The timebase and i.f. panels have been replaced but the fault persists.

The cause of the fault is in the sync separator stage (TR204), which is on the luminance panel. The most likely component to be defective is the high-value resistor R220 (4·7MΩ) which biases the base of TR204. If this is not so, check the other components in the stage.

KB VV70 VALIANT

When this dual-standard model is switched to 625-line operation it is unstable – if vision and sound are obtained, they remain for about a quarter of an hour and then fade. New valves have been fitted without improving matters.

First make sure that the earthing of the tuner unit is adequate. Then turn attention to the small decoupling capacitors associated with the anode and screen grid circuits of the i.f. valves. These can be recognised by their short leads, one of which is earthed – we suggest you replace them.

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TELEVISION OCT. 1975

Mild but apparently disconcerting compression at the right-hand side of the picture was the complaint from a critical customer. On the assumption that the trouble was simply a matter requiring some readjustment, the junior technician was sent off to restore the lost picture geometry equipped with the field service manual. Some while later a dejected junior returned, along with the receiver – a Grundig Model R500E/GB monochrome receiver.

On test in the workshop with a solid test signal applied, the non-linearity of the line scan was found to be most definitely apparent while simple readjustments had no effect. The fault in fact turned out to be one of the most difficult recently investigated. After checking all preset adjustments in the line timebase circuit, voltage checks were made. All these appeared to be reasonably close to the values given in the manual. The valves and several likely passive components were then checked, but the distortion was as bad as ever.

During the tests two effects were noted. First, line sync tended to be lost when adjustments were made to the preset controls in an endeavour to improve the linearity. Secondly, the lock was either lost completely or a false line lock occurred (an unsteady vertical band down the centre of the picture) when the channel was changed – for example when an off-air signal was applied in place of the workshop test signal.

As with nearly all modern receivers, flywheel line sync is used, and detailed attention was next directed to this area since the secondary symptoms suggested trouble here – the junior technician who was standing by was no longer dejected incidentally! The circuit is somewhat unusual: there is a PCH200 triode-heptode sync separator stage followed by a balanced double-diode flywheel sync discriminator with quite a complex load circuit involving the use of a high-resistance potential divider network and a flywheel sync balance control. The first step was to disconnect and measure the forward and reverse resistances of the flywheel sync discriminator diodes, but both gave normal readings. The line oscillator itself is of the PCF802 variety, the coil acting as the basic frequency control. It was found that this could be critically adjusted to give a fairly steady display, but that the balance control had no effect whatsoever.

A couple more measurements by the senior technician revealed the cause of the trouble. What do you think this was? See next month's Television *for the solution and a further item in the test case series.*

SOLUTION TO TEST CASE 153
(Page 547 last month)

It will be recalled that the technician had removed the line frequency triggering pulses from the PAL switch and had then discovered that their amplitude was significantly below the manufacturer's specified 18V (using an oscilloscope). The amplitude in fact was more like 1V.

The triggering pulses are derived from a winding on the line output transformer. The winding was checked for resistance (no actual winding resistance value was quoted in the manual for comparison) and the continuity was found to be OK. It was then remembered that a vertical line of interference sometimes occurred at the left of the picture – rather like a pulse discharge in the line output transformer. Pressure was applied to the winding area with a flat insulated probe while the pulses were being monitored on the 'scope, and a slight change in their amplitude was then detected.

There was nothing the technician could do apart from check the line output transformer by replacement. Fortunately the replacement could remain in position, for the trouble was then completely cured. The lesson? Incorrect ident can be due to a faulty line output transformer!

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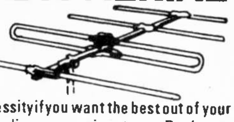

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CS2030
CS2211
CS2213
CS2220
CS2225
CS2227
CS2230
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CS2611
CS2630
CS2631

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CTV162
CTV167 Mk. 1 & 2
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CV2213
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