SEPTEMBER 1984

TELEVISION

SERVICING·PROJECTS·VIDEO·DEVELOPMENTS

VCR Servo Systems

Servicing the Grundig GSC100

The Salora Ipsalo-2 Circuit

CCTV Commentary ● VCR Clinic

TV Fault Finding ● DX-TV

TELEVISION

September 1984

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CORRESPONDENCE
All correspondence regarding advertisements should be addressed to the Advertisement Manager, "Television", King's Reach Tower, Stamford Street, London SE1 9LS. Editorial correspondence should be addressed to "Television", IPC Magazines Ltd., King's Reach Tower, Stamford Street, London SE1 9LS.

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

this month

OUR NEXT ISSUE DATED OCTOBER WILL BE PUBLISHED ON SEPTEMBER 19

P. V. TUBES

TEL: 0254 36521/32611

104 ABBEY STREET, ACCRINGTON

T.T.L. 74LS SERIES

74LS00	58	74LS37	35	74LS92	65	74LS160	90	74LS251	65
74LS02	58	74LS38	35	74LS93	60	74LS161	85	74LS253	95
74LS03	58	74LS40	35	74LS107	80	74LS162	4.04	74LS257	1.20
74LS04	58	74LS42	80	74LS109	58	74LS163	85	74LS258	95
74LS05	58	74LS47	85	74LS112	50	74LS184	85	74LS259	1.70
74LS08	58	74LS48	83	74LS113	44	74LS165	1.50	74LS273	1.90
74LS09	58	74LS49	33	74LS114	70	74LS174	85	74LS283	1.30
74LS10	58	74LS51	33	74LS123	80	74LS175	85	74LS293	1.20
74LS11	58	74LS54	43	74LS125	85	74LS191	1.02	74LS352	1.40
74LS13	37	74LS55	60	74LS126	80	74LS192	1.30	74LS353	1.40
74LS14	48	74LS73	60	74LS132	83	74LS193	1.30	74LS365	75
74LS15	33	74LS74	65	74LS138	83	74LS194A	75	74LS366	82
74LS20	35	74LS75	65	74LS139	65	74LS197	95	74LS367	1.65
74LS21	35	74LS76	65	74LS151	85	74LS240	2.20	74LS368	65
74LS22	35	74LS78	65	74LS153	85	74LS241	2.20	74LS373	1.40
74LS26	44	74LS83A	89	74LS155	65	74LS242	2.20	74LS374	1.55
74LS27	35	74LS86	39	74LS156	1.02	74LS243	2.20	74LS393	1.20
74LS30	35	74LS85	98	74LS157	78	74LS244	2.20	74LS670	1.78
74LS32	35	74LS90	60	74LS158	65	74LS245	2.30		

VOLTAGE REG.

7805	78
7806	78
7808	78
7812	78
7815	78
7818	78
7824	78
78L05	68
78L08	68
78L12	68
78L24	68
7905	98
7906	98
7908	98
7912	98
7915	98
7918	98
7924	98
79L05	72
79L12	72
79L15	72
79L24	72

'4000 B' SERIES CMOS

		4027B	39	4069B	22	4511B	76	4539B	77
		4028B	64	4070B	22	4512B	72	4541B	96
		4029B	90	4071B	22	4513B	1.68	4543B	1.12
4001B	21	4032B	1.04	4072B	22	4514B	1.88	4551B	96
4002B	21	4035B	80	4073B	22	4515B	1.88	4553B	2.40
4008B	72	4038B	99	4075B	22	4516B	76	4554B	1.20
4011B	21	4040B	72	4076B	80	4518B	76	4556B	48
4012B	21	4042B	58	4077B	22	4519B	64	4560B	1.76
4013B	30	4043B	71	4078B	22	4520B	76	4561B	74
4014B	74	4044B	71	4081B	22	4521B	1.68	4566B	1.20
4015B	76	4046B	96	4093B	43	4522B	88	4580B	3.60
4016B	31	4047B	70	4094B	1.56	4526B	88	4581B	1.84
4017B	66	4049UB	32	4099B	1.20	4527B	1.20	4582B	80
4018B	72	4050B	32	4160B	72	4528B	88	4583B	1.00
4020B	76	4051B	72	4161B	72	4529B	1.04	4584B	40
4021B	70	4052B	72	4162B	72	4530B	62	4585B	88
4022B	70	4053B	72	4163B	72	4531B	72	4597B	1.84
4023B	21	4060B	96	4502B	72	4532B	1.00	4598B	2.40
4024B	50	4066B	43	4505B	1.88	4536B	2.64	4599B	2.00
4025B	21	4068B	22	4510B	76	4538B	1.04		

I.C. SOCKETS

DIL to DIL

8 way	22
14 way	29
16 way	32
18 way	32
20 way	32
22 way	32
24 way	34
28 way	45
40 way	84

DIL to QUIL

14 way	32
16 way	34
18 way	37

QUIL to QUIL

14 way	32
16 way	36

MAINS DROPPERS

DECCA 20	2.48
DECCA 27R/47R	1.40
DECCA 56R/6R8	1.40
R.B.M. A823 56R/68R	94
R.B.M. 161	82
GEC 2000/2018	70
GEC 27840	64
PYE 713/15 3R5/15/45R	1.80
PYE 725/31 3R0/56R/27R	1.84
PYE 725 56R/27R	1.04
PHILIPS 210/5050 30R/125R/2k85	1.75
PHILIPS 210/5051 -/118R/148R	93
PHILIPS G8/5081 47R Section	50
PHILIPS G8/5083 2R2/68R	95
THORN 1400	1.20
THORN 1500	1.38
THORN 1600	1.77
THORN 3500	94
THORN 8000	1.24
THORN 8500	1.36
THORN 9800	1.30
DECCA 3R9 Modulohm	60

NEW VALVES

30FL2	1.70	EF183	99	PCF800	1.38	PL508	2.90
DY802	98	EF184	1.09	PCF801	1.13	PL509/19	5.30
DY86/7	66	EH90	1.02	PCF802	1.12		
ECC81	1.08	EL34	3.50	PCF805	1.80	PY88	81
ECC82	98	EL84	1.05	PCF806	1.30	PY500A	2.30
ECC83	1.07	EY86/7	68	PCF808	1.83	PY800/1	69
ECC84	80	EY500A	1.50	PCH200	1.45	UCH81	2.25
ECC85	98	EZ80/1	56	PCL82	1.20	UCL83	1.82
ECC88	1.35	GY501	1.45	PCL84	1.20	UY85	1.35
ECF80	80	GZ34	3.50	PCL86	92	PL802T	4.00
ECF82	86	KT66	8.50	PCL805	1.09	40KD6	5.30
ECH81	1.60	KT88	12.00	PD500	2.93	21LU8	3.00
ECH84	1.66	PC92	3.00	PFL200	1.86	17DW4A	1.60
ECL80	84	PC97	1.65	PL36	1.87	3AT2B	5.00
ECL82	1.30	PCC85	85	PL81	94	12BY7A	3.75
ECL86	1.99	PCC805	1.40	PL83	1.43	12HG7	3.20
EF80	95	PCF80	1.00	PL84	84		
EF86	1.96	PCF200	1.35	PL504	1.65		

THERMISTORS

VA1104	75
VA1040	75
VA8650	55
VA1039	35
GEC Dual Posistor	1.68
GEC Dual 2040 (CK1)	1.98

THERMAL CUT OUT

THORN 3000 2A Metal	1.60
GEC 2040 Metal	2.50
THORN 8000 Plastic	2.35

L.E.D's

5mm Red, Green, Yellow	14
T1 ¾ Amber	22
T1 3mm Red, Green, Yellow	14
Flashing Red CQX21	62
CQX22	66
3 Colour VJ18P	76
Panel Clips 3mm	4
5mm	4

CRYSTALS & FILTERS

6Mhz	74
5.5Mhz	74
4.3Mhz	1.30
8.8Mhz	1.30
9.94Mhz	6.00
10.692Mhz	6.00

MULTITURN POTS

100K	55
GEC TCE	55
PHILIPS G8	
DECCA, RANK	55

SERVICE WITH A SMILE

DISC CERAMIC CAPS

8kV (12kV)
39pF, 200pF, 150pF, 220pF, 180pF, 250pF — 40p

63V/100V
A range of pref. values 22pF-4700pF — 8p

POLYESTER CAPS

250V	0.01mF	12p
	0.1mF	
	0.22mF	
400V	0.01mF	12p
	0.1mF	
	0.22mF	

TANTALUM CAPACITORS

6.3V	47mF	42
	100mF	90
16V	10mF	22
	22mF	28
	47mF	1.03
25V	22mF	46
35V	0.1mF	13
	0.22mF	13
	0.47mF	13
	1mF	13
	2.2mF	17
	4.7mF	26
	10mF	57

LINE OUTPUT TRANS.

R.B.M. T20A	13.95
R.B.M. A774 Mono	11.74
R.B.M. Z179	15.00
R.B.M. Z718 22"	19.50
PHILIPS 320	8.70
PHILIPS 210/300 Mono	10.00
PHILIPS G8	8.75
PHILIPS G9	7.75
PHILIPS G11	13.50
PYE 697 (Printed)	14.50
PYE 713/731	10.00
PYE 725 90°	10.50
PYE 169	10.00
DECCA 80/100	8.58
DECCA 1700	9.00
DECCA 1730	8.58
DECCA 2230	8.58
GEC 2110	9.45
GEC 2040	9.50
GEC 2200	6.65
ITT CVC 1-9	10.85
ITT CVC 25/30/32	8.65
ITT CVC 20	8.60
THORN 3000 EHT	9.95
THORN 3000 SCAN	7.95
THORN 8000	11.33
THORN 8500	11.33
THORN 9000	10.65
THORN 3000/3500 Mains	10.00
THORN 1591	8.68
THORN 1691	9.68
THORN TX10	12.50
THORN 1615	9.75
PHILIPS KT3	7.70
RANK BUSHRANGER	£10.00
PYE 741	8.20
THORN 9800	23.00
B+O (2000, 3000)	12.70
B+O (3000 EHT)	18.90

RECTIFIER TRAYS

THORN 950 Mk II	4.25
THORN 1400 3 Stick	5.20
THORN 1500 3 Stick	5.20
THORN 1500 5 Stick	5.29
THORN 1600	4.95
THORN 3000/3500	7.98
THORN 8000	5.28
THORN 8500/8800	7.15
THORN 9000	7.93
DECCA 1730/1830	4.48
DECCA 30	6.76
DECCA 80	6.60
DECCA 100	7.50
UNIVERSAL ITT or REMO	6.00
GEC 2100	7.40
GEC 2200 (20AX)	6.50
GEC 2040/2028	6.60
GEC 2110 Pre Jan '77	7.00
GEC 2110 Post Jan '77	7.00
PHILIPS G8 Short Focus Lead	6.75
PHILIPS G8 Long Focus 550	6.75
PHILIPS G9	6.37
Pye/Philips K3 Tripler	10.65
PYE 691/3	6.58
PYE 713/4 Lead	8.79
PYE 713 Doubler 5 Lead	8.79
Philips/Pye KT3	6.67
PYE 731/725	7.60
R.B.M. A823 (plug in) AV	7.60
KORTING (similar to Siemens TVK1)	7.32
ITT KB CVC5/9	6.90
ITT KB CVC20/25/30 (Mullard)	5.95
RRI T20	6.80

RECTIFIER STICKS

TV11	74	TV18	90
TV13	79	TV20	1.20

REPLACEMENT ELECTROLYTICS

PYE 169 (200/200/100/32)	3.40
PHILIPS 320 (400/400/200V)	2.74
DECCA 30 (400/400/350V)	3.40
DECCA 80 (400/350V) DECCA 100 (800/250V)	3.97
DECCA 1700 (200/200/400/350V)	4.83
PHILIPS G8 (600/300V)	2.30
PHILIPS G9 (600/300V)	2.21
PHILIPS G11 (470/250V)	2.90
PYE 691/7 (200/300/350V)	2.70
PYE 731 (600/300V)	2.31
RBM A823 (2500/2500/30V)	1.66
RBM A823 (600/300V)	2.83
RBM Z146 (300/300/350V)	3.55
RR1 T20A (220/400V)	2.00
ITT CVC5/9 (200/200/75/25)	2.98
ITT CVC 20 (220/400V)	2.00
GEC 2110 (600/250V)	1.94
GEC 2040 (1000/2000/35V)	1.19
GEC 2040 (300/300/150/100/50)	4.10
THORN 3500 (400/40V)	30
THORN 950 (100/300/100/16/275V)	1.83
THORN 1400 (150/100/100/100/150/320V)	2.79
THORN 1500 (150/150/100/300V)	2.20
THORN 1500 (12/300V)	31
THORN 3500 (175/100/100/400/350V)	2.78
THORN 3500 (1000/63V)	86
THORN 3500 (1000/70V)	86
THORN 8000/8500 (2500/2500/63V)	3.38
THORN 8000/8500 (700/250V)	2.31
THORN 8000/8500 (400/350V)	2.56
THORN 9000 (400/400V)	3.28
GEC (200/200/150/50)	2.64
PHILIPS 69 2200/63V	1.25
THORN 4700 P/C 25V	1.20
THORN 1591/1691 4700/25V	1.20

CAPACITORS AXIAL

Volts	Mfd	Price			
			63V	1	12
6V3	33	9		2.2	12
10V	22	10		4.7	12
	47	10		10	11
	100	10		15	12
	220	15		22	13
	470	20		47	19
16V	33	11		100	23
	68	11		220	37
	220	16		470	49
	1000	27		1000	58
	3300	53		2200	94
25V	10	11	*100V*	10	13
	22	13		22	15
	47	15		47	20
	100	15		100	36
	220	29		220	70
	470	30	*450*	1	33
	1000	55		4.7	30
	2200	51		10	30
	4700	98		22	65
40V	10	10		33	75
	22	10	*500*	10	32
	400	48	*600*	1	41

MIXED DIELECTRIC CAPS

Volts D.C.					
250V	0.91mF	84	*1250V*	0.1mF	59
400V	0.22mF	29		0.91mF	1.15
600V	0.1mF	38	*1500V*	0.0022mF	28
1000V	0.01mF	24		0.0047mF	32
	0.047mF	46		0.022mF	30
	0.033mF	33		0.033mF	62
	0.1mF	35		0.005mF	65
	0.22mF	86	*2000V*	0.0052mF	1.20
	0.47mF	98			

CONVERGENCE POTS

3W/5R-6RB-10R-15R-20R 50R-100R-200R-500R — 60

METRIC CONVERGENCE POTS

PHILIPS G8 5R-10R-15R-20R-50R — 60

FUSES

	Per type	Pack of 10
1¼" QUICK BLOW		
100ma		73
250ma-500ma-750ma-1A		60
1.5A-2A-2.5A-3A-5A		60
1¼" ANTISURGE		
250ma, 500ma, 600ma, 630ma, 750ma, 850ma, 1A, 1.25A, 1.5A, 2A		1.70
2.5A, 3A, 5A		2.70
20mm ANTISURGE		
80ma		4.80
100ma		2.50
160ma, 200ma		2.20
315ma, 500ma, 630ma, 800ma, 1A, 1.25A, 1.6A, 2A		1.30
2.5A, 3.15A, 4A, 400ma		1.90
20mm QUICK BLOW		
100ma, 250ma, 500ma, 630ma, 800ma		90
1A, 1.25A, 1.6A, 2A, 2.5A, 3.15A, 5A		60
1" MAINS		
2A, 3A, 5A, 10A, 13A		1.00

NEW MONO TUBES

MULL. A31/510 110° 12"	18.50
MULL. A34/510 110° 14"	20.00
A50/120WR 110° 20"	15.00
A61/120WR 110° 24"	17.50
VEGA 12" 90° (Jap Types)	15.00
CME1520 (15" Mono)	15.00

MULLARD COLOUREX*

18" A47/343X	59.00
19" A49/120X	53.00
20" A51/110X	53.00
22" A56/120X	48.00
25" A63/200X	55.00
26" A66/120X	60.00
26" A67/120X	62.00
22" A56/500X	60.00
A51 570X	72.00
A56 510	60.00
A66 510	92.00

WHILE STOCKS LAST

1 year warranty Option on 4 years. Quotes on delivery and glass charges

REBUILT COLOUR TUBES

ALL AVAILABLE EX-STOCK ON GLASS FOR GLASS EXCHANGE FROM TRADE COUNTER. SOME TYPES AVAILABLE WITHOUT EXCHANGE FOR SMALL GLASS CHARGE

17" A44/271X	32.00
18" A47/342X (Low Focus)	32.00
18" A47/343X (Stnd Focus)	32.00
20" A51/110X	30.00
19" A49/120X	30.00
22" A56/120X	30.00
22" A55/14X	30.00
25" A63/200X	34.00
26" A66/120X	34.00
26" A67/120X	34.00
22" A56/140X (410X) 110°	36.00
26" A66/140X (410X) 110°	36.00
20" A51/161X	60.00
22" A56/510X	50.00
A56 540X	89.00
A66 540X	75.00
A66 500X	64.00

P.I.L. TUBES – we can rebuild your own glass – please ring for quotes.

SLIDER POTENT

Lin or Log
470R-1K-2K2-4K7 10K-47K-470K — 65

MIDGET CONTROLS

Insulated Spindle Length 44mm

Log or Lin Without Switch	
5K-10K-25K-50K-100K-250K-500K-1M	39p
With D.P.S.T. Switch	
Log: 5K-10K-25K-50K-100K 250K, 500K, 1M, 2M	81p
Dual gang Controls	1.25
16mm Rotary Controls 10K, 22K, 100K, 1M, 10K	39p

SKELETON PRE-SET POTS

Standard or miniature Horizontal or Vertical
100R-2M2 — 16p

THICK FILM RESISTOR NETWORK

THORN 3500 (5 pin connection)	1.98
PYE 731 (6 pin connection)	2.20
THORN 9000 (Circuit Ref. R704/7)	1.98

WIREWOUND RESISTORS*

4W 1R-10K	24p
7W 1R-22K	26p
11W 1R-22K	29p
17W 1R22K	32p

(Preferred values)*

EVER READY BATTERIES

HP2	26	PP6	82
HP7	12	PP7	82
HP11	24	PP9	84
HP16	13	R6PP	17
PP3	42	R14PP	26
PP3-C	53	1289	45

STOP PRESS

Special Prices
5¼" Floppy Disc

	1-10	10-40	50-90	100+
SS/SD	1.61	1.17	1.12	1.05
SS/DD	1.70	1.23	1.17	1.10
DS/DD	2.00	1.44	1.37	1.29

SERVICE MANUALS (Zero VAT)

THORN 1590/1	4.00	VIDCO 3V22	24.00	PHILIPS G8 520	7.00
1615	2.95	3V29/30	33.00	G9	4.20
1640/1	5.00	DECCA 30	3.60	G11	3.90
9000	8.20	80	5.35	K30	3.90
9800	6.80	70/90	3.90	KT3	3.90
Tx9	16.50	100	4.80	G8550	5.00
Tx10	19.20	110	3.90		

CARBON RESISTORS*

¼W 3R3-8M2	20
½W 3R3-8M2	20
1W 10R-10M	36
2W 10R-10M	62

Sold in packs of 10 per type i.e. per value

RECHARGEABLES

EVER READY

RX6 (HP7)	1.10
RX14 (HP11)	1.95
RX20 (HP2)	2.15
RX22 (PP3)	3.75
Universal Charger	6.00

WE WILL ONLY SUPPLY TOP QUALITY, BRANDED COMPONENTS. REPUTATION COUNTS WITH US

G.G.L.COMPONENTS

108 SCOTLAND ROAD, CARLISLE, CUMBRIA CA3 9EY
PHONE (0228) 20358/139693

BUY WITH

INTEGRATED CIRCUITS

TYPE	PRICE (£)
AN103	1.95
AN214	2.25
AN217	2.44
AN240	2.20
AN253	1.93
AN264	1.77
AN315	1.66
AN318	6.95
AN337	4.41
AN360	1.45
AN5431	2.76
AN6332	6.97
AN7110	1.93
AN7114	2.33
AN7115	2.37
AN7120	2.43
AN7140	2.10
AN7145	3.25
AN7150	2.89
AN7151	2.89
HA1137	2.30
HA1144	2.39
HA1151	1.97
HA1156	1.97
HA1166	2.65
HA1197	2.30
HA1199	2.30
HA1202	1.75
HA1211	1.87
HA1306	2.97
HA1319	2.99
HA1322	2.10
HA1325	2.30
HA1338	2.78
HA1339	2.80
HA1342A	2.33
HA1366 W/WR	2.30
HA1368	2.20
HA1371	2.97
HA1374	2.56
HA1377	3.80
HA1388	4.20
HA1397	4.15
HA11211	2.43
KIA7217	2.75
HA11221	2.77
LA1201	1.88
LA1230	2.30
LA1365	2.25
LA2200	2.25

TYPE	PRICE (£)
LA3122	2.10
LA3301	1.97
LA3350	1.93
LA4031	1.66
LA4031P	2.45
LA4032	2.34
LA4051	2.79
LA4101	1.88
LA4102	1.97
LA4400	2.80
LA4420	1.94
LA4422	2.75
LA4430	1.93
LA4460	2.95
LA4461	2.95
MB3712	2.30
MB3713	2.25
MB8719	5.20
MC1327A	1.00
MC1358P	1.60
MC1330P	.90
ML231B	1.95
ML232B	1.70
ML237	2.50
ML238	4.22
TA7072P	2.75
TA7108P	2.10
TA7120P	2.05
TA7129	3.00
TA7130P	1.20
TA7139P	2.80
TA7157P	3.00
TA7171P	3.40
TA7172P	3.40
TA7176AP	2.90
TA7193P	4.20
TA7202P	3.00
TA7203P	3.00
TA7204P	1.80
TA7205AP	1.60
TA7208P	2.20
TA7210P	5.60
TA7222P	1.70
TA7223P	3.15
TA7227	4.65
TA7310P	1.70
TA7313P	2.10
TAA550	.28
TBA120AS	.70
TBA120SB	.90
TBA120U	1.00
TBA395	1.25
TBA396	.85

TYPE	PRICE (£)
TBA520	1.30
TBA530	1.00
TBA540	1.27
TBA550	1.40
TBA560Q	1.60
TBA750Q	2.45
TBA800	.80
TBA810AS	1.15
TBA820	1.40
TBA890	2.95
TBA920Q	1.50
TBA950/2X	2.65
TBA990	1.55
TCA270S	1.30
TCA800	1.95
TCA940	1.55
TDA1002A	1.50
TDA1003A	2.80
TDA1004A	2.70
TDA1035	3.20
TDA1044	3.10
TDA1170	1.80
TDA1412	.90
TDA2020	2.95
TDA2522	1.80
TDA2523	2.25
TDA2530	2.10
TDA2532	2.20
TDA2540	1.95
TDA2560	1.80
TDA2581	1.70
TDA2590	2.25
TDA2591	2.70
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TDA2600	5.50
TDA2611A	1.50
TDA2640	1.80
TDA3560	5.10
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SAS570S	1.90
SAS580	2.40
SAS590	2.40
SL901B	4.80
SL917B	6.95
SN76003N	2.05
SN76013N	1.80
SN76023N	1.80
SN76110N	.90
SN76226DN	1.45
SN76227N	1.00
SN76660N	.65
STK0039	6.45
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TYPE	PRICE (£)
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STK011	7.35
STK014	7.65
STK015	7.15
STK016	7.45
STK020	9.05
STK032	11.32
STK035	12.67
STK036	12.67
STK043	11.33
STK050	20.75
STK070	21.95
STK077	8.56
STK078	8.45
STK082	9.75
STK086	12.89
STK415	9.66
STK433	7.25
STK435	7.75
STK437	7.77
STK439	7.86
STK441	9.52
STK443	11.33
STK459	9.55
STK463	10.88
STK501	8.98
UPC41C	2.95
UPC554C	1.30
UPC555H	0.70
UPC566H3	2.10
UPC577H	3.00
UPC585C	1.40
UPC1009H	2.15
UPC1017G	2.55
UPC1018C	1.15
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UPC1026C	1.45
UPC1028H	2.15
UPC1031H	2.40
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UPC1042C	2.40
UPC1043C	2.45
UPC1156H	2.45
UPC1168C	2.70
UPC1170C	1.55
UPC1176C	2.15
UPC1177H	2.30
UPC1178C	2.20
UPC1180C	3.05
UPC1181H	2.20
UPC1182H	2.35
UPC1183H	2.35

TYPE	PRICE (£)
UPC1185H2	3.30
UPC1188H	3.30
UPC1190C	2.10
UPC1198H	1.30
UPC1200V	1.90
UPC1208C	1.85
UPC1211C	4.05
UPC1215V	2.50
UPC1216V	2.00
UPC1217G	3.35
UPC1218H	2.75
UPC1222	2.05
UPC1223	3.40
UPC1225	3.10
UPC1226	2.55
UPC1227	2.10
UPC1230H	3.45
UPC1245	1.99
UPC1250	2.45
UPC1350C	4.50
UPC1353C	2.60
UPC1356C2	3.05
UPC1358H	3.05
UPC1363C	3.20
UPC1365C	5.05
UPC1366C	2.85
UPC1367C	2.85
UPC1368C	3.76
UPC1370C2	3.80
UPC1373H	1.20
UPC1377C	4.60
UPC1378H	3.80
UPC1384C	5.50
UPC2002H	2.20

TRANSISTORS

TYPE	PRICE
AC127	22
AC128	22
AC128K	30
AC187K	30
AC188K	33
AD149	70
AD161	42
AD162	42
AF127	36
AU110	2.10
AU113	3.50
BC107	14
BC108	14
BC109	14
BC141	26
BC142	23
BC143	25
BC147	09
BC148	09
BC157	10
BC158	11
BC159	11
BC160	22
BC172	10
BC177	22
BC182	10
BC182L	11
BC183L	11
BC184L	11
BC208	12
BC212L	10
BC213L	10
BC214L	10
BC237B	11
BC337	11
BC338	10
BC547	10

TYPE	PRICE
BC548	10
BC557	10
BC558	10
BD124P	55
BD131	33
BD132	33
BD201	80
BD202	70
BD203	70
BD204	83
BD222	50
BD232	50
BD233	37
BD234	40
BD235	32
BD236	43
BD237	40
BD238	39
BD410	50
BD434	50
BD437	70
BD438	78
BD707	1.05
BDX32	1.65
BF194	12
BF195	13
BF196	11
BF197	11
BF198	14
BF241	15
BF256LC	25
BF258	25
BF259	26
BF337	28
BF338	30
BF458	30
BF459	36
BFR90	1.60
BFY51	22

TYPE	PRICE
BR100	18
BR101	32
BR103	55
BT106	1.15
BT116	1.30
BU126	1.78
BU204	1.50
BU205	1.42
BU206	1.35
BU208A	1.40
BU208/02	1.70
BU326A	1.48
BU407	1.12
BU500	1.80
BU526	2.00
BU826	3.20
R2008B	1.45
R2010B	1.45
R2540	2.35
TIP31C	46
TIP32C	47
TIP33B	80
TIP41C	48
TIP42C	48
TIP2955	70
TIP3055	55
TV106/02	1.60
2N3054	55
2N3055	50
2SC1172Y	1.85
2SC2029	2.00
2SC2078	2.00
2SC2078	2.20
2SC1969	2.45
Sony.SG613/6533	8.50

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RBM Z718 18/20/22	22.95
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PYE 725 (90)	10.20
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DECCA 80	8.58
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PCL84	81
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PCL86	81
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PL508	2.90
PL509/519	5.65
PY88	69
PY500A	1.90
PY81/800	69

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RBM A823	7.85
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PHILIPS G9	6.45
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DECCA 80	6.30
OECCA 100	6.76
ITT CVC 20/30	6.85
Universal	5.90

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BY133	.15
BY164	.40
BY179	.60
BY210/800	.30
BY223	.86
BY227M	.23
BYX10	.20
BYX55/600	.26
BYX71/600	.78
OA90	.07
1N4001-7	.07
1N5401-8	.12
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BZY88-range	.11

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THORN3500(1000)70V	.85
THORN9000(400)400V	2.75

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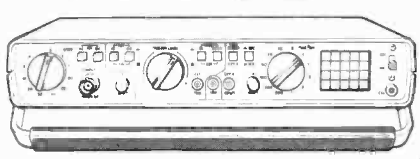

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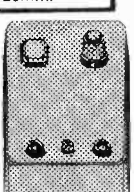

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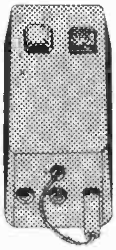

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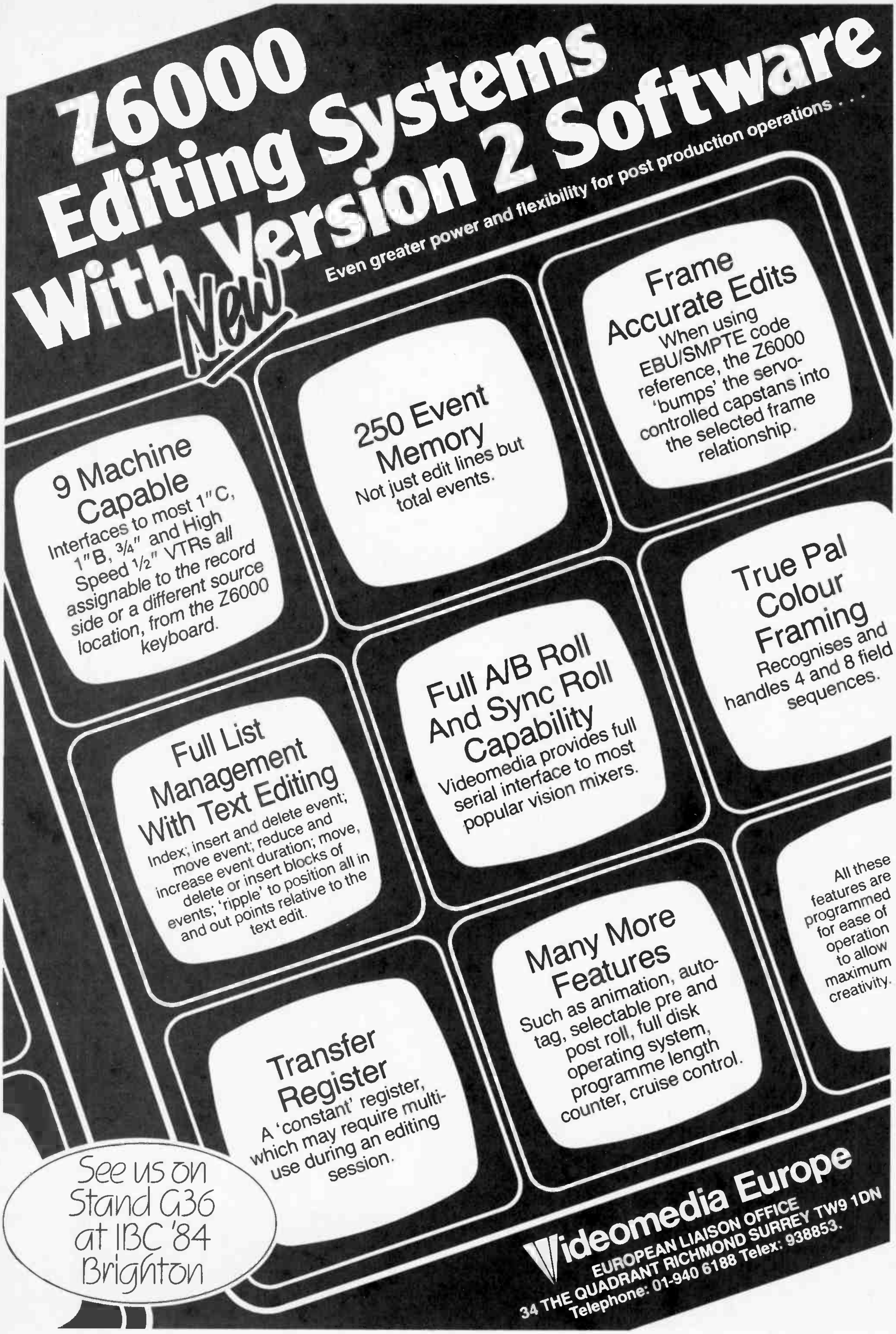

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Lessons from the Japanese

The effect that Japanese consumer manufacturing companies have had on standards of quality and reliability world wide is now appreciated by all. So much so that the question is why US and European companies lagged behind for so long? The fact seems to be that manufacturing, certainly in the consumer sector, had become something of a shambles in the west during the fifties and sixties. There was a happy go lucky approach and an understanding that when things went wrong the dealer would put them right. So we had stock faults, cars that were never right from new and so on. Inevitably there was a backlash and the consumer movement was born.

This dilatory approach to quality control didn't do for the Japanese at all. For their mass produced goods to be accepted world wide they had to work correctly from new and keep on working. Distance and the language problem made it difficult to rely on dealer networks to sort out the problems, but quite apart from this there was a different emphasis in Japanese manufacturing firms. The shop floor was seen as the centre of the operation and all attention was focused on it. The Japanese have an extraordinary aptitude for organising production. Not only efficient production lines but stock control, manning, quality control and everything else. Everyone concentrated on getting the product right, which meant producing it right. Contrast this with what tended to happen in the west. There, getting the product right meant market research, finding out the subconscious motives of prospective purchasers and so on. So emphasis was placed on the look of the product and its "sales features". The shop floor was left to take care of itself – you'd probably get trouble with the foreman or union if you interfered too much anyway. Salesmen, nay marketing men, concentrated on putting the firm's image across, accountants concentrated on making a profit, and production was supposed to come up with something or other in the required quantity at the appropriate time – the pre-Christmas rush, the spring sales boom and so on.

A vast mythology grew up over this – the supposed sex appeal of cars for example. The sales manager was assumed to know what he was about: his graphs showed when sales peaked, and production was organised to suit. Let's not belittle salesmanship however. It had become quite an art in the west and to some extent the engine of economic growth.

Because of cultural differences, this approach didn't suit the Japanese. Japanese women are regarded in a very Victorian light, so you don't devote time to getting the sex appeal of the latest car, stereo or whatever right. The emphasis in the highly ordered Japanese society is on the firm, and within the firm on production. It's interesting that the Japanese have been able to apply this technique wherever they've set up – and Japanese consumer goods manufacturers have now spread their operations around the globe. For geo-economic reasons, Japanese manufacturers had to be export orientated, but it was appreciated that you couldn't simply flood the west and destroy jobs there. That way the public wouldn't be able to buy the goods. So production lines were set up in the USA, the UK and elsewhere – the Japanese had learnt about the dangers of protectionism in the thirties. From being export orientated, Japanese manufacturers became multinational.

This fitted in rather neatly with the west's ability at salesmanship. Couple the latter with Japanese manufacturing ability and you've a sure formula for success. It's ironical that western sales organisations have contributed so much to the success of Japanese manufacturing concerns. But western countries would have been in difficulty had they come to rely on Japan as the consumer goods workshop of the world. Could Japanese manufacturing ability be exported? Could something so rooted in Japanese attitudes be successfully transplanted?

The answer as we know is yes. The story of Japanese success in this direction is an interesting one – with the same fundamental emphasis placed on the shop floor. The Japanese approach has not been rigidly applied elsewhere however – you don't start the day in Devon or California by singing the company song, and local management is left to get on with it subject to the overall requirements of quality control and efficient production.

It's interesting that the Japanese seem to have a different time scale to that usual in western countries. A fascinating report in the *Financial Times* recently chronicled Matsushita's approach to getting established in the USA. The story has parallels in the UK. Rather than start up in open competition on a green field site, the decision was taken to buy market share. By great good luck this suited Motorola, whose technical and manufacturing interests were moving in other directions. So in 1974 Matsushita took over Motorola's rundown TV plant in the suburbs of Chicago – and then spent some ten years getting it right!

Whilst being flexible, it seems that Japanese control has to be total. Hence Plymouth worked once Rank had left it to Toshiba but the joint GEC-Hitachi operation at Hirwaun failed to work successfully. It will be interesting to see how things develop now that GEC have pulled out.

Japanese concentration on the manufacturing process seems to be coupled with an element of benign neglect elsewhere. In another recent *Financial Times* piece Shizuo Takano, senior managing director of JVC, commented on the lack of auditing in Japanese companies. "We do have auditors but, to be honest, they don't do very much"! With that sort of management approach, it's not surprising that Japanese firms can adopt a longer time scale than is usual in the west!

CORRECTION – SONY KV2000UB

Under the heading "power supply fault finding" in Part 1 last month the advice was given to start off at about 150V a.c. from a variac. This should have read about 110V. It's important to start at 110V and then increase the input voltage gradually.

BUMPER ISSUE!

Watch out for our October issue which will contain extra pages and a data card listing AV in/out connections for the majority of VCRs that have been sold in the UK.

FRONT COVER

This month's cover photo shows an engineer carrying out VCR tests in the Thorn-EMI-Ferguson video laboratory. Our thanks to Ferguson for their assistance.

The Salora Ipsalo-2 Circuit

The Salora Ipsalo-1 circuit was described in the September 1980 issue of *Television* and was employed in versions of the Salora G chassis up to serial number 300,000 and versions of the H chassis up to serial number 200,000. To recap, Ipsalo stands for integrated power supply and line output, i.e. it's an ingenious circuit in which a single transformer is used as the switch-mode and line output transformer while also providing mains isolation. The aim is reduced power consumption. In the Ipsalo-1 circuit two thyristors were connected in series with the transformer's primary winding, one providing protection and a soft-start action while the other acted as the chopper device to provide regulation. Hence two separate driver transformers were required.

Now thyristors have tended to become unpopular for use as switching devices in TV sets. They're more difficult to control than transistors, and tend to produce interference. So transistors have come to predominate in power supplies and line output stages. The Ipsalo-2 circuit, which is used in later versions of the G and H chassis and the current J chassis, is an example of this tendency. The thyristors are out, replaced by a couple of switching transistors, while a single driver transformer (with separate secondaries) further simplifies matters.

A simplified circuit of Ipsalo-2 is shown in Fig. 1. At switch-on the mains bridge rectifier DB708-711 produces a 320V supply across the reservoir capacitor CB721. This is smoothed by RB713/CB722. Once the circuit comes into operation, the switching transistors TB700 and TB701 connect the primary winding of the transformer MB500 across this supply when they are switched on. As with any switch-mode power supply, the energy delivered to the secondary windings on the transformer is controlled by the on/off times of the switching arrangement, in this case the two transistors TB700/1. By using a pulse-width modulator whose output mark-space ratio is controlled by feedback, regulation is achieved. Energy saving is provided by the diodes associated with the two switching transistors. When the transistors are switched off, the voltage across the transformer's primary winding will try to reverse. DB705 and DB704 will then conduct, returning the unused energy to the smoothing capacitor CB722. DB703 and DB706 conduct on the overshoot.

The line oscillator provides trigger pulses for both the chopper control and the line drive circuitry. The action of the line output stage charges CB513 to 142V.

Since the set's supplies are derived from the secondary windings on the transformer, a start-up system is required. A neat arrangement is used for this purpose. At switch-on CB715 will charge via RB734/716/715. When the voltage across it reaches some 35V the diac DB725 will fire, discharging CB715 (partially) and providing TB701 with base drive. TB700 is driven by transformer action. When the voltage across CB715 has fallen to 25V DB725 and the transistors switch off. As a result of this action a 10V p-p sawtooth drive waveform is developed across CB715. This mode of operation enables DB504 to produce a 28V supply across CB510. The 28V is fed to a simple emitter-follower regulator in the switch-mode control circuit (within the thick-film hybrid i.c.). This produces an 8·5V start-up supply for the control circuit and the line oscillator and driver stages. Once the line oscillator gets going,

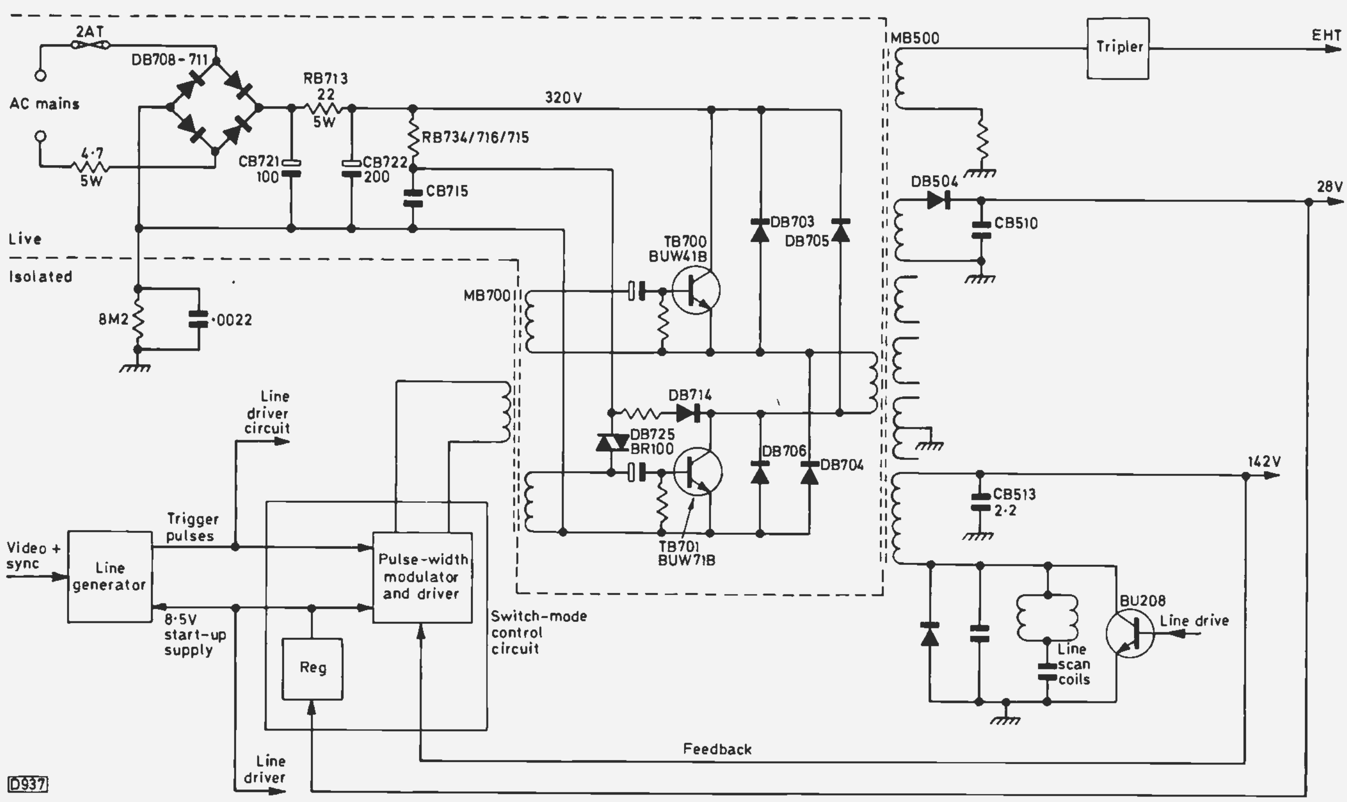

Fig. 1: Simplified circuit/block diagram of the Salora Ipsalo-2 system.

full operation commences. The start-up system is then disabled since DB714 switches on each time TB701 conducts, ensuring that the charge on CB715 doesn't reach the level at which DB725 fires. During normal operation the line oscillator, driver and switch-mode control circuit are powered by 15V/12V supplies derived from another secondary winding on the transformer.

The switch-mode control circuit consists of a bistable multivibrator (the pulse-width modulator) and a driver transistor for transformer MB700 plus extra bits for regulation etc. Regulation is achieved by using an *RC* charging circuit which is fed from the 142V h.t. rail, i.e. the supply to the *RC* network is proportional to the e.h.t. The 8μsec trigger pulses from the line oscillator are used to discharge the capacitor in this *RC* network. The capacitor then charges at a rate depending on the supply to the network. When the voltage across the capacitor has risen sufficiently, the bistable is triggered. The width of the output pulse from the bistable is thus dependent on the e.h.t. This arrangement also provides the soft-start action, the h.t. voltage building up gradually after switch-on. In addition, overload protection is incorporated by bringing a zener diode into operation under overload conditions to disable the *RC* charging network.

The short (8μsec) trigger pulses provided by the line oscillator necessitate some complication in the line drive circuit. A monostable multivibrator is used to stretch the pulses before application to the line driver transistor, the width control being incorporated in the monostable's *RC* timing network. To obtain a standby condition, an inverter is powered and used to invert the input to the base of the line driver transistor. As a result, the switch-mode and line output sections of the circuit operate with the wrong phase relationship and the energy is drained from the line side.

CCTV Commentary

Andy Denham

When I heard that EMI had sold their camera interests to Frowds of Portsmouth, my first hope was that the new owners would introduce some improvements. Having almost always worked on the Surveyor II in pouring rain atop a 20ft pole, I've on many occasions cursed the lack of access. I eventually came to the conclusion that the only way to work on the beast was to take a spare panel to the site, fitted with some coaxial cable and mains flex, and take the camera down for removal to an on-site workshop. Most of our cameras are fitted with silicon diode tubes, so they usually have a motorised lens with remote lens control for zoom and focusing, and usually a remote iris servo amplifier. These extras demand a highly technical piece of equipment for testing – a PJ996 battery lantern. This completes the test equipment.

We were recently asked to update and add to an existing installation, using Surveyor IIs, so it was with some misgivings that I fitted three of them from Frowds. Access is still difficult, and the old complaint that the camera has to be dismantled for access to the interior still holds. Once inside, we had to fiddle with nuts and bolts to set up the camera with its large lens assembly. The modified video circuit seemed to give better results than the original version, and the internal iris servo is very good. All in all however this is still the familiar EMI camera.

The Surveyor VI

More recently still a Surveyor VI arrived from Frowds. I carefully unpacked all the boxes – sun shield, wiper unit, washer unit and, in the last box (of course), the camera itself. The first thing we noticed was the change to plugs and sockets at the rear of the housing – no more dicky edge connector. Perhaps the only minus point here is that pan head connections can no longer be made at the rear of the camera unless you are using the internal telemetry. Access is much improved: by simply removing four screws the innards slide out of the housing, complete with the lens assembly.

The only external control is still mechanical focusing, which positions the tube for the lens in use. Our camera sported a massive 15-150mm 10:1 zoom lens, with motorised gearing fed from a socket at the rear of the camera.

A quick look through the technical specification showed some improvement on the earlier design. As usual, the sync can be by crystal, mains lock or external gen-lock. The standard is CCIR 625 lines 50Hz, or EIA 525 lines 60Hz, with 2:1 interlace in both cases. Internal protection is provided in the event of scan failure or excessive tube heater voltage, and the heater is soft-started to improve its life. The h.t. is not applied until the heater reaches its normal temperature, improving tube reliability. Links on the SPG board enable 900V to be selected for high-resolution tubes, e.g. vidicons and Newvicons, or 500V for silicon diode tubes.

The camera consumes only 14W, plus 4W for the window heater, and can be run off 200-250V 50/60Hz or 100-125V 50/60Hz a.c. supplies, or 24V a.c. (50/60Hz) or +12V/−12V d.c. supplies with slight modification (a single rail 12V version is to be made available later).

An internal telemetry panel that takes control commands via the coaxial cable is available as an optional extra.

In my opinion a much improved camera.

Hitachi Monochrome Monitors

Some servicing experiences with the Hitachi VM905-910 range of monitors are worth relating. The cause of cogging/line tear can often be traced to the boost reservoir capacitor or alternatively the line output stage supply filter capacitor. These are both electrolytics of 220/330μF. The usual cause of no line scan (line down the middle of the screen) is failure of the non-polarised electrolytic line scan coupling capacitor (3·3/4·7μF). No e.h.t. is often due to the U06C boost diode being dry-jointed. If you need to replace the boost diode, a BY298 is a suitable alternative. For no or weak sync, check the sync separator transistor's base coupling and emitter decoupling electrolytics. In the event of no or smeary video, poor contrast or shading on the left-hand side, check the video output transistor's h.t. supply decoupling capacitor. For no field scan/cramping, check the 1,000μF field scan coil coupling capacitor. In the 906/910 poor field linearity/lack of height can be caused by the 10μF coupling capacitor connected to the slider of the height control. In the 905/909, severe field foldover can be caused by the 100μF coupling capacitor to the base of the field output transistor. All these capacitors are electrolytics.

Tiny Tim's Dilemma

Les Lawry-Johns

Tiny Tim sat on his bench stool and looked at his little feet swinging beneath. He looked back at his desk, at what was causing him such acute pain. His bank statement said he'd a small amount in his current account. The income tax man said he owed a great deal more. The VAT was due and the wholesalers' statements completed the mess.

What was Tiny Tim to do? Go into the red? He already owed the bank a lot of money for something else, so he didn't feel inclined to throw himself on their mercy any more – even if they would play with him. He could throw himself off a cliff, but that might hurt. So Tiny sat and pondered. It was easier than working. After all, he'd worked his little fingers to the bone for more years than he could remember, not even having a day off, except Christmas Day that is. Even then old Fred had brought his set in at seven o'clock one Christmas night, which made Tim very angry though he didn't show it – good will to all men, except Fred. Now, after all that work, what had he to show for it? A nasty great tax demand for a start.

War Effort

Tim thought of the time years ago when he didn't have to work so hard. On D-day, when the soldiers were storming ashore amidst all that flack, Tiny Tim was in Gibraltar unpacking Blackburn Barracudas from their crates and helping to assemble them. He then helped to take them to bits again for crating and sending on to India. This procedure had puzzled Tim until he was told that they were originally unpacked and flown to India. As they needed a complete overhaul when they arrived it had been decided to ship them all the way instead. But no one had issued an order to stop the unpacking. So they were unpacked and built, then unbuilt and repacked and put on another boat. Thus Tim's war effort never received the acclaim it deserved. But the sun had shone and Tim had got his knees brown and had been repeatedly thrown out of the bars on Main Street – because he didn't like the pianist playing the White Cliffs of Dover and kept throwing a chair at him.

He'd done the same thing in Alexandria and got thrown out of the bars in Beer Street. This was the time when Subby Thomson was shooting down those Junker JU52s that dropped the cornettos over Benghazi. Oh dear how Tim's little mind rambles on. He was young then, and naughty of course. Tales have it that he should be blind, but instead he's just short-sighted. He got fed up last year, not being able to see properly through his glasses which he's repeatedly mended for the last twenty years or so. So he went off to see the man who makes you see better and ended up with an expensive pair of spectacles that enabled him to see a bumble bee about a mile away. He was so pleased, until he discovered that he couldn't see anything less than two feet away. So his nice new glasses remain in their case and he still has to wear his battered ones.

Tim sat and looked at his feet, or rather his shoes. His old shoes. He'd like some new ones, even if they did come from Italy. But he certainly couldn't afford to buy a pair with all this tax hanging over him – especially since Tinker Bell had demanded a new gas cooker, and had got it of course. So he'd have to put up with the pebbles hurting his little feet as he walked his dog across the car park to where Peter Ripley parks his nice new car. Peter always laughs when he sees Tim, and Tim's glad he's so happy. Must be something to do with his wife being so pretty and all that.

Memories of FJC

Tim scolded himself for being so selfish. He mustn't want new things when he can make do with old ones. He remembered being scolded by F.J. Camm, the original editor of *Television*. F.J. had told him off for sending in too high an account for answering readers' queries. "Two and sixpence is too much, especially as they are mainly repetitive." So Tim had knocked ten per cent off each monthly account for a while. For a little while.

F.J. was a formidable man. Someone not to be trifled with. After all his brother Sidney Camm had designed those lovely Hawker aircraft, including the Hurricane which Subby Thomson used to shoot down the JU52s. Yes indeed, F.J. was a man to be reckoned with in the Practical days. Not at all like the present editor who is kindly and helpful, always ready to cut large tracts of nasty bits out of Tiny Tim's articles so as not to offend our readers, who are such sensitive souls. I bet they didn't get slung out of the bars in Alex during the war. Or in Gib.

Thirty Years Ago

Tim remembered the very first article he'd submitted to F.J., thirty years ago in 1954. On servicing the HMV 1807. Tim had suggested that this could form the start of a series on servicing TV receivers – practical hints on commercial models. "We shall require more than one to start a series" came the reply, "so we suggest you submit a further three or four." Tim struggled and came up with a further couple of hundred or so and blushes to think how serious he was, studiously writing them all with his little pen because he couldn't afford a typewriter. Tinker Bell bought him one for Christmas some years ago, so that he could earn more money to buy gas stoves and things like that.

So it was that in September 1954 we kicked off: "This series of articles is designed to help those who possess a commercial set of popular make, or who may be asked to help in the servicing of such a receiver. The whole point of these articles is that nearly every television set possesses its own peculiarities which, if known, make servicing much simpler. Time and again the same faults crop up with surprising regularity." There was a lot of "kitchen table" servicing back in the days when sets were cumbersome but amenable and service engineers were few and far between. We've come a long way together since then.

Back to Earth

After a sleepless (almost) night Tim came down to see what bills the postman had brought to upset him further. A nicely typed letter caught his eye. It was from his accountant. "Don't pay that tax demand Les (I mean Tim). It's a mistake and you've paid too much already. Wait until you hear from them to confirm our figures." Oh Glory be, Glory be – and a nice new pair of shoes. The little angel that used to sit on Tim's shoulder and look after him is still there after all. And Tim thought the bitch had gone.

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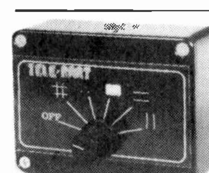

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TV Fault Finding

Reports from Mick Dutton, Jim Rainey, Tony Thompson, Robin D. Smith and Malcolm Burrell

Decca 140 Chassis

One or two problems have cropped up recently on this chassis. First, we had a batch of faulty line output transformers. The problem was with the built-in first anode control, which either drifted downhill making the picture dark or uphill causing excessive brightness with flyback lines. The power supply consists of the now familiar self-oscillating chopper with TDA4600 i.c.: we've had several BU426A chopper transistors fail after just a few hours' use, a replacement working perfectly. We've also had two cases of the mica washer behind this transistor breaking down – this is not obvious until the transistor is removed. In this case the symptom was recycling tripping.

One set suffered from very intermittent colour dropout, leaving a green and white display. This was due to the collector tabs of Q211 and Q203 on the tube base panel touching together – the wiring harness had been dressed too tightly, pulling on the components.

R423 (2·2MΩ), which is in series with the field hold control, tends to change value. The result is lack of height or more often field roll with a false lock position when the control is adjusted.

Very occasional failure to start was in one case traced to a crack in the print between D805 and R802 in the start-up circuit.

A set with remote control had a flickering LED display with occasionally no remote control. This was traced to a dry-joint where the lead is connected to the 5V line on the display panel. **M.D.**

Thorn TX9 Chassis

The problem with this 14in. portable (PC1001 main panel) was slight lack of height. Even with the height control at maximum the raster was about half an inch short at the top and bottom. A voltage check at the control showed that the cause was lack of voltage – due to the 3·3MΩ feed resistor R268 having gone high in value. **T.T.**

Fidelity CTV14R

The initial fault was reduced field scan (2½in.) with foldover. Whilst making voltage measurements around the TDA1170S field timebase i.c. the field collapsed then the set tripped and went dead. A replacement chip restored the original fault condition. The linearity control had little effect other than making matters worse, and gentle prodding around the area of the chip restored the picture to normal – though only momentarily. A dry-joint perhaps? I've had them before on this chassis. After running over the area with fresh solder we'd lots of shiny joints but the problem remained. Tap again, same result. No print cracks could be found so component prodding with a plastic knitting needle was resorted to. The culprit turned out to be C706 (10μF) in the feedback circuit. **T.T.**

Rank T22 Chassis

The symptom was low brightness, flickering to full brightness intermittently. At times the picture would disappear, leaving almost total darkness apart from an odd line of colour here and there. It's seldom easy to make voltage checks with an intermittent fault, but the blacked out screen remained long enough for me to discover that the first anode voltages were low. 4R42 (150kΩ) in the first anode supply network was found to have a circular burn, a replacement restoring normal operation. **T.T.**

Philips G9 Chassis

The problem of tuning drift with one of these sets caused us a lot of trouble. Checks on the tuner and tuning control circuit failed to reveal anything of any significance – and the fault wouldn't show up in the workshop. The set went back and forth between us and the customer two or three times before we changed the tuner, which solved the problem. Our local channels are in group A, but the customer was linked to a communal system that uses group C/D channels. It appears that the tuner didn't like operating at the higher frequencies. **R.D.S.**

Rank T20 Chassis

The power supply was working correctly, providing the 200V h.t. line, but the line output stage was dead. A quick check revealed that 5R8, the 1Ω resistor in series with the line output transistor's base, was open-circuit.

Another fault we had on one of these sets was bad EW bowing with excessive width. The EW loading coil 5L2 had shorted turns. **R.D.S.**

ITT Hybrid CTVs

We still get these sets in occasionally. An unusual fault we had recently was maximum colour saturation with the customer's colour control having no effect. The colour control circuit consists of a bridge arrangement with a tapped coil, a couple of varicap diodes, a capacitive trimmer and a resistive bias network. Various tests on the resistors and diodes were carried out before we decided to try the effect of adjusting the trimmer (C160). A quick turn cleared the fault and after setting it up (for no colour at the minimum setting of the colour control) correct saturation control was achieved. We can only assume that C160 was dirty/noisy.

The fault on another of these sets was intermittent low gain with slight tuner drift. Every day the set would suddenly go low gain (snowy picture). We looked for dry-joints on the i.f. strip and changed the tuner, but the fault persisted. In fact we spent quite a lot of time on it before we discovered that the i.f. preamplifier transistor T13d was faulty. **R.D.S.**

Philips G8 Chassis

The set was dead as a result of a lightning strike. Inspection showed that the earth part of the power supply printed circuit had blown away, and after bridging the print and switching on the h.t. was restored – but there was no e.h.t. Many checks were made to find out why the

– continued on page 594

Servicing the Grundig 2×4 Super

Part 3

Mike Phelan

This month we'll look at the machine's servo and DTF departments. As the V2000 system has been described in detail in these pages before, we'll give just a brief recap on the DTF system.

With DTF (dynamic track following) the video heads are mounted on piezoelectric arms which can be bent to move the heads in the vertical plane to centre them on the recorded tracks. On a basic machine this means that the customer's tracking control is eliminated; on a machine with trick playback facilities there will also be no noise bars on the picture at the various speeds.

The process is in two parts. In the record mode the servos work normally but no control track is laid down. Instead, a master oscillator produces five frequences (f1–f5) four of which are recorded in sequence field by field along with the luminance and colour signals. The frequencies lie below the lower chroma sideband and are chosen so that the harmonics cause no picture interference. The fifth frequency f5 is recorded as a one and a half line burst following the field sync pulse. After this the machine goes into playback for one and a half lines: as there's a one and a half line offset between successive tracks, the burst from the previous track may be picked up. If this occurs the head is moved to give greater track spacing before recording is resumed. Only one head is controlled in this way.

In the playback mode the four frequencies that were recorded in track by track sequence are filtered out. Any crosstalk between a previous or following line produces difference signals which are used to control the head positions. The order in which the frequencies are recorded on successive tracks is f1, 2, 4, 3 (firing order!). The difference frequencies produced by crosstalk between tracks are approximately 15kHz and 46kHz (alternately and opposite from one head to the other) and are filtered out for control purposes. When one head is playing back, the presence of a 15kHz signal will bend it up while a 46kHz signal will bend it down; vice versa for the other head. The output stages that control the actuators (arms on which the heads are mounted) are operated from the ±150V rails.

DTF Module

A block diagram of the DTF module is shown in Fig. 6 The microcomputer i.c. (IC2640) is reset every time threading occurs to reset the programme at the start of record or playback. The external clock IC2660 also clocks

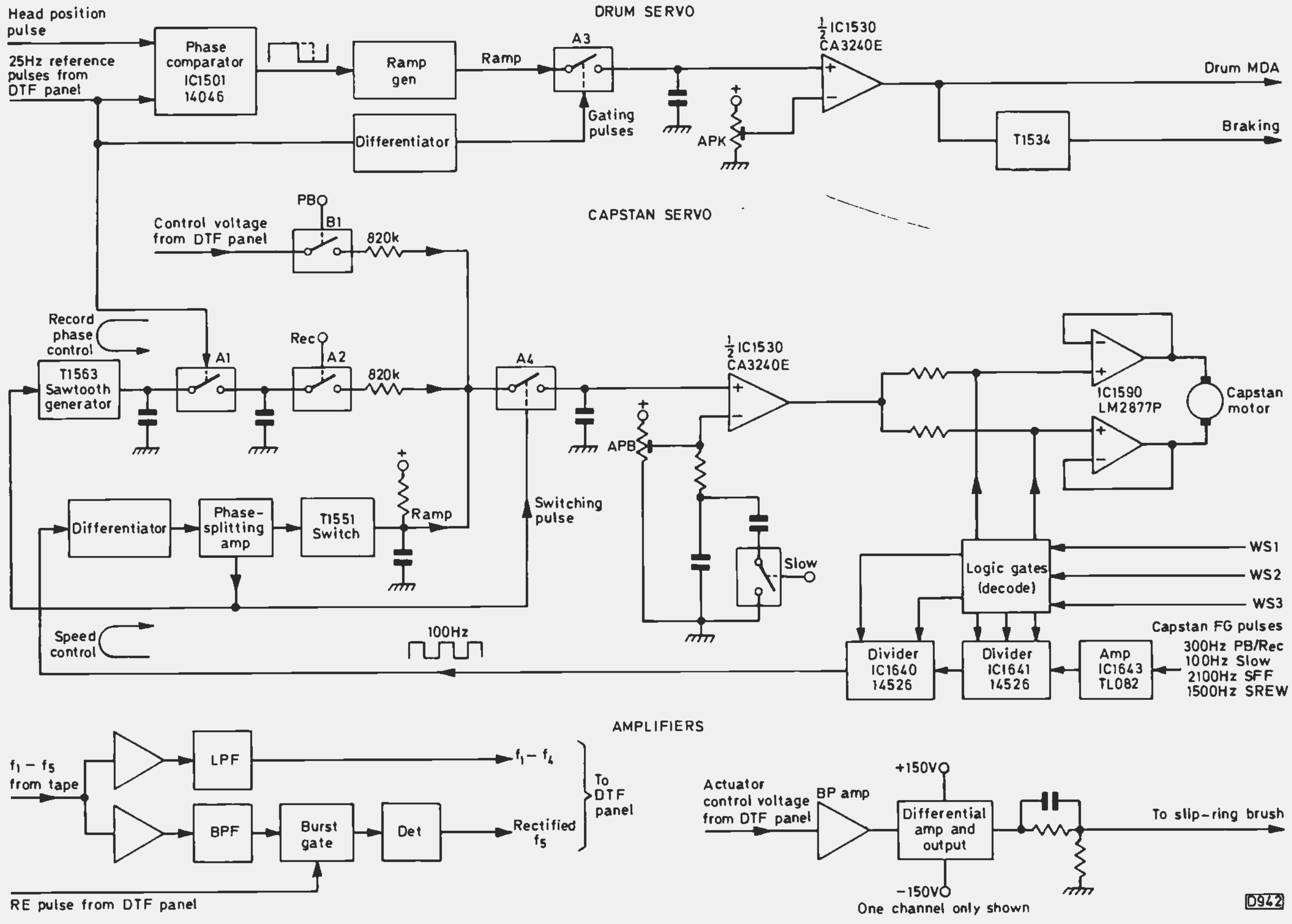


Fig. 5: Block diagram of the servo panel.

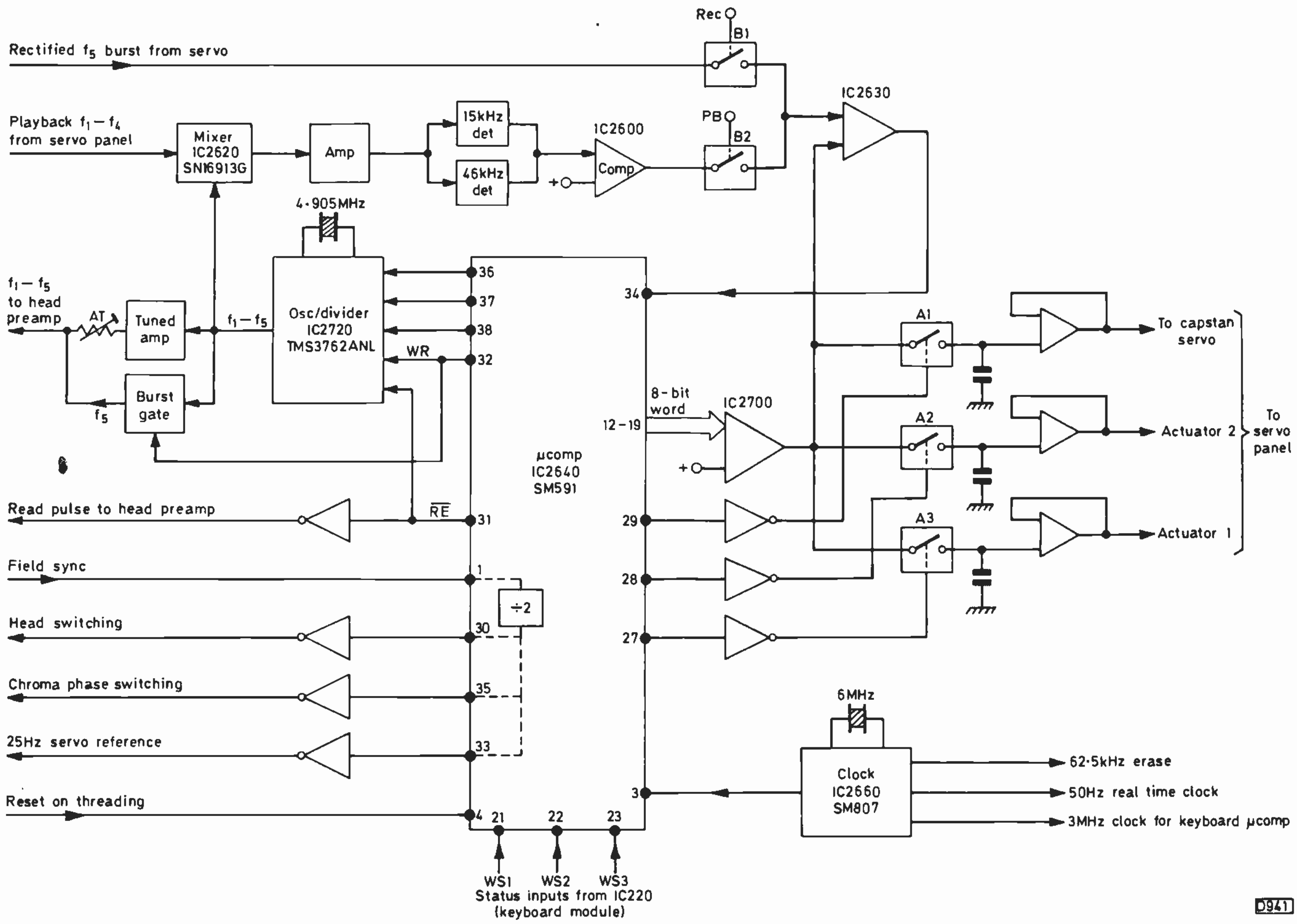


Fig. 6: Block diagram of the DTF panel.

the sequence control microcomputer on the keyboard and supplies the erase head and the real-time clock. A flip-flop divider within IC2640 provides outputs for head switching and chroma carrier phase shifting. This is also used as the servo reference, keeping the component count down.

Pins 36, 37 and 38 of IC2640 programme the divider in IC2720 to give the correct sequence of frequencies, while the WR pulse from pin 32 opens the gate for one and a half lines to record the f5 "burst". The RE pulse follows this to switch the head preamplifier to playback. The off-tape burst is rectified on the servo board and fed via switch B1 to the comparator IC2630 whose other input is fed with a d.c. level from IC2700. As the microcomputer i.c. is a digital device, IC2700 and a resistive network are used as a DAC to convert the 8-bit output to a voltage. This 8-bit word indicates the previous DTF burst's amplitude. So the machine knows how the track spacing is varying and corrects this by moving actuator 2. In the record mode A2 is closed while A1 and A3 are open.

During playback f1–f4 are filtered out by a broadband tuned amplifier and mixed in IC2620 with f1–f4 from IC2720. The output from IC2620 consists of a mixture of 15kHz and 46kHz which is then amplified and rectified. If the proportions of the two signals are unequal, the output from IC2600 goes high or low. This output is passed via switch B2 to comparator IC2630 whose output is fed back to the microcomputer i.c.

The DTF process is not continuous. Sixteen samples per field are looked at, the results being fed back to IC2700 in the form of an 8-bit data word. The outputs from IC2700 go to switches A1–3. A2 and A3 operate on alternate fields, sixteen times per field, the output capacitors holding the charge between each switch-on. A1 is switched on every 20msec during playback, feeding an output to the capstan servo. We'll return to this later.

Servo Module

A block diagram of the servo module is shown in Fig. 5. Table 1 shows the WS code table – you'll recall that this 3-bit code tells the servo and DTF which mode the machine is in.

The servo circuit is very simple and uses standard linear and logic i.c.s. We'll look at the head servo first. This is a phase control loop only but is slightly different from VHS ones. The two signals to be compared are applied to IC1501. One signal comes from an optodetector on the lower drum, the other from pin 33 of the DTF microcomputer i.c. This latter signal is derived from the field sync pulses on record and from the DTF clock on playback. As the servo operates in the same way in both modes no switching is involved – selection of the appropriate reference is done on the DTF board. IC1501 does away with the need for a speed control loop as its output is a squarewave whose mark–space ratio is determined by the phase difference between the two input signals – if there's a speed error the output will be predominantly high or low. The output is integrated to form a ramp which is sampled by gate A3, the gate being switched by the reference pulse after differentiation. The charge on the hold capacitor controls the head MDA. Should the motor tend to run excessively fast, T1534 turns on to operate the brake circuit. Simple but effective.

The capstan servo has a speed loop and, in record, a

Table 1: WS codes

Mode	*WS1*	*WS2*	*WS3*
Record	0	1	0
Playback	0	1	1
Still	1	1	1
Slow	0	0	1
SFF	1	0	1
SREW	1	0	0

phase loop which compares the capstan FG with the reference. The phase loop is inoperative on playback, but the output from switch A1 on the DTF board is fed via B1 through a bleed resistor to the control line. We can now go into this.

If the tape speed is too high (within the confines of the speed loop) the DTF will bend both heads in the same direction. If the error is cumulative, control will periodically be lost. This won't do of course, so the DTF sample voltage is bled into the capstan servo to correct the tape speed – in effect altering the tracking as with a manual control.

The two 14526 programmable dividers IC1640-1 cater for the different capstan motor speeds (playback, slow motion, etc.). The division ratio is determined by whether pins 2, 5, 11 and 14 are low or high, the output being 100Hz irrespective of mode – the input frequencies are shown in Fig. 5. An array of logic gates decodes the WS signals to give the dividers the appropriate instructions and reverses the motor for SREW – there's no reel servo on this machine.

Some of you may be wondering how the head speed is altered in the trick modes to avoid loss of line sync – there doesn't seem to be anything in the head servo to do this. It's done by the DTF microcomputer altering the 25Hz reference frequency slightly.

Fault Finding

Now to faults. The first question must be: how does one distinguish between DTF and servo faults? You are presented with a picture covered in noise bars, but where does the fault lie? Totally incorrect head or capstan speed is fairly obvious. Failure of the head or capstan phase control loop in record will cause slowly moving noise bars on the machine's own recordings: if the head servo is at fault the noise will move even in still frame. Misadjustment of APB (capstan servo) produces severe wow during record. Failure of one or both DTF channels will give passable playback but several noise bars in fast search – don't forget the two 100Ω resistors in the power supply for this one.

A scope on the slipring brushes should show a sort of wobbly squarewave – only on one in record. Test point DTF-3 gives rows of dots and dashes – adjust APB to make them coincide, using a known good tape. If the dots are not fairly straight there's a tape path fault – look for bent guides, the cassette lift not square, dirt on the capstan, etc.

In fast search the rows of dashes become triangular but the rows of dots stay straight. Adjust VA1 and VA2 (DTF output gain controls) to make this so, on the machine's own recordings. The triangular ramp of dashes is because the heads have to be moved to cross several tracks. In the trick modes the microcomputer produces a ramp, leaving the DTF to apply only a small amount of correction.

We've had a few failures of IC1590 (LM2877) which gets very hot when faulty – the capstan motor runs very slowly. If the capstan speed is incorrect, don't forget that the output from IC1640 will still be at 100Hz. The cause is sometimes a defective gate in the WS decoder. If one of the WS codes is stuck permanently high or low however the machine will go into the wrong mode but will be working correctly for that mode – not doing what it's told in other words.

We've had a few failures of passive components in the servos – sometimes difficult to locate. In one or two cases we've had to scope a good working machine and draw waveforms all over the manual to find the fault!

The DTF module is reliable. Up to now the only problems we've had have been failure of IC2620 and the 4·9MHz crystal – both giving no DTF. The DTF output transistors (on the servo board) can go short-circuit repeatedly, burning out the 100Ω resistors in the power supply. Slight noise bars during fast search, sometimes clearing, can in most cases be removed by carefully adjusting VA1 and VA2. The head servo adjustment APK moves the switching point: so this is the way to adjust it finely, using a good prerecorded tape and a monitor with the picture height reduced.

Next month a few words about the tape deck, the motor connection board, etc.

TV Fault Finding

– continued from page 591

line timebase wasn't working, and as the oscillator receives its supply from the output stage (after starting up) I decided to power it from an external 18V source. A scope check then revealed that the oscillator was working, but the rest of the timebase was still dead. I eventually found that part of the earth print on the i.f. strip had blown apart, and after bridging this the set came to life. Why this should prevent the oscillator from driving the rest of the line timebase is not clear, but it did! **R.D.S.**

Thorn TX9 Chassis

The 1·6A mains fuse FS1 kept on blowing. The line timebase can be isolated from the power supply by disconnecting the fault-finding link (PC1040 main panel). This proved that the fault was in the power supply, and D66 (1N4007) which is in series with the h.t. rectifier thyristor turned out to be short-circuit. Odd that – it's not fitted in later production, though the thyristor type was changed. **R.D.S.**

Waltham W190

The fault with this set was a plain raster with no modulation. Some quick checks revealed that the 13V supply was missing due to the 13V zener diode D608 (ZY13) having gone short-circuit. It's a 20in. monochrome set with some unusual circuitry – there's a common transformer for the chopper and line output circuits. **J.R.**

Philips K30 Chassis

The set was dead with no h.t. at the collector of the line output transistor. There was 300V at the collector of the chopper transistor however so it seemed that this was without drive. It's always worthwhile removing the chopper drive panel and checking the semiconductor devices before condemning the TDA2581Q control i.c. The BSS58 driver transistor turned out to be short-circuit base-to-emitter. **M.B.**

Cable 84

Harold Peters

Cable 84, the second annual conference and exhibition for the cable and satellite industry, was held at Wembley over July 10-12th, only eight and a half hours after the Cable and Broadcasting Bill had finally passed through the Commons and about three weeks before it was due to receive the Royal Assent. Some 300 delegates attended the conference itself and were mainly concerned with the problems of getting cable networks started. At the exhibition greater interest was being shown in the stands displaying receiving and test equipment rather than cable machinery and electronics.

The show was much larger than Cable 83, and this time you could walk out on to the roof to inspect the "dish farm" that provided signals from ECS and Intelsat V to the stands below. Distribution of the signals was entrusted to Megasat Ltd. who were picking up all the transponders available, including Music Box which had started operations early to catch the show. Music Box shares the same transponder as Sky, offset and with different polarisation. The transmissions are unscrambled and the sound carrier is at 6·6MHz with a pair of stereo coding signals at 7·1MHz. It was being received and demonstrated via a 1·2m dish on one stand – two exhibitors were offering complete 11GHz packages to pick up Music Box at around £1,200. Signals from the Russian satellite Gorizont were hardly to be seen, which was not surprising in view of what was on offer from ECS and Intelsat V.

GEC demonstrated Pal and MAC-C signals side-by-side, using the PM5544 test pattern, a severe test. The difference was about the same as between 405 and 625 lines when BBC-2 began in the sixties – impressive to the enthusiast, but not enough of a difference to sell the extra gear necessary from a general public point of view.

The slow and bumpy ride the Cable Bill had through parliament forced many of those involved in this field to consider other outlets, producing increased interest in smaller distribution systems, e.g. a modest dish atop a block of flats to provide extra channels to the communal system below. The logical progression towards DBS is only a matter of time, particularly now that the signals from ECS are coming in better than expected.

Some of the programmes are scrambled, but this seems to be something that programme contractors agree to only with reluctance – they'd like a simpler way of collecting their revenue.

Cable 85 next year will be held at Brighton on July 9-11th.

Teletopics

VIDEO DISCS

CBS, the US broadcast and entertainments group, are to cease production of CED videodiscs. The company has been producing the discs at their Carrollton, Georgia plant since 1982. CBS comment that the decision by RCA to end production of CED disc players led to a substantial fall in the demand for discs.

The future of the video disc appears to lie increasingly in specialised applications – for educational/training purposes where the interactive possibilities are an advantage, for juke box use (as previously mentioned in this column), and for use with microcomputers for video games and other purposes. It's interesting to note that JVC were showing an MSX microcomputer (the Japanese microcomputer standard adopted by a number of Japanese electronics firms) linked via an interface unit to a VHD player for video games purposes at the recent Chicago Consumer Electronics Show.

WHITHER 8mm?

As the year progresses, the likelihood of 8mm video equipment being introduced on the European market seems to be receding. Back in March we reported that the system "is to be introduced by a number of firms later this year". That was at the time of Kodak's announcement of the Matsushita-developed Kodavision 8mm video system. Shortly after this came the announcement that Polaroid would be introducing a Toshiba-developed 8mm system. It seems that the film companies saw 8mm as a way of getting into the video field in a big way. Video firms appear to have reservations however. Development of 8mm systems continues, but the VHS-C and Betamovie compact video systems look set to dominate the portable video field for some time to come.

One problem with 8mm systems is the tape. Due to the higher recording density, the more recently developed types of video tape will have to be used, either metal powder or metal evaporated. The trouble with metal powder tape is that special heads are required. Metal evaporated tape can be used with standard head technology but is difficult and expensive to manufacture. Both types of tape are a lot more expensive than standard video tape. This presents something of a chicken-and-egg problem: the price of the tape won't come down until bulk production starts. In addition, it seems that PAL/SECAM operation with a drum speed of 1,500 r.p.m. (set by the European field frequency) is more difficult than NTSC operation with a drum speed of 1,800 r.p.m. (60Hz field frequency).

VIDEO HEAD REPLACEMENT SERVICE

A new service being launched by Manchester Colour Engineering Services Ltd. of 42-46 Moss Road, Stretford, Nr Manchester (telephone 061-865 6021/2) will enable substantial savings to be made when VCR video heads wear out. Instead of having to buy a complete upper drum when the heads are worn or damaged, service departments and VCR suppliers will be able to send the defective drum to MCES who will re-equip it with new glass-filled Japanese heads to the latest specifications. The cost of this is considerably less than that of a replacement drum.

MCES is an independent company and is the first to be permitted to install the same fully automated, computer-controlled optico-electronic equipment used by leading Japanese VCR manufacturers on their production lines. MCES staff have received training in Japan as part of the operation. The complex equipment used enables replacement heads to be aligned to an accuracy of some 0·3 microns.

The service is to start at the beginning of September and will initially be restricted to two-head VHS drums used in Akai, Ferguson, Hitachi, ITT, JVC, Panasonic, Nord-Mende, Saba and Telefunken machines. A service for Beta units is to be offered later.

MCES has provided various services to the TV trade for over a decade, including u.h.f. tuner alignment and servicing of units such as Mullard text decoders, aerial boosters, Philips handsets, printed panels, etc.

TELETEXT-SPECTRUM ADAPTOR

O.E. Ltd. (North Point, Gilwilly Industrial Estate, Penrith, Cumbria CA11 9BN, telephone 0768 66748) have introduced an adaptor that enables a Sinclair Spectrum microcomputer (either 16K or 48K type) to be used as a teletext decoder. The TTX2000 adaptor, with interface cable and instructions, is available from the manufacturers at around £145 inclusive of VAT and postage/packing. It sits directly beneath the Spectrum to form a compact unit and will work with standard monochrome or colour receivers. There are four preset channel controls and the pages are called up by keying the appropriate number. The usual options such as hold and reveal are provided for. Teletext pages can be held on screen, stored on a microdrive for later recall, or printed out using a Spectrum or any compatible printer. O.E. Ltd. have also announced plans for a telesoftware programme to allow TTX2000 users to receive and download broadcast software for use with the ZX Spectrum. This downloader facility will be available as an upgrade ROM.

NEW COLOUR ENCODING IC

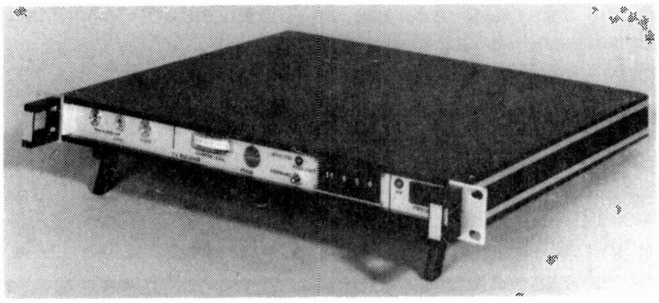
The New Motorola MC1377P l.s.i. encoder chip accepts RGB inputs and provides a composite output to either the NTSC or PAL standard. To simplify interfacing with a variety of sources, the RGB inputs are a.c. coupled: 1V peak-to-peak signals give full colour saturation. The only other input required is composite sync. The chroma and luminance signals are looped out of the chip to allow for bandwidth and delay tailoring. The device contains a subcarrier oscillator which can be used as a master oscillator or be driven from an external source, a voltage-controlled 90° phase shifter, two double-sideband modulators, RGB input matrixes and blanking level clamps.

MITSUBISHI'S 40in. HIGH-DEFINITION TUBE

Mitsubishi have announced in Tokyo the development of the world's first 40in. (diagonal) high resolution tube for high-definition TV (1,125 lines) use. The aspect ratio is 5:3 and the phosphor dot pitch 0·45mm. Previous high-definition tubes had been limited to the 30/32in. sizes by the strength and weight of the glass required. Mitsubishi have also developed a wide-range, high-output video circuit with a flat response to 30MHz, and deflection circuits to ensure a high standard of linearity. In addition a digital convergence circuit achieves a precision of 0·1 per cent of screen width over the entire screen.

SINGLE-CHIP TELETEXT DECODER

The new ITT TPU2700 provides a single-chip teletext decoder with the capability of acquiring and storing eight pages simultaneously in conjunction with a 64K bit DRAM. It decodes the standard level-1 teletext transmissions and has been designed to interface with the Digivision 2000 series chips. The TPU2700's on-chip FIFO buffer enables it to be used with standard low-cost DRAM without speed problems.



The new, compact Marconi Model P3400 satellite TV receiver is only 44·5mm thick. It's been designed for high quality, cost effective reception of the new European satellite TV transmissions from satellites such as ECS and the Intelsat series. The main users are likely to be cable system operators and telecommunications organisations requiring high quality vision and sound signals for distribution via terrestrial networks. The receiver is also intended for uses such as hotels and conference centres, language teaching institutes and for broadcasting organisations. The input at 900-1,700MHz comes from a low-noise downconverter mounted on the outdoor dish. For encrypted transmissions a further decoding unit is employed after the receiver to recover the vision and sound from the composite signal.

Compensation for ghost images with delays of up to 0·8μsec is automatically performed by the chip, which has underline capability and automatic character set selection – it will serve in receivers for eight different language teletext transmissions. The device comes in a 40-pin plastic DIP encapsulation, requires a single 5V supply and consumes typically 1·25W.

VCR SERVICING COURSES

The London Electronics College will from September be offering, in conjunction with the Manpower Services Commission, a full-time, six-week intensive training course in VCR servicing. The course includes a high percentage of practical work and instruction on state-of-the-art techniques such as digital and microcomputer technology as applied to VCRs. It's been developed in liaison with industry to help alleviate the present shortage of skilled video engineers and is intended for qualified TV technicians, or applicants with a similar background, who wish to extend their skills. The first two courses start on September 17th 1984 and January 7th 1985 and are open to both private fee paying and MSC sponsored applicants. Tuition fee for the full course is £600 plus VAT. For further details apply to the London Electronics College, 20 Penywern Road, London SW5 9SU (telephone 01-373 8721).

DIY HEAD MAINTENANCE KIT

The Monolith Electronics Co., Ltd. (5-7 Church Street, Crewkerne, Somerset, telephone 0460 74321) have introduced a new and more comprehensive video head replacement and maintenance kit for the home enthusiast. The VMC02 kit contains a novel head-concentricity guage for aligning Betamax heads to an accuracy of better than three thousandths of a millimetre, a stroboscopic tacho disc for verifying the head rotational speed with VHS machines, handling gloves, a cross-head screwdriver, an inspection mirror, a can of air-blast dust remover, an antistatic cloth, cleaning fluid, shaped spatulas, replacement service labels and a quality mains-operated soldering iron with solder – all for £19·95 including VAT plus £1·50 post and packing by mail order. A set of step-by-step instructions and a stock list of heads available from Monolith are provided. Customers can make free use, by telephone, of Monolith's advisory and service department.

PORTABLE CCTV SURVEILLANCE SYSTEM

The Viguard portable CCTV surveillance kit, which is designed to provide temporary security, has been introduced by Pilkington Security Equipment Ltd. (Colomendy Industrial Estate, Rhyl Road, Denbigh, Clwyd, N. Wales). It consists of a video camera, 7in. screen monitor, interfaces and a power supply, all contained in two lightweight suitcases, plus a separate fibre-optic cable reel to provide a video link of up to 1km. The fibre-optic cable allows the system to be used in an electronically noisy environment, cannot be bridged or tapped without detection, and provides good signal quality. Viguard can be powered from the mains or a 12V car battery via a cigarette lighter socket.

VCR Servo Systems

Part 1

Eugene Trundle

The circuits used in VCRs to process the luminance, colour and sound signals are fairly standardised and by now well understood. When it comes to system control and the servos however there's a wide diversity of techniques in use, varying between machines of different age and manufacture. It's also here that the major differences between basic "record and play" machines and those with added "trick" modes – still frame, slow motion and so on – are to be found. In the syscon department microcomputer techniques are now universally used – up to three of these complex i.c.s may be found lurking on the syscon panel. In the most advanced of current models microcompter i.c.s are also finding their way into "trick-servo" circuits.

Many of us last made a study of servo circuits and techniques in the days of piano-key operated machines of one type or another. The simple arrangements used in these VCRs are not difficult to understand and service. Things have come a long way since then however, as a glance at the manual for a modern machine will show. The basic principles remain the same, and it's the purpose of this article to identify these and relate them to the various circuit arrangements that have been used over the years.

Basic Requirements

Let's start by setting down the bare essentials of servo operation in a domestic helical-scan machine. During record the capstan motor must rotate at an even speed to pull the tape past the heads at a rate appropriate to the format (N1500/N1700/VHS/Beta/V2000). This can be done without using a servo, but because variations in friction and load can effect the speed a simple servo system is generally provided to ensure steady passage of the tape.

The capstan speed is tied to a reference, usually a stable crystal oscillator though in some early machines (Philips and single-motor Beta models) the 50Hz mains supply was used. Hence the simple servo system shown in Fig. 1. Here we have a phase comparator that produces an error voltage proportional to the time difference between its two inputs, in this case the reference waveform and the PG (pulse generator) feedback pulses. The error output voltage is used to modify the motor's speed and set it so that a steady relationship exists between the reference and the PG pulses. The shaft's position is thus phased to the reference. The PG pulses are produced by a couple of magnets mounted of the flywheel. Thus two PG pulses are produced per revolution of the flywheel.

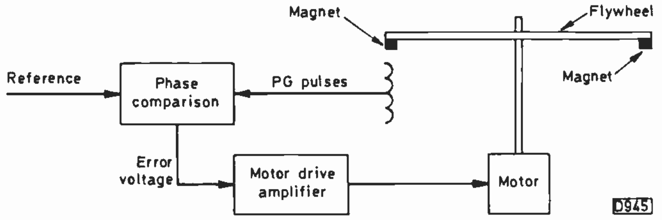


Fig. 1: Basic servo control loop.

When it comes to the head drum, the first point is that we have to record one 20msec TV field per head sweep. With two heads mounted diametrically opposite to each other in the drum, this implies 20msec per half revolution of the drum, 40msec per revolution and a precise speed of 1,500 r.p.m. This in unalterable where we have a 50 fields per second TV system: regardless of format, 1,500 r.p.m. is the required speed.

Having set the drum's speed, we have a second requirement. At some point during the field we have to switch from one recording head to the other. This will create a minor picture disturbance which must be kept out of sight. The field blanking period seems to be the ideal time to do this switching, but this period contains a series of critical timing pulses. Discontinuity here due to the head switchover could well cause vertical jitter on playback. The head switchover point is thus chosen to be about seven lines before the field sync pulse, and is "lost" off the bottom of the screen in the normally slightly overscanned raster. Now to keep the head switching point at this precise location we need a means of synchronising the drum's rotation to the incoming field sync pulses. A PG on the head drum provides a signal that indicates the head's position. We can compare the timing of this signal with that of the field sync pulses, using a servo like that shown in Fig. 1, to ensure that each head sweep starts just before the arrival of the field sync pulse in the TV signal being recorded.

So much for record. How about playback? Starting again with the capstan, we have the same requirement of a steady rotational speed, and some machines use the same arrangement as on record with no switching at all. The head drum must rotate at precisely 1,500 r.p.m., as during record, so that the heads pass over the tape at the correct angle. This will ensure that the head sweeps are parallel with the tracks recorded on the tape but will do nothing to ensure that they coincide, with the heads centred on the correct tracks — remember that due to the head azimuth offset, each head can read only its "own" tracks correctly.

Control Track

Unlike a conventional gramophone record groove which guides the stylus in addition to carrying the signal information, a magnetic tape track is not mechanically

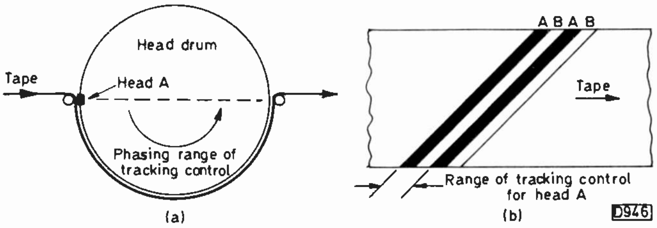


Fig. 2: Effect of the playback tracking control.

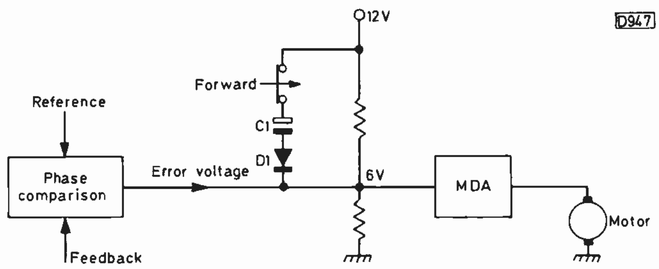


Fig. 3: Addition of a simple speed control arrangement.

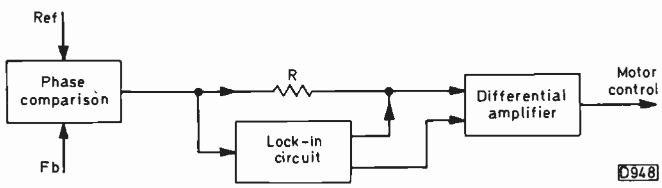


Fig. 4: Lock-in system used in Philips N1500 machines.

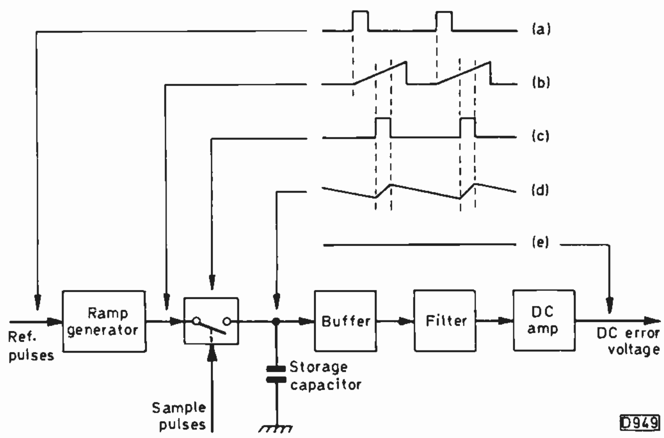


Fig. 5: Sample-and-hold principle.

locked to the reading head. In the V2000 system, specially recorded track identification signals enable the tracks to be identified and the heads kept in accurate alignment with them. The VHS and Beta systems rely on a separate marker system to indicate the position of each video track on the tape. This is the purpose of the control track, a narrow margin at the bottom edge of the tape, on which pulses are laid down during recording – one pulse for every two video tracks.

These control pulses can be used to phase the rotation of either the capstan or the head drum so that a fixed timing relationship is established between the tape tracks and the head sweeps. By phasing we mean getting the positions of the heads/tracks to coincide in addition to the speeds being correct. A potentiometer (tracking control) can be used to adjust the phasing process so that correct tracking is set and maintained, with each head following a path down the centre of its tracks to obtain minimum noise and inter-track crosstalk on playback.

Most machines are capstan controlled on playback, the control track pulses being used as a reference signal for the capstan servo. Fig. 2 shows the effect of the tracking control. It normally has a range of about 180° of head rotation, thus embracing about two track widths. This ensures that correct tracking can be achieved with any tape under any conditions.

Speed and Phase

So far we've identified two distinct characteristics of the behaviour of a rotating shaft under servo control. These are its speed, which with a VCR is determined by the TV system and the format, and its phase, whose importance lies in the need to establish a specific head position/sync pulse relationship on record and head path/track position relationship on playback. The basic servo loop shown in Fig. 1 makes a poor job of speed control, so a separate means of establishing the correct speed quickly is required. In early machines this took two forms, see Figs. 3 and 4.

Fig. 3 shows a simple servo arrangement in which the error voltage output is mixed with a steady voltage from a potentiometer network connected across the supply rail. The potentiometer network provides a standing bias corresponding to the motor's normal running voltage, the overall arrangement providing a "window" of servo operation around the 6V point. The standing bias forms a crude speed control circuit: when "forward" is selected, the charging current of C1 via D1 increases the voltage applied to the motor so that it accelerates rapidly from standstill to a point within the lock-in range of the phase-controlling servo circuit.

The alternative approach shown in Fig. 4 was used in N1500 series Philips machines and takes the form of a lock-in or starting circuit. This governs the gain of the motor control amplifier according to the degree of ripple generated in the sample-and-hold phase comparator circuit – this ripple is proportional to the speed error. As the correct speed is approached, this ripple decreases and the effect of the circuit lessens. Once phase lock is achieved, it has no effect on the operation of the servo. As we shall see, later VCRs use a feedback loop for speed control in addition to that used for phase control, with an FG (frequency generator) on the controlled shaft to provide feedback pulses.

Sample-and-hold Technique

Let's briefly recap on the sample-and-hold principle. It's a very common arrangement and has only recently been succeeded by digitally-based systems. Fundamental to either technique is the requirement to produce an error voltage output proportional to the time lapse between two inputs – reference and sample. The reference will be some local timing source and the sample a tacho pulse (PG) from the controlled shaft/flywheel.

The basic idea is illustrated in Fig. 5. The reference pulse (a) is used to start a ramp (trapezoid) generator which produces a linear ramp (b) whose amplitude at any subsequent instant will be proportional to the elapsed time. At some point during the ramp the sample pulse (c) arrives. This briefly closes a switch between the ramp source and a storage capacitor. As a result, the latter is charged to a voltage proportional to the elapsed time. Provided its discharge path is a high-impedance one, the capacitor holds its charge between sampling pulses. This charge forms the error voltage (d) and (e) which is used to control the motor. Note that some means must be pro-

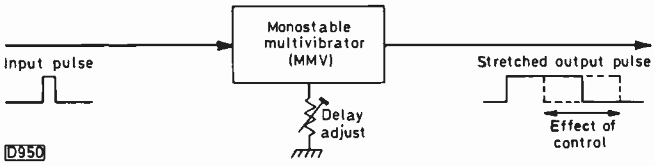


Fig. 6: Use of a monostable multivibrator (MMV) for pulse stretching, providing an adjustable delay.

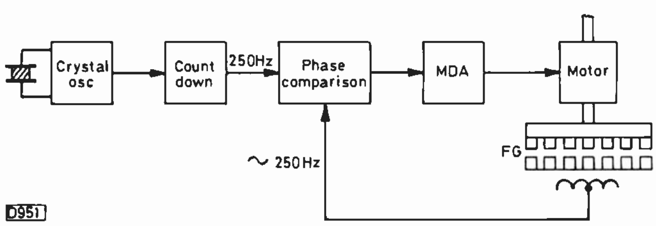


Fig. 7: Use of a frequency generator (FG). In the first FG circuits the "tone wheel" output was matched to a crystal oscillator in a phase-lock loop.

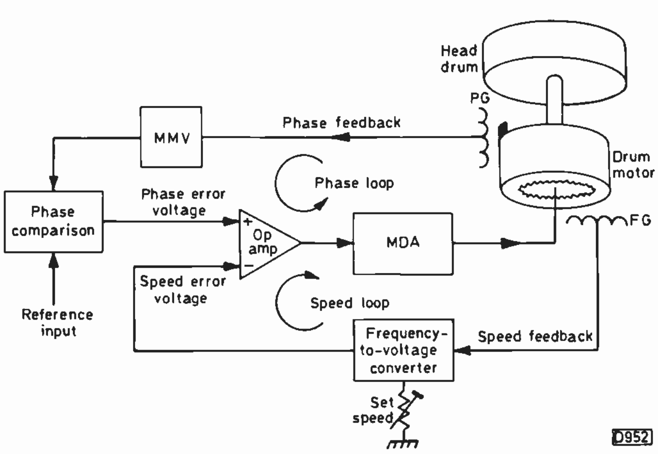


Fig. 8: Dual-loop servo system using an FG for speed feedback and a PG for phase control.

vided to discharge the storage capacitor between the sample pulses – otherwise it will charge to the peak voltage and stay there.

To obtain a symmetrical pull-in range, the ramp is normally sampled at about its mid-point. Since the error voltage output is proportional to the time lapse between the two input pulses, the circuit can be arranged so that either the reference or the sample feedback pulse triggers the ramp generator while the other does the sampling – both configurations are used in practice. The error voltage output along with the speed correction voltage is used to control the motor. A closed control-loop is thus established, and once conditions have settled down the motor's shaft will be phased to the reference source.

We've now got a phase-lock situation, but it's unlikely that the phase relationship established will be exactly correct. During record we may be recording the field sync pulses half way along the track. On playback the control pulses may be aligning the heads beside rather than in the centre of the tracks. In both cases we need to be able to adjust the servo's phasing in order to achieve the required result.

Phasing Adjustment

For record, presets labelled "head-switching point" are provided to adjust the head phasing and set the changeover point to just seven lines before the field sync pulse. During playback a similar control is provided on the front panel to align the head sweeps with the tape tracks – the tracking control. The technique used in both cases is to delay either the reference or the feedback sample pulses in order to establish the exact phase relationship required.

This variable delay is simply achieved by using a monostable multivibrator (MMV for short) whose adjustable *RC* time-constant network provides the delay required. Once triggered, the multivibrator will provide a delay governed by the tracking control which is incorportated in its *RC* network. This delay or pulse-stretching feature is widely used – you'll find lots of MMVs in servo circuits. Fig. 6 illustrates the idea.

Speed Control

If a shaft is rotating in phase with a reference signal its speed must be spot on. After a disturbance however the correct speed must be re-established quickly. If we try to do this via the phase-control loop we will require a gently sloping ramp in order to cater for a wide range of speed variations – and this doesn't make for accurate phase control, because the small error voltage produced by a gently sloping ramp will have little effect on the servo action, leading to "soft" phase locking. A steep ramp gives tight and accurate phase locking because a large correction voltage is produced by small phase errors, but once a speed error is present the sampling pulses will appear at random on the ramp, confusing the sample-and-hold circuit and producing a jittery error voltage. As a result the motor will hunt, the instability playing havoc with the picture (and sound if it's the capstan motor that's being controlled).

Thus for close and accurate control it's best to have a dual servo loop, one to establish the correct speed and another to maintain the correct phase condition. This dual system is particularly important in portable VCRs where gyroscopic effects can occur, and in trick-speed and clever-edit machines where fast, precise control and quick speed recovery are necessary. All current and recent VCRs have dual loops for one or both servos.

For speed control we need a frequency feedback signal in the form of a tone whose frequency is proportional to r.p.m. Most motors nowadays are direct-drive types with the FG (frequency generator) built in. It takes the form of a multi-toothed wheel or a series of magnets that pass over a stationary coil system. Unusually, the Ferguson 3V01 (a piano-key portable) has a capacitive FG system for both the drum and the capstan: the toothed wheel spins within a toothed stator, the regular capacitance variation being sensed and amplified by a high-impedance f.e.t. stage.

For capstan speed control, the FG signal can be "paced" by a crystal oscillator, equilibrium being established when (say) one FG pulse occurs for every 9,800 crystal clock pulses – this is easy to arrange with i.c.-based counting circuits. This offers rigid speed lock with no necessity for a capstan tachogenerator, see Fig. 7. While an FG is used in this system, it's still basically a phase-locked loop, but with the advantage of closer control over the motor since there are more "beats to the bar". The system shown is a sort of half-way house between PG phase control and the true FG speed feedback control technique described below. A circuit like that shown in Fig. 7 must be supported by a resistive potential divider to establish the normal rotational speed initially.

The head drum's rotational speed cannot be locked to the likes of a crystal clock because phase locking to the incoming field sync pulses is required when recording –

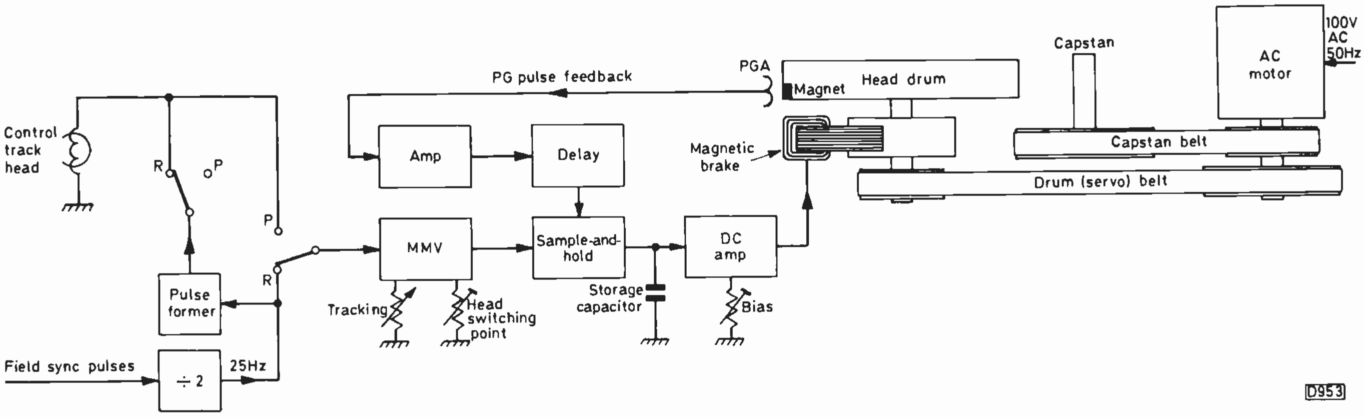


Fig. 9: Simple drum and capstan drive system using a single synchronous a.c. motor and a single servo loop.

and you can't lock anything to two independent clocks! For this reason the FG feedback tone is passed through a frequency-to-voltage converter (see Fig. 8). This produces a motor drive voltage that's inversely proportional to motor speed, and has a powerful and fast control action. The converter's output is added to the phase control error voltage before application to the motor drive amplifier. The "reference" in this case is a d.c. potential tapped from the set-speed preset. Fig. 8 shows a simple dual-loop servo system for drum control – this configuration is used in both drum and capstan servos in modern machines.

Fault Symptoms

When faced with a servo fault it's usually not difficult to decide which of the loops is in trouble. If the phase loop is is trouble, say due to a missing control track pulse on playback or no field sync input during record, the speed will be correct but the phasing will drift about. As a result there'll be cyclical tracking errors during playback. These errors can be momentarily corrected by the set-speed potentiometer but not by the tracking control. During record, a tape whose head switching point drifts up and down the screen at random will be produced.

Speed errors are usually more dramatic. A capstan running at the wrong speed will affect the tracking and the playback sound pitch, while drum speed problems will usually break the line sync on the replayed picture. Loss of the reference signal will often result in the motor trying to run at 10,000 r.p.m. which, hopefully, will invoke stop via the syscon. On the Sony C9 for example this symptom can be caused by lack of the 4·43MHz colour subcarrier signal due to a blown fuse on the chroma board.

Practical Arrangements

So far we've covered basic servo requirements and the basic circuit blocks used in servo implementation. We'll go on to examine some of the ways in which different manufacturers have gone about arranging their servo systems. The earliest design, used in the Philips N1500 machine, has been described at length on previous occasions. Instead of going over this ground again we'll start off with the unusual and ingenious single-motor design used with great success in the Sony SL8000 and the Sanyo VTC9300 series.

A block diagram is shown in Fig. 9. These machines use a single a.c. motor energised from a 100V secondary winding on the mains transformer. It's an eight-pole hysteresis type motor, and at 50Hz rotates at exactly 750 r.p.m. Separate motor-shaft mounted pulleys drive the capstan and the drum, the pulley diameters being such that the capstan shaft rotates at a peripheral speed of 1·87cm/sec (the Beta linear tape speed) while the head drum rotates at 1,520 r.p.m., which is 1·3 per cent fast. The single servo system works on the head drum only, providing control by means of an eddy-current braking system attached to the drum shaft. The idea is that the magnetic brake slows down the head by 1·3 per cent to achieve the correct drum speed of 1,500 r.p.m. The drum's phase is controlled over a narrow range by varying the current in the brake coil.

During record, the capstan speed is determined by the mains frequency. Drum speed is set by the mains frequency "minus" the effect of the standing bias current in the brake coil, the drum's phasing being controlled by the output from a sample-and-hold circuit. The reference for the latter is a 25Hz pulse derived from the incoming field sync pulses via a divide-by-two bistable circuit. The feedback sample pulses are obtained from the two PG coils on the drum. The head changeover point is set by varying the delay provided by a MMV in the reference pulse path.

During playback the capstan speed is again set by the mains frequency, and again a standing bias is applied to the brake coil to set the drum's speed at 1,500 r.p.m. The servo reference this time is the 25Hz off-tape control track pulses, with feedback from the drum PG as previously. The exact phase relationship is established by the user's tracking control, which varies the delay in the reference signal path.

This very simple single-servo idea works well. There is little to go wrong, and it's rugged and reliable. It does however make for a large and weighty machine with a fairly high power consumption, and the potential for any trick-mode playback other than a ragged picture-pause facility (produced by withdrawing the pinch roller) is nil. It won't tolerate much variation in external timing references either. During playback, the signals are governed by the frequency of the a.c. mains supply. For recording, the timebases used in any video source must be very accurate – a camera with a 1·5 per cent scanning speed error can cause complete loss of servo operation.

Servo systems with independent motors for the capstan and drum offer not only better stability and closer control but also the potential for various trick-speed playback modes and noise-free still frame. The degree to which these possibilities are exploited depends very much on the price and vintage of the machine. Next month we'll go on to consider separate motor systems.

TV Test Pattern Generator

Part 4

Tony Jenkins, G8TBF (JRW Developments)

Experience with the unit has resulted in some minor modifications.

It's been found that some batches of SN74LS04 i.c.s (IC1, logic board) are reluctant to oscillate at 20MHz though they are perfectly happy running at 10MHz. We therefore recommend the use of an SN74S04. The values of R1 and R2 have to be reduced to take into account the greater current taken by the S version of this i.c. – 330Ω has been found to be satisfactory in both positions. The idea is that both sections of the i.c. are biased for linear operation.

C2 is increased to 0·1μF for correct operation of the even/odd field detector. As the line ident output is not used it's been deleted from the board. A separate positive-going composite sync output has been added.

The following modifications have been made to the encoder/modulator board. The colour burst enable pulse at pin 15 of the TEA1002 was found to occur too early and to have insufficient duration. As a result the receiver's burst detector is likely to have an inadequate burst input, resulting in loss of colour. The first problem was overcome by introducing a delay in the sync pulse feed to pin 4 of the 4528. This consists of a 470Ω resistor in series with the pin and an 0·001μF capacitor to chassis. The modification has been incorporated in the board design. The duration of the enable pulse has been increased by changing the value of R4 to 8·2kΩ.

We also found that the action of the background control VR4 was too fierce in operation. The cure is to connect R1 to 5V instead of 12V. This is also taken care of in the board design.

Later batches of the TEA1002 appear to have a lower d.c. pedestal at the output, requiring D2 to be changed to the 1·5V type BZV46-1V5. If a 2V type is fitted, there can be sync crushing. We also recommend changing the value of R11 to 3·9kΩ to provide better biasing conditions for the UM1286.

If the sound facility is not to be used we suggest earthing pin 3 of the modulator to prevent spurious signals and general noise producing modulation. Most constructors will probably require some sort of sound facility and one of the simplest possible circuits that can be used is shown in Fig. 10. It consists of a CMOS type 4017 synchronous decade counter/divider. The i.c. is clocked by the 7·8kHz output pulses from IC5: its output is taken from the carryover pin and consists of 780Hz squarewaves with a 1:1 mark-space ratio. This signal is connected directly to pin 3 of the modulator. If an audio output is required, use a 10kΩ potentiometer and take the output from the slider. The circuit is so simple that it can be built on a small piece of Vero board or hard-wired on a 16-pin i.c. socket. A more sophisticated audio oscillator with a variable frequency sinewave output is planned for the near future.

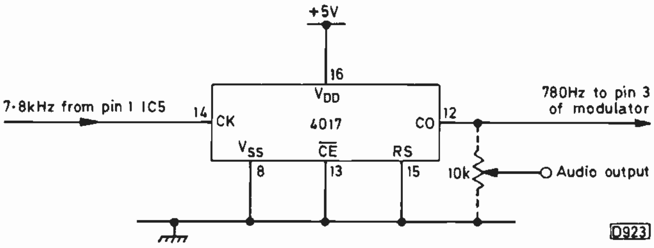


Fig. 10: Simple way of obtaining a 780Hz audio signal.

Construction

The logic and encoder boards have been laid out to allow very simple interconnections when the two boards are stacked, i.e. one board is mounted atop the other. We suggest placing the encoder board on top as it has to be set up. A clearance of about 25mm between the boards is recommended – use spacers, threaded or unthreaded, plastic or metal. Once the boards have been stacked the connecting leads can be made, using either tinned copper wire (approximately 20 s.w.g.), individual insulated wire, or ribbon cable. If ribbon cable is used, leave a small loop to allow the top board to be hinged for access to the component side of the logic board. The power supply leads connect directly to the encoder board: the interconnecting leads include the 5V supply for the logic board.

Take the u.h.f. output from the modulator to a u.h.f. coaxial socket on the front panel via a phono plug and a short piece of 75Ω coaxial cable. The composite video output can be taken from the encoder board to a 75Ω BNC socket on the front panel via a short length of 75Ω coaxial cable. Note the extra earth pad on the encoder board for the coaxial cable braid. Composite sync and/or field sync can also be brought out if required, direct from the logic board. For the case we suggest the RS Components 508-655, but any plastic or metal enclosure of suitable size will do. Efficient decoupling throughout results in low radiation from the unit.

Assuming that there are no constructional errors, setting all the controls midway should produce a display, probably in colour. The first adjustment required is to the 8·8MHz oscillator. This is best done with a frequency counter connected to pin 14 of the TEA1002, but setting C1 midway or even using a fixed 12pF capacitor will probably be adequate. The grey-scale setting procedure is as follows.

(1) Turn VR1, VR2 and VR3 full anticlockwise.
(2) Adjust VR4 for a grey background to the crosshatch pattern.
(3) Adjust VR3 until the left half of the grey-scale rectangle is at the same grey level as the background.
(4) Adjust VR2 until the extreme left square is almost but not quite black.
(5) Adjust VR1 until the extreme left square is black.

Some final tweaking may be necessary to ensure that there's a progressive black-to-white scale. If any control is advanced too far the d.c. level will drop below black level and cause sync disturbance – visible on the screen as pulling.

All key points on the logic board are labelled in the circuit diagram and probing a "dead" board with a scope

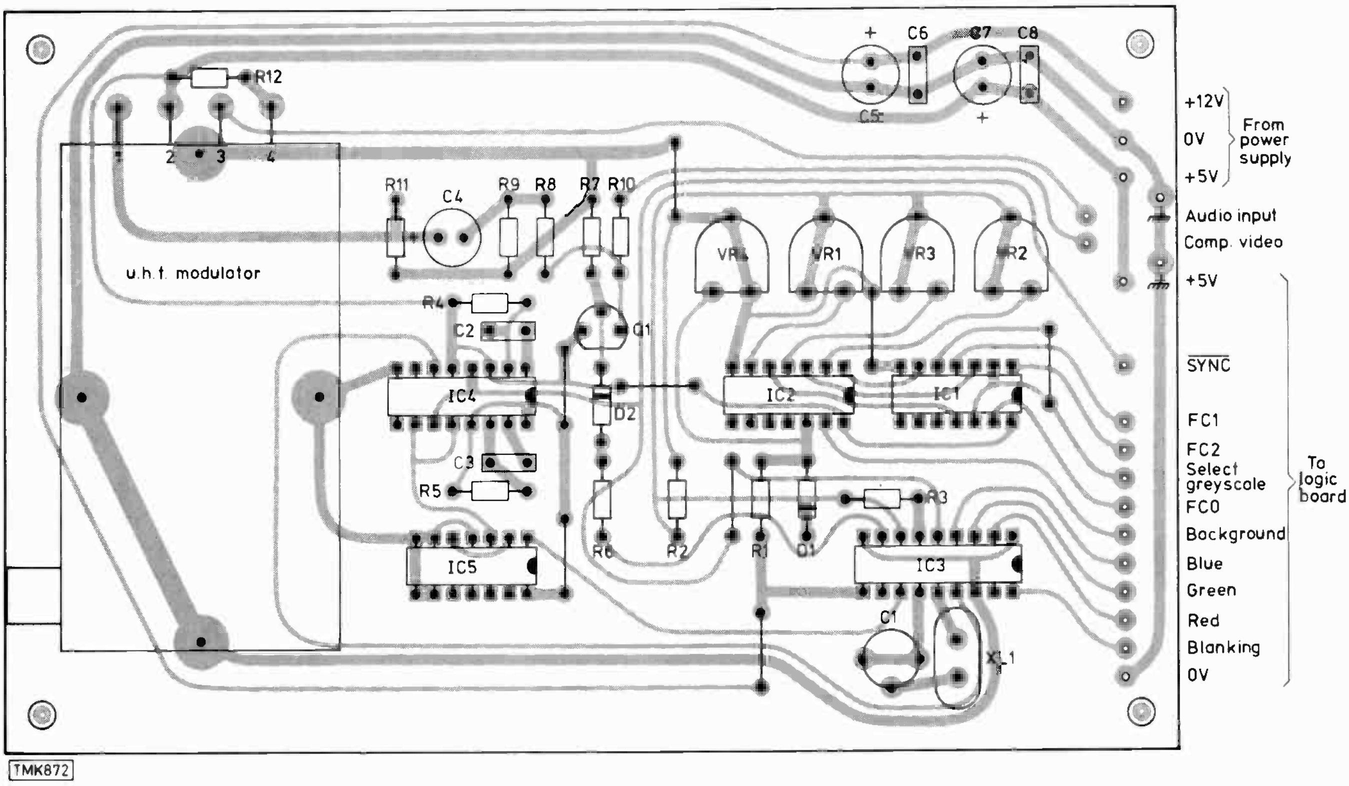


Fig. 11: Encoder/modulator board component layout.

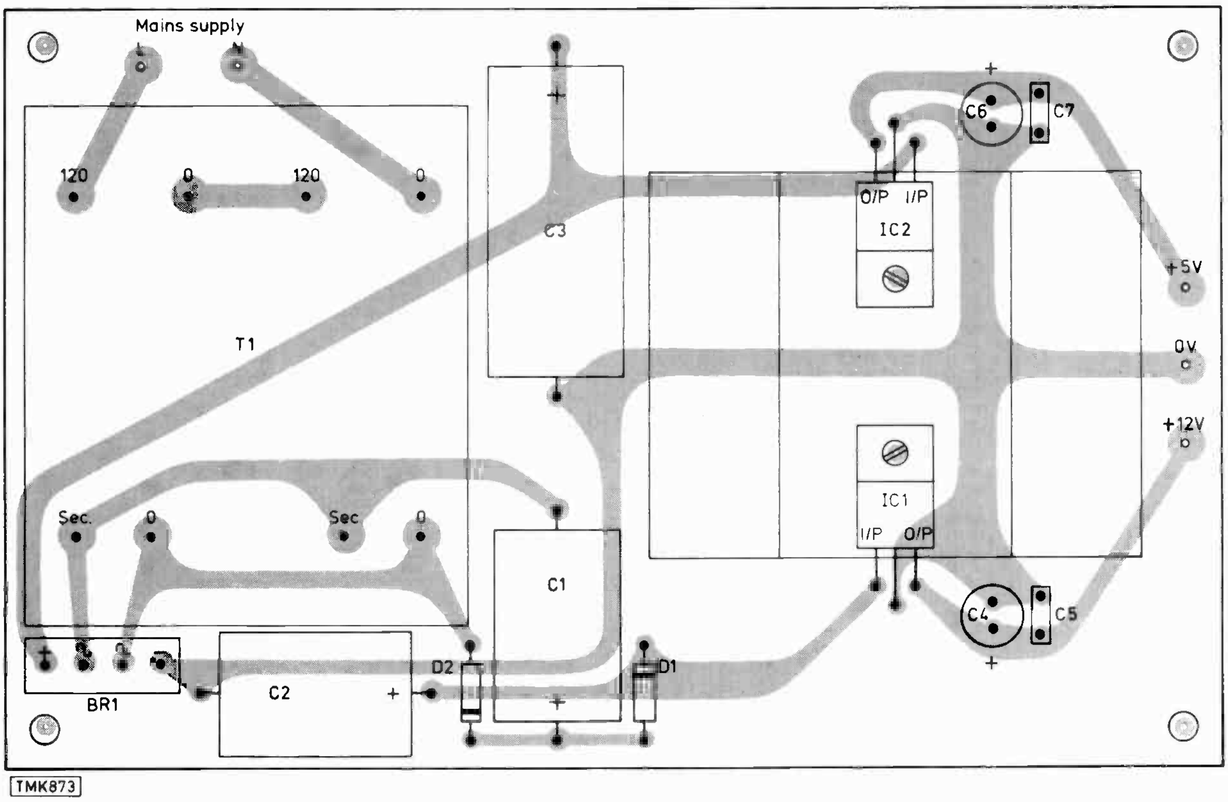


Fig. 12: Power supply panel component layout.

will quickly reveal the cause of the fault. The ZNA234E (IC8) does not normally run hot, but if you are concerned a small U-shaped heatsink can be bonded to the top using cyanoacrylate adhesive. The total current consumption of the unit is around 600mA from the 5V rail and 60mA from the 12V rail.

If an i.c. on the logic board develops a fault extraction can be a messy business. We suggest cutting the pins from the body then removing each pin separately, taking great care not to lift tracks from the top of the board. It's best to use sockets for the i.c.s.

The bandwidth of the chroma signal is not limited. This leads to interference on colour transitions and some moiré effects. A bandpass filter would be required to reduce these effects. As this would delay the chroma signal, a compensating delay line would have to be added in the luminance circuit to ensure correct timing of the two signals. We decided that the extra complication was not justified since the interference is negligible with any use to which the generator is likely to be put.

ECONOMIC DEVICES, PO BOX 228, TELFORD TF2 8QP

18029	1.58
16181	1.13
16182	1.13
16334	0.88
16335	0.72
16446	0.09
16800	1.25
16799	2.16
16801	0.88
16802	1.03
16803	4.81
16905	1.35
17074	6.00
17127	3.91
17376	1.43
1N4001	0.05
1N4002	0.05
1N4003	0.05
1N4004	0.06
1N4005	0.07
1N4006	0.07
1N4007	0.07
1N4148	0.03
1N4448	0.12
1N5401	0.12
1N5402	0.13
1N5403	0.14
1N5404	0.15
1N5408	0.18
1N914	0.05
1S44	0.06
1S5012A	0.73
1S921	0.09
2582	1.94
2N1302	0.24
2N1303	0.34
2N2218	0.38
2N2219A	0.29
2N2222	0.34
2N2646	0.75
2N2904	0.32
2N2905	0.39
2N2906	0.34
2N3053	0.24
2N3054	0.90
2N3055	0.55
2N3055H	0.77
2N3442	1.06
2N3702	0.12
2N3703	0.12
2N3704	0.12
2N3705	0.12
2N3706	0.12
2N3707	0.14
2N3711	0.14
2N3771	1.85
2N3772	1.55
2N3773	1.85
2N3819	0.28
2N3823	1.06
2N3904	0.56
2N3906	0.56
2N4101	1.10
2N4240	3.00
2N4443	1.35
2N4444	1.12
2N4914	0.85
2N5064	0.84
2N5293	0.45
2N5294	0.45
2N5296	0.40
2N5297	0.45
2N5298	0.55
2N5490	1.35
2N5496	0.45
2N6107	0.53
2N6109	1.43
2N6122	1.00
2N6130	0.85
2N6133	0.57
2N6178	0.86
2N6180	0.86
2N696	0.39
2N698	0.39
2N707	0.39
2SA1027	1.15
2SA1076	1.78
2SA329	0.38
2SA351	1.06
2SA489	1.06
2SA490	1.51
2SA493	0.95
2SA628	1.03
2SA637	1.32
2SA673	1.11
2SA683	1.46
2SA684	1.33
2SA748	0.88
2SA818	1.85
2SA835	2.27
2SA940	1.84
2SA951	1.23
2SA986-Y	0.54
2SB325	3.51
2SB337	1.85
2SB375	3.51
2SB400	0.36
2SB407	2.94
2SB411	3.00
2SB511	1.40
2SB54	1.26
2SB56	1.26
2SB618A	1.40
2SB681	2.44
2SB695	1.70
2SB75	0.94
2SB861	0.88
2SC1034	5.81
2SC1050	3.66

2SC1061	0.54
2SC1096	1.05
2SC1104	2.00
2SC1106	4.12
2SC1114	5.81
2SC1124	1.10
2SC1151A	4.29
2SC1152	4.25
2SC1157	4.12
2SC1162	0.95
2SC1172	1.92
2SC1195	2.83
2SC1213	0.75
2SC1226	1.32
2SC1306	0.85
2SC1307	1.35
2SC1316	3.40
2SC1364	0.49
2SC1383	1.39
2SC1398	0.51
2SC1410	2.17
2SC1413	3.08
2SC1505	0.56
2SC1578	6.67
2SC1617	3.35
2SC1670	2.84
2SC1678	1.25
2SC1810	1.40
2SC1815	0.41
2SC1829	2.01
2SC1875	4.77
2SC1891	3.35
2SC1929	2.25
2SC1942	5.70
2SC1945	4.11
2SC1953	1.75
2SC1957	0.86
2SC1959	0.36
2SC1962	1.75
2SC1969	2.92
2SC2027	2.67
2SC2028	1.91
2SC2029	1.49
2SC2057	1.07
2SC2073	1.40
2SC2078	1.25
2SC2091	0.59
2SC2122A	4.65
2SC2141	1.89
2SC2166	1.35
2SC2216	0.62
2SC2233	2.20
2SC2271	3.64
2SC2278	1.83
2SC2335-KIT	7.81
2SC2526	1.70
2SC2551	0.95
2SC2570	1.00
2SC2570A	0.95
2SC264A	4.38
2SC2671	1.99
2SC2728	0.95
2SC372	1.27
2SC373	1.05
2SC383	1.20
2SC388	0.45
2SC41	1.99
2SC458	0.56
2SC495	0.83
2SC506	3.36
2SC515A	1.28
2SC537	0.49
2SC558	3.35
2SC605L	1.05
2SC620	1.32
2SC643A	1.40
2SC673	1.11
2SC681	4.00
2SC684	1.50
2SC685A	2.62
2SC693	0.89
2SC710	0.62
2SC717	1.92
2SC734	1.30
2SC735	1.05
2SC782	2.24
2SC790	1.15
2SC806	10.28
2SC814	1.26
2SC828	0.25
2SC867A	2.49
2SC926A	1.29
2SC930	0.49
2SC935	3.75
2SC936	1.58
2SC937	3.25
2SC940	4.25
2SD1138	0.78
2SD198	3.51
2SD234	0.42
2SD235	0.54
2SD257	2.67
2SD291	2.67
2SD292	2.35
2SD313	2.59
2SD315	2.67
2SD325D	1.36
2SD350	7.83
2SD350A	2.08
2SD353	3.25
2SD389	2.19
2SD401	1.57
2SD551	2.20
2SD588A	1.25
2SD621	8.88
2SD657	2.54
2SD731	1.72
2SD811	3.86
2SD869	2.40

2SD898B	2.67
40408	0.45
40594	1.39
40595	1.39
40636	0.86
40871	1.39
40872	1.39
60857	1.10
74LS132	0.72
74LS138	0.85
74LS157	0.79
74LS161AN	1.18
74LS196	1.25
74LS20	0.25
74LS244	1.65
74LS30	0.29
74LS367	1.05
74LS373	1.55
74LS47	1.05
74LS73	0.39
74LS74	0.39
74LS75	0.52
74LS86	0.49
74LS90	0.75
74LS92	0.75
74LS93	0.75
74LS95B	0.85
7805 TO-220	0.63
7805 TO-3	1.05
7806	0.86
7808	0.54
7812 TO-3	0.54
7812 TO-220	1.05
7815	0.55
7818	0.55
7824	0.55
AC107	0.66
AC117	0.39
AC123K	0.39
AC128	0.28
AC138	0.88
AC141	0.26
AC142K	0.39
AC151	0.25
AC153	0.30
AC153K	0.36
AC176	0.17
AC176K	0.40
AC179	0.25
AC183	0.65
AC186	0.30
AC186K	0.50
AC187	0.35
AC187-01	0.40
AC187K	0.39
AC188	0.33
AC188-01	0.40
AC188K	0.39
AC193K	0.59
AC194K	0.59
AD140	0.96
AD142	0.96
AD143	0.96
AD145	1.45
AD149	0.81
AD161	0.30
AD162	0.30
AD262	0.95
AF114	2.24
AF115	0.79
AF116	0.79
AF117	0.75
AF118	0.75
AF121	0.50
AF124	0.36
AF125	0.36
AF126	0.36
AF127	0.36
AF139	0.48
AF178	0.75
AF179	0.50
AF180	0.50
AF181	0.48
AF182	0.50
AF186	0.48
AF239	0.48
AF279	0.80
AL100	3.86
AL102	1.75
AL103	2.43
AL113	1.80
AN208	3.22
AN210	2.07
AN214	2.05
AN214Q	2.05
AN231	5.56
AN234	5.02
AN235	4.84
AN236	3.02
AN238	4.98
AN239	3.95
AN240P	1.88
AN241	1.55
AN245	2.54
AN247P	2.62
AN252	2.33
AN253	2.70
AN262	1.58
AN272	5.36
AN281	5.52
AN295	5.01
AN301	3.30
AN302	3.62
AN303	3.25
AN305	8.07
AN313	3.10
AN315	2.12
AN316	5.58
AN318	4.75

AN320	4.97
AN322	4.38
AN331	2.99
AN337	3.99
AN340P	1.06
AN355	3.36
AN362	1.47
AN5111	2.34
AN5132	3.99
AN5250	3.33
AN5435	2.00
AN5610	6.75
AN5613	3.72
AN5620X	4.63
AN6320N	3.89
AN6342	1.36
AN6344	4.88
AN6383	10.20
AN6551	0.56
AN6552	0.52
AN7145	2.04
AN7150	2.22
AN7151	2.05
AN7156	2.05
AN7158	2.34
AN7218	1.49
AP58076	4.25
AS580S	1.43
AU106	1.96
AU110	1.96
AU113	2.15
AY102	2.62
AY105K	1.89
AY106	1.98
BA102	0.30
BA1310 (IC)	1.72
BA1320 (IC)	1.22
BA1330 (IC)	1.82
BA145	0.17
BA154	0.08
BA155-01	0.12
BA156	0.12
BA157	0.17
BA159	0.12
BA182	0.17
BA222 (IC)	1.26
BA284/2	0.15
BA301 (IC)	0.92
BA302	0.90
BA311 (IC)	1.06
BA312 (IC)	0.98
BA313 (IC)	1.28
BA316	0.07
BA317	0.07
BA318	0.08
BA328 (IC)	0.80
BA333 (IC)	1.24
BA401 (IC)	0.58
BA511 (IC)	1.98
BA521 (IC)	1.81
BA532 (IC)	1.88
BA536 (IC)	2.72
BA6304A (IC)	2.65
BA843 (IC)	3.60
BAV10	0.10
BAV18	0.10
BAV19	0.10
BAV20	0.10
BAV21	0.17
BAX12	0.10
BAX13	0.10
BAX16	0.10
BB105B	0.22
BB119	0.15
BC107	0.13
BC107B	0.14
BC108	0.12
BC108A	0.12
BC108B	0.15
BC109	0.11
BC109B	0.13
BC113	0.12
BC114	0.17
BC115	0.14
BC116	0.20
BC116A	0.53
BC117	0.18
BC118	0.18
BC119	0.30
BC125	0.18
BC126	0.18
BC132	0.18
BC135	0.12
BC136	0.15
BC137	0.16
BC138	0.30
BC139	0.32
BC140	0.33
BC141	0.28
BC142	0.30
BC143	0.28
BC147	0.10
BC147A	0.42
BC148	0.11
BC148B	0.11
BC148C	0.11
BC149	0.10
BC149B	0.11
BC153	0.12
BC154	0.12
BC157	0.14
BC158	0.09
BC159	0.14
BC160	0.36
BC161	0.36
BC167	0.32
BC168	0.32
BC169C	0.14
BC170	0.14

BC171	0.10
BC172	0.09
BC172B	0.24
BC173	0.15
BC174B	0.24
BC177	0.18
BC178	0.23
BC179	0.23
BC182	0.08
BC182B	0.23
BC182L	0.09
BC182LB	0.12
BC183	0.09
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BC184	0.09
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BC184LB	0.23
BC186	0.24
BC187	0.18
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BC207	0.12
BC212	0.10
BC212B	0.23
BC212L	0.09
BC212LB	0.23
BC213	0.09
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BC213LB	0.23
BC214	0.09
BC214L	0.12
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BC225	0.24
BC237	0.09
BC238	0.09
BC238A	0.11
BC239B	0.08
BC251A	0.15
BC252	0.12
BC258	0.22
BC261A	0.20
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BC287	0.45
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BC301	0.36
BC302	0.30
BC303	0.34
BC307	0.09
BC307A	0.14
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BC309	0.15
BC317A	0.11
BC323	0.92
BC327	0.15
BC328	0.10
BC337	0.08
BC338	0.10
BC360	0.30
BC368	0.23
BC440	0.99
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BC461	0.42
BC462	0.27
BC463	0.58
BC464	0.58
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BC477	0.25
BC478	0.29
BC479	0.29
BC532	0.25
BC546	0.15
BC547	0.09
BC548	0.09
BC549	0.09
BC550	0.36
BC556	0.12
BC557	0.09
BC558	0.09
BC559	0.09
BC560C	0.10
BC635	0.18
BC636	0.18
BC637	0.18
BC638	0.18
BC639	0.18
BC640	0.18
BC879	0.28
BC880	0.28
BCX32	0.33
BCX33	0.24
BCX34	0.36
BCX37	0.80
BCY70	0.27
BCY71	0.19
BCY72	0.18
BD115	0.29
BD116	0.63
BD124	1.19
BD124P +KIT	0.62
BD131	0.38
BD132	0.38
BD133	0.48
BD135	0.32
BD136	0.32
BD137	0.32
BD138	0.41
BD139	0.27
BD140	0.33
BD144	1.30
BD150	1.08
BD157	0.80
BD159	0.40
BD160	1.45
BD163	0.64
BD165	0.56

BD166	0.38
BD168	0.86
BD175	0.39
BD177	0.39
BD179	0.44
BD181	0.90
BD182	0.90
BD183	0.90
BD184	1.10
BD187	0.48
BD189	0.35
BD190	0.59
BD201	0.54
BD202	0.54
BD203	0.54
BD204	0.54
BD207	1.00
BD208	1.00
BD222	0.44
BD225	0.44
BD228	0.57
BD229	0.63
BD231	0.45
BD232	0.44
BD234	0.38
BD235	0.43
BD236	0.45
BD237	0.38
BD238	0.29
BD239	0.44
BD240	0.36
BD240D	0.47
BD241	0.45
BD242	0.45
BD243	0.44
BD243A	0.50
BD244	0.44
BD244A	0.77
BD245C	0.88
BD246C	0.74
BD253	0.95
BD278A	0.60
BD317	1.96
BD318	2.08
BD375	0.38
BD377	0.23
BD379	0.89
BD380	0.69
BD410	0.44
BD412	5.70
BD418	0.76
BD433	0.33
BD434	0.39
BD435	0.42
BD436	0.42
BD437	0.41
BD438	0.44
BD441	1.29
BD442	0.56
BD507	0.54
BD508	0.54
BD509	1.29
BD510	0.45
BD518	1.36
BD519	1.36
BD529	0.38
BD530	0.60
BD533	0.80
BD534	0.36
BD535	0.44
BD536	0.55
BD537	0.80
BD538	0.80
BD544B	0.75
BD580	1.06
BD590	1.06
BD598	1.13
BD645	3.62
BD677	0.55
BD680	0.69
BD681	1.34
BD695	2.09
BD696	2.24
BD697	3.27
BD698	1.68
BD699	3.17
BD700	3.36
BD702	2.94
BD707	0.55
BD709	0.72
BD710	0.72
BD807	0.60
BD809	0.60
BD810	0.60
BD879	0.64
BD880	0.65
BD895	1.98
BD899	2.25
BD901	0.55
BDV64B	1.14
BDV65B	1.14
BDX32	1.50
BDX53	0.80
BDX53A	3.68
BDX54B	2.37
BDX62A	1.92
BDX63A	1.95
BDX64A	2.37
BDX65A	2.37
BDX76	0.53
BDY20	1.10
BDY62/01	4.20
BDY81	1.07
BF115	0.36
BF117	0.36
BF118	0.60
BF121	0.22
BF123	0.11
BF127	0.11

BF137	0.11
BF152	0.28
BF153	0.52
BF154	0.23
BF157	0.23
BF158	0.16
BF159	0.16
BF160	0.28
BF167	0.34
BF173	0.30
BF177	0.50
BF178	0.36
BF179	0.32
BF180	0.32
BF181	0.29
BF182	0.30
BF183	0.35
BF184	0.39
BF185	0.35
BF194	0.15
BF195	0.12
BF196	0.15
BF197	0.14
BF198	0.15
BF199	0.15
BF200	0.33
BF216	0.32
BF218	0.32
BF222	0.50
BF224	0.15
BF237	0.59
BF240	0.15
BF241	0.15
BF244	0.23
BF245A	0.33
BF255	0.18
BF256	0.25
BF256LC	0.38
BF257	0.30
BF258	0.29
BF259	0.30
BF262	0.51
BF263	0.51
BF264	0.33
BF271	0.30
BF273	0.18
BF274	0.18
BF324	0.16
BF336	0.27
BF337	0.36
BF338	0.36
BF355	0.36
BF362	0.54
BF363	0.54
BF371	0.45
BF391	0.36
BF393	0.90
BF417	1.20
BF418	1.70
BF422	0.26
BF423	0.26
BF435	0.49
BF450	0.30
BF451	0.26
BF457	0.37
BF458	0.35
BF459	0.35
BF460	0.54
BF469	0.27
BF470	0.28
BF471	0.28
BF472	0.28
BF479	0.55
BF480	0.54
BF495	0.58
BF506	0.39
BF509	0.37
BF523	0.18
BF594	0.24
BF595	0.24
BF596	0.16
BF597	0.24
BF617	0.95
BF618	0.95
BF694	0.20
BF757	0.59
BF758	0.59
BF759	0.30
BF760	0.59
BF762	0.30
BF870	0.27
BF871	0.84
BF900	0.68
BF907	1.62
BF959	0.38
BF970	0.55
BFR39	0.36
BFR52	0.45
BFR62	0.36
BFR79	0.29
BFR81	0.45
BFR86	0.98
BFR89	0.39
BFT41	0.27
BFT42	0.39
BFT43	0.39
BFT84	0.36
BFW10	0.79
BFX29	0.30
BFX30	0.59
BFX84	0.33
BFX85	0.25
BFX87	0.50
BFX88	0.30
BFX89	0.36
BFY50	0.24
BFY51	0.24
BFY52	0.24
BFY90	0.96

BLY49	2.00
BR100	0.20
BR101	0.37
BR103	0.45
BR88B	0.58
BRC-M-300	1.58
BRC116	0.88
BRC1330	1.80
BRC300	1.82
BRC4443	1.12
BRC4444	1.12
BRC5296	0.70
BRC6109	0.75
BRC82	0.98
BRC83	0.98
BRC84	0.98
BRX44	0.54
BRX49	0.45
BRY39	0.50
BRY55	0.60
BRY56	0.38
BSR59	1.17
BSS38	0.30
BSTBD1409	2.40
BSTB01405	4.37
BSTC0146	2.25
BSTC0233	2.25
BSTC0246	4.51
BSTC1233	3.91
BSTC3146	0.71
BSTCC0143	2.79
BSTC0643	3.06
BSV57B	2.66
BSW68	0.38
BSX19	0.30
BSX20	0.30
BSX21	0.45
BSY52	0.45
BSY79	0.46
BT100A	1.46
BT106	1.20
BT108	1.31
BT109	1.31
BT112	2.25
BT113	2.25
BT116	1.52
BT119	1.80
BT120	1.80
BT121	2.25
BT122	2.25
BT123	1.80
BT125	2.25
BT126	2.25
BT128	2.25
BT128P	2.79
BT129	2.25
BT151-800R	1.47
BT151 500R	1.25
BTT6018	2.20
BTT6218	2.20
BTT8024	4.02
BTT8124	4.44
BTT8214	5.44
BTT8224	2.70
BU105	1.66
BU106	2.25
BU108	1.90
BU109S	1.90
BU110	2.52
BU111Y	3.78
BU124	1.25
BU126	1.11
BU134S	4.15
BU204	1.29
BU205	0.98
BU206	1.20
BU207	1.50
BU208	0.98
BU208/02	0.98
BU208A	0.98
BU208D	1.43
BU209	1.80
BU226	2.08
BU312	2.16
BU326	0.75
BU326A	1.40
BU326S	2.25
BU406	1.35
BU407	0.74
BU407D	1.29
BU412	4.80
BU426	1.95
BU426A	1.67
BU427	2.67
BU500	1.61
BU508A	1.33
BU526	1.65
BU608D	1.42
BU806	1.29
BU806D	1.35
BU807	1.40
BU826A	2.79
BUV46	1.13
BUV84	1.12
BUN81A	3.15
BUN84	1.56
BUX84	1.47
BY126	0.11
BY127	0.11
BY133	0.11
BY164	0.50
BY176	1.38
BY179	1.42
BY182	0.95
BY184	0.42
BY187	0.70
BY189	1.20
BY198	2.38
BY201/2	1.36

BY203/20	0.18
BY206	0.17
BY207	0.22
BY210-400	0.24
BY210-600	0.27
BY210-800	0.30
BY223	0.85
BY224-400	0.90
BY225-100	0.79
BY226	0.28
BY227	0.44
BY228	0.54
BY255	0.97
BY298	0.25
BY299	0.25
BY476A	0.76
BYW56	0.30
BYX10	0.26
BYX55-350	0.40
BYX55-600	0.25
BYX71-350	0.67
BYX71-600	0.85
BYX94	0.18
BYY56	1.09
BZV15-C12	0.72
BZV15-C12R	0.72
BZV15-C24	0.72
BZV15-C24R	0.72
BZV15-C30R	0.72
BZX61 Range	0.16
BZX70-C11	0.54
BZX70-C12	0.54
BZX70-C15	0.54
BZX70-C30	0.54
BZX70-C47	0.54
BZX79 Range	0.09
BZY88 Range	0.09
BZY93-C12	0.99
BZY93-C18	0.99
BZY93-C24	0.99
BZY93-C24R	0.99
BZY93-C30	0.99
BZY93-C47	0.99
BZY93-C68	0.99
BZY93-C7V5	0.99
ZTK33	0.39
ZX18	2.47
C106D	0.46
C1129	0.52
CA1310E	2.45
CA3044	3.18
CA3046	2.23
CA3060	1.50
CA3065	1.17
CA3089	3.35
CA3089E	1.30
CA3090	1.25
CA3094	2.00
CA3131EN	2.83
CA3132EN	2.83
CAH76023N	6.00
CBF16848N-07	1.41
CD4001	0.24
CD4002	0.24
CD4008	0.96
CD4011	0.23
CD4012	0.24
CD4013	0.37
CD4016	0.37
CD4017	0.74
CD4020	0.92
CD4021	0.24
CD4023	0.25
CD4025	0.54
CD4028	0.76
CD4047	0.96
CD4049	0.52
CD4050	0.50
CD4052	0.88
CD4053	0.72
CD4069	0.23
CD4081	0.26
CD4093	0.72
CD4511	1.00
CD4517	1.06
CP5521	16.20
CV-12E	2.49
CX034	10.75
CX095D	2.85
CX104	8.49
CX108	6.92
CX109	6.92
CX121	10.75
CX130	4.90
CX131	10.75
CX134	10.75
CX136	10.75
CX137	10.75
CX139	10.75
CX157	4.40
CX158	3.44
CX170	6.92
CX177	5.99
CX506	8.40
CX507	6.92
CX758	6.92
D1693	2.35
DEC1	1.52
DEC2	1.52
E1222	0.36
E5024	0.25
E5386	0.22
E5529	0.22
E8021	1.17
E9003	0.41
E9005	0.45
ER1400	10.12
ESN310BP	3.86
ESM432C	4.18

IF YOU DON'T SEE IT LISTED ASK FOR QUOTE. GIVE MAKE MODEL LOCATION. REMEMBER TO ADD 0.60p POST & HANDLING. ADD 15% VAT TO TOTAL

ECONOMIC DEVICES, PO BOX 228, TELFORD TF2 8QP

ESM532C	4.18
ESM632C	4.18
ESM732C	4.18
ETT6016	2.85
ETTR6016	2.16
FND500	5.25
FT3055	1.85
GF758	0.82
GF759	1.82
GF761	0.78
GH3F	1.85
HA11211	2.30
HA11215	4.80
HA11225	3.90
HA11226	7.56
HA11229	2.51
HA11235	3.80
HA1124	4.70
HA11244	4.32
HA1125	3.90
HA11251	3.38
HA1137W	2.57
HA1138	3.56
HA11414	2.50
HA1144	6.38
HA1156	1.23
HA11580	7.80
HA1160	3.45
HA1166	3.08
HA1167	5.13
HA11711	16.13
HA11713	6.70
HA11714	7.05
HA11715	7.05
HA11718	6.79
HA11724	15.80
HA11725	16.80
HA1180	4.88
HA1203	1.56
HA1306	1.74
HA1322	1.74
HA1339	1.76
HA1342	1.80
HA1350	2.97
HA1365	3.65
HA1366WR	1.62
HA1367	3.20
HA1368	1.69
HA1368R	1.86
HA1370	2.97
HA1377	2.88
HA1389	1.62
HA1389R	1.74
HA1392	2.88
HA1397	2.97
HA1398	2.88
HA1406	1.80
HA17723	5.40
HBF4030AF	2.25
HD4480	15.60
HD44801A05	15.90
HM6231	8.50
HM6232	7.71
HM9102	2.92
HM9104	2.94
HT4207	15.80
IS689	1.87
IS751	1.87
ITT2003	0.20
K174YP	2.95
KA2101	2.85
KC581C	5.47
KC582C	3.45
KC583C	4.80
L129V	1.78
L200CV	1.88
LA1111AP	0.80
LA1201	0.90
LA1210	1.38
LA1320	1.46
LA1352	1.40
LA1357N	5.90
LA1364	2.74
LA1365J	2.79
LA1385	1.70
LA1387	4.57
LA3155	0.90
LA3300	1.40
LA3301	1.28
LA3350	1.30
LA3361	1.30
LA4030P	2.37
LA4031P	3.00
LA4032P	1.48
LA4050P	1.42
LA4051P	1.62
LA4100	1.62
LA4101	1.18
LA4102	2.55
LA4112	4.35
LA4125	2.46
LA4138	2.00
LA4140	0.80
LA4192	2.88
LA4220	1.34
LA4400	2.04
LA4420	1.56
LA4422	1.56
LA4430	1.48
LA4460	1.92
LA4461	2.00
LA5112N	1.62
LA7020	6.86
LA7025	7.31
LA7800	2.12
LA7801	3.60
LD3120	1.20
LM1011N	2.95
LM1017N	1.96

LM1303P/N	1.50
LM1310P/N	1.25
LM3065N	0.77
LM317CKC	1.30
LM339N	0.88
LM3407	1.29
LM340T5	0.75
LM340T12	0.75
LM340T5	0.75
LM342N	0.56
LM384N01	1.84
LM567CN	1.30
LM748	1.85
LM8360	2.78
LM8361	2.78
M1024	2.55
M1025	4.70
M1124	2.54
M1130	4.86
M191	5.74
M193	18.55
M51102L	4.82
M5115P	4.34
M51231P	2.79
M5124P	4.30
M5134-9341	3.75
M51394P	6.25
M5142P	4.38
M5143P	6.86
M5144P	3.42
M51513L	2.06
M51515BL	3.10
M51516L	3.40
M51517L	2.90
M5152L	1.00
M51522	4.90
M5191P	4.49
M5192	2.00
M53273P	0.92
M53274P	1.20
MA06	0.97
MA8001	0.74
MB3705	1.62
MB3712	2.85
MB3713	1.30
MB3730	2.94
MC13002	4.86
MC1303P	1.96
MC1307P	1.90
MC1310P	1.25
MC1327P	1.20
MC1330P	1.23
MC1349P	1.20
MC1350P	1.10
MC1351P	0.75
MC1352P	1.01
MC1357P	1.95
MC1358P	1.55
MC14001	7.15
MC14011	0.23
MC14013	0.37
MC14016CP	0.37
MC14025	0.54
MC14049UBC	0.52
MC1438R	0.95
MC14493P	2.56
MC14510BAL	3.15
MC14556BCP	3.15
MC1712	3.52
MC7724CP	3.17
MC7818C	1.98
MC7824CP	4.25
MC78M12	0.75
MC78M24	0.85
MCR101	0.80
MCR106/5	1.17
MCR220/7	1.34
ME0402	0.27
ME0404	0.23
ME0404/2	0.42
ME0411	0.45
ME0412	0.21
ME4102	0.45
ME545B	9.10
ME6002	0.23
ME6102	0.45
ME8001	0.26
MJ2501	4.95
MJ2955	1.34
MJ3000	2.15
MJ3001	1.30
MJ3028	2.40
MJ481	1.39
MJ802	4.95
MJE2955	1.71
MJE3055	0.78
MJE340	0.44
MJE520	0.44
ML231	2.28
ML232B	3.30
ML237B	2.28
ML238	4.02
ML741CS	0.36
ML923	2.18
ML0926	3.25
MM5314N	3.72
MM5316N	3.72
MM5318N	2.82
MM5369N	1.82
MM5387AA/N	11.50
MM5841N	5.90
MP8112	1.35
MP8113	1.35
MP8512	1.23
MPF256C	0.54
MPS6570	0.43
MPSA42	0.59
MPSA56	0.24
MPSA92	1.11

MPSU05	0.78
MPSU10	0.78
MPSU55	0.90
MPSU56	0.30
MPSU60	1.20
MR510	0.30
MR812	0.80
MR914	0.46
MSSD7002	0.65
MVS240	0.52
MVS460	0.30
MVS460-02	0.55
ME545B	2.95
ME545B	3.80
ME5534N	1.40
ME555	0.34
ME556	0.75
ME5560N	3.16
ME565N	1.20
ME645BN	3.80
ME646N	3.80
ME650N	3.94
ME645BN	3.80
MP1106	4.80
OA200	0.10
OA202	0.10
OA47	0.10
OA90	0.07
OA91	0.08
OA95	0.08
OC28	0.96
OC29	1.95
OC35	0.96
OC36	1.16
OC44	0.40
OC45	0.40
OC75	0.40
ON188	1.70
ON236	2.90
OT112	0.98
OT121	0.70
PD144	2.03
PT1017	2.43
PT2014	2.76
PT6042	1.82
R1038	1.99
R1039	1.99
R2008B	1.20
R2009	1.20
R2001B	1.20
R2029	1.20
R2030	1.20
R2257	2.16
R2265	1.95
R2305	1.07
R2306	1.23
R2322	1.26
R2323	1.23
R2348	1.82
R2354A	1.82
R2354B	1.82
R2441	1.23
R2443	0.80
R2461	2.10
R2477	0.92
R2501	1.16
R2540	1.80
R2540X	3.00
R2615	0.80
RC4195NB	1.96
RCA16029	1.82
RCA16083	4.81
RCA16334	0.92
RCA16335	1.23
RCA16600	1.25
RCA16799	2.16
RCA16801	0.86
RCA16802	0.98
RCA17028	2.25
RCA17074	6.00
RCA17376	1.43
RCA60857	4.50
RGP10	0.45
RT402	1.40
RT905A	2.00
S0280	1.94
S0281	1.94
S041P	1.26
S042P	1.46
S1299	4.30
S175	18.95
S2062D	1.88
S2800	5.25
S2800D	2.55
S2802	3.15
S3702S	4.73
S3703F	4.73
S3707	3.92
S40W	7.99
S551	4.12
S552	4.12
S6080B	2.75
S6087AR	4.45
SAA1020	4.32
SAA1021	4.32
SAA1024	2.55
SAA1025	4.70
SAA1050	3.78
SAA1051	5.30
SAA1061	3.28
SAA1075	4.41
SAA1082	8.04
SAA1121	4.32
SAA1124	2.55
SAA1130	4.86
SAA1174	5.75
SAA1250	3.78
SAA1251	5.30
SAA5000	3.65

SAA5010	4.98
SAA5012	6.58
SAA5020	5.25
SAA5030	7.50
SAA5040A	14.75
SAA5050	8.50
SAA661B	1.88
SAA700	3.80
SAB1009B	4.53
SAB1046P	3.86
SAB3011	7.34
SAB3012	5.34
SAB3013	3.28
SAB3021	7.18
SAB3022B	12.34
SAB3023B	11.18
SAB3024	4.77
SAB3209	4.75
SAB3210	2.93
SAB4209	12.75
SAF1031	2.30
SAF1032	5.80
SAF1039	11.86
SAS5010	7.62
SAS560	1.88
SAS560S	2.97
SAS560T	2.85
SAS570	1.61
SAS570S	0.00
SAS570T	2.50
SAS580	4.41
SAS5800	2.62
SAS590	4.55
SAS5900	2.32
SAS660	2.50
SAS6600	1.20
SAS660S	1.20
SAS6610	1.20
SAS670	2.50
SAS6700	1.20
SAS670S	1.20
SAS6710	1.20
SAS6800	2.30
SAS6810	1.30
SBA550B	1.95
SBA750	1.46
SC9488P	1.90
SC9503	1.50
SC9504P	1.46
SC9511P	1.90
SCR957	1.20
SG264A	4.38
SG613	7.88
SG629	6.28
SG6533	9.37
SI-1020N	4.76
SI-1125HD	10.70
SI-1130N	6.30
SKB2/08	0.70
SKE2F 1/04	1.26
SKE2G 2/04	0.95
SKE2G 3/04	0.95
SKE4F 1/02	1.26
SKE4F 1/06	0.66
SKE4F 2/06	2.10
SKE4F 2/08	0.80
SKE4G 2/02	0.87
SKE5F 3/10	1.45
SL1310	2.85
SL1327E	1.20
SL1430	1.26
SL1430T	2.10
SL1432	2.25
SL414	3.35
SL432A	3.12
SL437	6.80
SL439	2.25
SL480	5.00
SL490	1.78
SL901B	6.08
SL917B	7.95
SL918A	5.63
SN6848	8.82
SN16861N-07	1.59
SN16862N-07	1.68
SN16880N	3.30
SN16985	8.13
SN16966N	5.49
SN29715N	5.49
SN29716N	3.32
SN29717N	6.53
SN29722	10.65
SN29723AN	6.95
SN29744N	2.08
SN29764AN	3.38
SN29767	3.61
SN29770AN	2.04
SN29771BN	4.23
SN29772BN	4.21
SN29773	2.28
SN29791	1.51
SN29798N	3.89
SN29845	2.14
SN29848	1.66
SN29861	2.08
SN29862	2.08
SN72709	0.48
SN7400N	0.24
SN7401N	0.24
SN7402N	0.59
SN7404N	0.21
SN7408N	0.24
SN7410N	0.24
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SN74122	0.95
SN7413N	0.33
SN74141	1.41
SN74151AN	1.51
SN74154N	1.15

SN74190	1.81
SN7420N	0.38
SN7430	0.28
SN7440N	0.24
SN7473	0.56
SN7474N	0.72
SN7490AN	0.93
SN75110N	0.75
SN76001ANQ	2.25
SN76003N	2.81
SN76013N	3.63
SN76013ND	2.25
SN76013NDG	8.07
SN76023N	2.35
SN76023ND	1.04
SN76033N	2.33
SN76105N	2.36
SN76110N	1.13
SN76115AN	1.46
SN76131	1.74
SN76226DN	1.28
SN76227N	0.88
SN76228N	2.97
SN76231	2.31
SN76242	4.75
SN76243	4.75
SN76322	2.51
SN76360	1.97
SN76390	2.80
SN76396	2.63
SN76510N	0.95
SN76530P	1.90
SN76532N	1.80
SN76533N	1.56
SN76540N	1.80
SN76544	1.60
SN76545	4.55
SN76546	3.15
SN76546N	3.15
SN76549	2.35
SN76550	0.30
SN76551	1.35
SN76570	2.80
SN76600	1.10
SN76611	2.35
SN76620	2.35
SN76622	1.50
SN76623	0.62
SN76630	2.31
SN76640	3.85
SN76650N	1.24
SN76651	1.35
SN76660N	2.25
SN76665N	1.35
SN76666N	0.98
SN76705	3.38
SN76705N	3.99
SN76707N	3.99
SN76709	4.65
SN76709N	4.95
SN76730	4.23
SN76810N	0.62
SN76920N	2.63
SN94041	3.45
SN94042	3.95
SP8385	0.50
STA441C	2.27
STK0029	3.42
STK0039	4.00
STK0050	4.96
STK0059	6.48
STK0080	8.32
STK011	3.86
STK013	7.04
STK014	7.14
STK015	5.12
STK016	4.82
STK022	4.77
STK025	7.20
STK040	7.09
STK043	7.09
STK054	6.48
STK070	20.28
STK077	7.00
STK078	5.52
STK082	7.54
STK086	9.90
STK2101	5.74
STK2110	6.86
STK2230	6.66
STK415	6.04
STK433	9.35
STK435	5.44
STK436	5.70
STK437	8.10
STK439	6.26
STK441	8.96
STK443	9.35
STK459	6.56
STK460	5.78
STK461	7.14
STK463	8.06
STK465	7.32
STK466	10.70
STK501	5.74
STK502	5.74
STR441	6.34
STR453	6.75
STR6020	7.20
T6007V	0.69
T6007N	0.62
T6016	0.36
T6017	0.65
T6018V	0.65
T6021	0.36
T6022V	3.56
T6026	0.89
T6027	0.73
T6028V	0.35

T6029V	4.41
T6032V	0.89
T6033V	0.73
T6035V	0.86
T6036	0.44
T6037	1.91
T6041V	0.86
T6044V	0.86
T6045	1.09
T6049	1.10
T6052V	0.76
T6058	0.46
T6059	1.05
T8001V	1.89
T9003V	0.86
T9005V	2.16
T9010V	0.87
T9011V	1.27
T9013V	5.81
T9014V	1.52
T9016	0.92
T9022N	0.39
T9034V	1.25
T9035V	1.26
T9038V	6.15
T9051	2.55
T9053V	1.03
T9054V	0.92
T9057V	0.63
T9063V	2.94
TA5814	1.35
TA7020P	4.36
TA7027	4.36
TA7050	1.58
TA7051	1.58
TA7060AP	0.80
TA7061AP	0.78
TA7069	2.84
TA7070P	1.52
TA7071	3.35
TA7072P	1.35
TA7073P	4.05
TA7074P	1.95
TA7076P	4.95
TA7089N	1.41
TA7089P	1.36
TA7092P	3.85
TA7093P	1.64
TA7102P	5.34
TA7108P	1.40
TA7109	3.37
TA7120P	0.58
TA7122B/P	0.54
TA7124P	2.00
TA7130P	1.15
TA7136AP	1.15
TA7137P	0.85
TA7141AP	3.51
TA7146P	8.04
TA7148P	1.51
TA7149P	2.10
TA7153P	4.53
TA7161P	5.66
TA7162P	4.25
TA7169	4.80
TA7171P	2.53
TA7172P	1.28
TA7176P	2.25
TA7193P	4.44
TA7201P	3.25
TA7202P	2.24
TA7203P	1.95
TA7204P	1.95
TA7205	1.25
TA7208P	1.95
TA7210P	3.25
TA7214P	2.90
TA7215P	2.09
TA7217AP	1.36
TA7222	1.95
TA7227P	1.69
TA7229P	4.10
TA7310P	1.95
TA7313AP	1.36
TA7314	5.10
TA7609	3.00
TA7611AP	3.54
TA7676P	3.05
TAA300	2.99
TAA310A	0.27
TAA320A	1.15
TAA350A	1.62
TAA435	1.65
TAA550	0.33
TAA570	1.58
TAA611B12	1.50
TAA621AX1	2.00
TAA630S	3.31
TAA640	3.85
TAA661B	1.59
TAA700	2.35
TAA840	2.27
TAA930	4.42
TAA970	2.57
TAD100	1.91
TAG232-600	0.86
TAG626-600	0.84
TBA120	0.95
TBA120A	0.95
TBA120AS	0.95
TBA120S	0.95
TBA120SB	0.95
TBA120T	0.95
TBA120U	0.95
TBA120UB	3.47
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TBA1440G	3.40
TBA1441	1.59
TBA240A	3.42

TBA395	1.35
TBA395Q	1.80
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TBA440P	1.55
TBA480	1.42
TBA480Q	1.67
TBA500PQ	4.95
TBA510	1.55
TBA510S	6.39
TBA520	1.67
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TBA530	0.86
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TBA540	0.98
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TBA550	1.95
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TBA560C	0.86
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TBA570	1.55
TBA570A	1.55
TBA570Q	1.35
TBA625A	1.97
TBA625B	1.97
TBA625C	1.97
TBA641A12	3.75
TBA641BX1	2.07
TBA651	1.80
TBA673	2.35
TBA700Q	2.19
TBA720	2.85
TBA730	1.75
TBA750Q	1.46
TBA760	1.55
TBA780	3.00
TBA800	0.80
TBA810AS	1.46
TBA810S	1.46
TBA810T	1.46
TBA820	0.83
TBA820M	1.65
TBA890	1.85
TBA900	2.25
TBA920	1.50
TBA920Q	2.10
TBA940	1.70
TBA950	1.55
TBA970	2.88
TBA970Q	2.98
TBA990	1.65
TBA990Q	1.95
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TC4001	1.29
TC4053BP	3.94
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TCA160B	1.62
TCA270Q	1.55
TCA270S	1.95
TCA270SQ	1.65
TCA290A	2.05
TCA420A	1.90
TCA440	1.65
TCA4500A	1.95
TCA530	1.80
TCA640	2.63
TCA650	1.85
TCA660B	2.63
TCA730	3.84
TCA740	2.25
TCA750	1.75
TCA760B	2.79
TCA800	1.65
TCA800Q	2.25
TCA830S	1.94
TCA900	1.85
TCA910	1.50
TCA940E	1.60
TCE330	3.53
TCE527	1.37
TCE82	0.98
TCE83	0.98
TCE84	0.98
TCEP100	4.80
TCEP100Q	9.31
TD190	0.54
TD3F700H	6.00
TD3F800H	2.25
TD3F800R	3.21
TD3F900H	3.78
TD3F900R36	3.78
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TDA1003A	2.15
TDA1004A	2.15
TDA1005A	2.15
TDA1006A	2.15
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TDA1011	2.60
TDA1028	2.22
TDA1029	4.44
TDA1034B	2.20
TDA1035T	1.83
TDA1037	1.45
TDA1041	1.96
TDA1044	1.61
TDA1047	2.14
TDA1054M	1.10
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TDA1170	2.15
TDA1170S	1.85
TDA1180	2.25
TDA1190	1.91
TDA1190Z	2.25
TDA1200A	1.30
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TDA1230	2.93
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TDA1330	1.60
TDA1365	6.35
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TDA1420	1.48
TDA1470	2.63
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TDA1905	1.25
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TDA1940	2.54
TDA1950	2.54
TDA2002	1.20
TDA2003	1.05
TDA2004	2.52
TDA2006	1.25
TDA2010	2.79
TDA2020	2.75
TDA2030	1.85
TDA2140	1.44
TDA2150	5.63
TDA2151	1.75
TDA2160	3.64
TDA2161	1.88
TDA2190	3.11
TDA2510	1.82
TDA2520	2.15
TDA2521	2.15
TDA2522	2.81
TDA2523	2.75
TDA2524	4.50
TDA2525	2.96
TDA2530	2.19
TDA2532	2.51
TDA2533	2.09
TDA2540	1.95
TDA2541	1.95
TDA2545Q	3.16
TDA2560	1.97
TDA2571A	2.81
TDA2575A	2.95
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TDA2577	5.31
TDA2581	1.95
TDA2582	1.98
TDA2590	2.80
TDA2591	2.80
TDA2591Q	2.80
TDA2593	2.24
TDA2594	2.80
TDA2600	5.80
TDA2610	2.53
TDA2611A	1.25
TDA2611AQ	2.55
TDA2612Q	4.25
TDA2620	1.96
TDA2630	2.34
TDA2631	2.48
TDA2640	2.25
TDA2643	6.93
TDA2651	2.95
TDA2652	7.05
TDA2653	2.95
TDA2654	2.91
TDA2655B	3.15
TDA2660	2.24
TDA2661	2.24
TDA2670	2.50
TDA2670A	1.76
TDA2680	2.30
TDA2690A	2.40
TDA2780AQ	2.18
TDA2790Q	5.92
TDA2791	2.50
TDA2795	2.95
TDA2800	6.12
TDA3000T	2.31
TDA3030A	10.44
TDA3190	1.75
TDA3300B	7.75
TDA3500	5.95
TDA3501	10.99
TDA3506	10.12
TDA3510	5.95
TDA3520	8.82
TDA3521	12.17
TDA3560	6.87
TDA3561	7.50
TDA3571Q	2.25
TDA3571A	5.67
TDA3576	4.76
TDA3950	2.81
TDA3950B	1.40
TDA4050A	3.15
TDA4180P	1.74
TDA4260	1.40
TDA4280	6.45
TDA4290	4.06
TDA440	1.95
TDA4400	2.06
TDA4420	4.25
TDA4422	5.63
TDA4430	4.34
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TDA4432	2.06
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TDA4610	2.42
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TDA5600	2.88
TDA5700	2.10
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TDA9503	2.80
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TE527	1.25
TE538	0.36
TE626	1.35
TEA1002	3.15
TDA1009	0.96
TEA1020SP	5.34
TEA1087	0.46
TIC106C	0.55
TIC106M	0.55
TIC116D	0.80
TIC44	0.65
TIC45	0.70
TIC47	0.70
TIP120	0.96
TIP110	0.48
TIP112	0.80
TIP117	0.86
TIP120	0.73
TIP121	1.08
TIP126	0.96
TIP127	1.30
TIP2955	0.78
TIP29A	0.41
TIP29B	0.57
TIP29C	0.40
TIP3055	0.65
TIP30A	0.41
TIP30B	0.63
TIP31B	0.35
TIP31C	0.63
TIP32B	0.35
TIP32C	0.66
TIP33C	1.25
TIP34	1.07
TIP41A	0.39
TIP41B	0.28
TIP41C	0.44
TIP42A	0.39
TIP42B	0.71
TIP42C	0.44
TIP47	0.65
TIP48	0.63
TIP49	3.28
TIS43	1.21
TIS90	0.22
TIS91	0.26
TL071CP	2.02
TMS1000NL	10.78
TMS3748NS	11.86
TMS4116	1.87
TV106	1.20
TY6010B	2.70
U05G	1.03
U143M	2.80
U3700	0.55
U37003	0.44
UA723CA	5.02
UA758PC	3.06
UA783P3C	1.07
UAA170	2.14
UAA180	2.14
ULN2165	1.35
ULN2204	7.00
ULN2216F	1.95
UPC1001H	2.50
UPC1009C	5.74
UPC1020H	2.12
UPC1025H	2.49
UPC1026C	1.24
UPC1028H	0.90
UPC1030H	2.06
UPC1031H	8.05
UPC1031H2	6.00
UPC1032H	0.94
UPC1154H	1.75
UPC1156H	1.45
UPC1181H	1.25
UPC1182H	1.82
UPC1185H	2.94
UPC1186H	0.95
UPC1212C	0.95
UPC1213C	0.95
UPC1217C	2.24
UPC1350C	1.75
UPC1351C	1.64
UPC1353	6.75
UPC1360C	4.10
UPC1362	7.95
UPC1365	5.79
UPC1366	4.23
UPC1458	7.87
UPC2002	1.48
UPC30C	2.22
UPC32C	4.49
UPC41C	3.72
UPC554C	1.68
UPC558C	3.67
UPC566H	2.78
UPC572	3.51
UPC575C2	3.72
UPC576H	2.60
UPC577H	0.64
UPC587C2	2.34
UPC592H	1.02
UPD1514C	7.56
UPD851	14.39
UPX27C	1.98
X0022CE	3.67
X0035TA	4.35
X0056CE	3.90
X0062CE	4.95
X0065CE	3.48
X0109CE	6.10
X1074AF	6.36
XC949P	1.20
Y730	0.24
Y969	0.60

IF YOU DON'T SEE IT LISTED ASK FOR QUOTE. GIVE MAKE MODEL LOCATION. REMEMBER TO ADD 0.60p POST & HANDLING. ADD 15% VAT TO TOTAL

VCR Clinic

Tony Thompson, Steve Beeching, T. Eng. (C.E.I.), Mike Phelan, Ian Hutton, Peter Dolman, Les Grogan, Malcolm George, Hugh Allison, John Coombes and Peter Blundell, Tech. (C.E.I.)

Panasonic NV333

A couple of faults on this otherwise quite reliable machine have come to light on a number of occasions. First, if the customer tends to use the wired remote control and the machine won't respond to on-board commands, working only with the remote control system, it's a good idea to change the minijack remote control input socket. This is a weak link and can go open.

Secondly, when a cassette has been loaded but the machine won't respond to any commands, even eject, don't get too involved before you've checked the cassette-down switch. This little devil lives under the main board and is a bit fiddly to get at due to the construction of the machine. It's a simple looking device with thin, long springy contacts. To check, bridge across it with wire: the machine should then respond to all function commands. It can be cleaned up but won't last. A replacement is necessary, though you can leave it bridged across as a temporary measure. **T.T.**

Grundig 2 × 4 Super

One of these machines would occasionally refuse to go into playback – it would move the loading ring slightly, then return to stop. Fast forward and rewind were o.k., but search fast forward and rewind did the same. We finally found that the autostop adjustment (BEA) was slightly out: the autostop worked, but in all modes except fast wind the too sensitive adjustment prompted the stop mode. **M.P.**

Hitachi VT9700

This machine had given us trouble for over a year. Every time it was brought in with the complaint that it ran slow it worked normally, much to our customer's embarrassment. Even bench testing with a scope tied to the servo failed to show anything amiss. Eventually, while on the bench for the umpteenth time, it stopped dead in its tracks. The capstan motor had seized solid, but by now it was some five months out of guarantee. Anyway I sent the motor to Hitachi with a covering letter describing the problem and asking whether they could see their way to supplying an under-guarantee replacement. Those nice people at Hitachi sent me one FOC and after fitting it the machine ran fine. For an hour or two anyway, then the original fault appeared, the first time we'd seen it.

After a certain amount of probing about we found that the output from the capstan servo sample and hold circuit was a squarewave, which also made the machine warble badly. The capstan trapezoid wasn't there and the charging capacitor C506 was found to be hanging on by only one leg. Refitting it restored normal operation. **S.B.**

JVC HRC3

It seems that all the world knew about it except me, and maybe some of you. It came to pass that a customer with a JVC HRC3 mini portable VCR had problems. These occurred when his recordings were placed in a cassette adaptor and then into an Hitachi VT19. At the beginning of each new recording the VT19 would go into the LP mode for about five-ten seconds. Not a lot, but it seemed like ages before it reverted to normal speed. Well, I blamed the Hitachi VCR, which has suffered from certain problems (clock display keeps resetting; motorboating on one of the audio channels). Not so however – the same difficulty arose when a two-speed JVC HR7655 was tried. The problem lies within the HRC3's control track pulse recording level circuit. But don't try to do the modification yourselves – you'll only end in tears! **S.B.**

Odds and Ends

As if boards with double sided print aren't enough, the latest information on the new JVC camcorder (GRC1) to be launched this autumn has it that there will be "dedicated i.c.s, special four-layer boards and increased component density". Only a fool would try to repair one without specialised knowledge.

Did you hear about the stereo hi-fi VCR that records stereo audio on the helical tracks but has only a mono static head, thus making it non-compatible with current stereo VHS tapes? Panasonic did. So beware Sony – inside information from a long way away indicates that at least one Beta manufacturer has done the same thing. The audio switching is left, right and normal. Left and right are the new hi-fi channels and normal is a mono static head. Good authority has it that the forthcoming JVC HRD725 hi-fi will have a stereo static head. **S.B.**

Mitsubishi HS310

Playback was not possible because the head drum was running at the wrong speed. A recording was made and played back on another machine. This was successful, so whatever was wrong was something that acted on the drum servo on playback but not on record. On record the reference signal is obtained from the field sync. On playback the signal is divided down from the 4·433MHz crystal oscillator on the YC board – the oscillator and divider are both in IC6F3. Checks showed that both these signals were missing. Spraying the crystal (X6F2) with freezer restored normal operation and a replacement cleared the fault. **I.H.**

Ferguson 3V35

This machine came in with the head drum running at about 3,000 r.p.m.! Slowing it down by hand gave quite a good picture. We first checked the supply voltage to the HA13008 drum motor amplifier chip (IC407), having been caught out by this before. It was spot on at 13V. The HA13008 and quite a few other bits had been changed. We moved back to the preceding error amplifier chip and found that the drum phase error input (pin 12) was bouncing around all over the place while the drum speed input (pin 13) was low. As pin 13 goes low to increase the motor's speed, this meant that the fault was prior to this point – had it been high, this would have meant that the fault was between this point and the motor, and that the servo was making an attempt to correct the situation.

The FG feedback signal was o.k. in amplitude at pin 3 of the BA6328 drum speed discriminator chip IC404, where it enters for amplification, but the output at pin 4 was low and noisy. There's a feedback loop between these two pins and the culprit was in this network – C465 (100pF) was leaky. **M.P.**

Mitsubishi HS310

Several of these machines have been brought to us with vague complaints such as "sometimes stops in the timer mode, I think" and "just won't run satisfactorily". They've all worked faultlessly in the workshop however. Following much inaccurate speculation, the cause was eventually found to be a simple one – failure of the cassette lamp. The type used has a nasty habit of going open-circuit intermittently and momentarily, thus returning the machine to the stop mode. A defective lamp can usually be identified by watching for changes in its brightness while administering a deft flick with the thumb and forefinger. **P.D.**

Hitachi Disc Player

Sound o.k. but very weak video was the complaint with this disc player. We bypassed the r.f. modulator by feeding directly into the TV set's video input socket. The modulator is fed by an emitter-follower transistor (Q503) and we could find little when we made a scope check at its emitter (TP43). Furthermore Q503's collector voltage was only 5·4V instead of 10·8V. The 10·8V output from the power supply was correct (TP91) and the only thing between this and the collector of Q503 is the filter resistor R574 (2·2Ω, 0·25W). Replacing this cleared the fault. **L.G.**

Sony C7

The customer brought in a dusty looking C7 saying that it had stopped, a puff of smoke coming from just above the clock display. Checks in the power supply revealed that the chopper transistors Q101/2 were short-circuit while the resistor in series with them (R101) was open-circuit. Ah ha! I thought, I've read about this one (January 1984). So I sent off to Sony for the A6738-159A replacement kit. This was fitted and the power supply was run up under no load conditions, performing o.k. The rest of the C7 was powered from a 12V bench supply and produced talking pictures with colour, without taking too much current. So the power supply was confidently refitted and all plugs and sockets were connected. Guess what happened when I turned on? Another puff of smoke and Q101/Q102/R101 had again bit the dust. Further checks revealed that the two 4·7μF electrolytics associated with Q101/2 had fallen in value to something like 0·5μF. Sony replacements for all these items provided a final cure, but the next time it happened to me I decided that BU408s and 4μF, 350V electrolytics seem to provide a cheaper, reliable solution. **M.G.**

Akai VS5EK

While chatting up one of our lovely secretaries it transpired that she had to take her video cassettes round to a neighbour's house to rewind them since her machine would only play and record! When we checked the machine, attempting either fast forward or rewind created a furious "bleeping" and the ejected cassettes came out with a foot of tape hanging loose.

A look over the top mechanics revealed that the fast forward/rewind jockey wheel wasn't moving: careful examination underneath then revealed that the spring connecting the jockey wheel and the tape supply wheel brake had broken. This spring is well obscured by a lever, and is an experiment in self-control to replace. Since half the broken spring was missing, the unit was held "right way up" and gently shaken until the spring fell out – along with two hairgrips, a paper clip and a dead moth . . . **H.A.**

Ferguson 3V22

The problem was loss of line lock on playback. The drum pickup head was producing output pulses but the waveforms around the AN318 drum servo i.c. didn't seem to be of the correct shape. Replacing the chip cured the trouble **J.C.**

Ferguson 3V30

When the machine was switched on the cassette's supply reel would rotate for approximately ten seconds then stop. After this no commands would be accepted. I at first suspected the end sensor of being leaky, but a replacement didn't provide a cure. It was then noticed that the same thing happened if no cassette was present. Checking the inputs to the control microcomputer i.c. showed that the unload switch wasn't making contact. **P.B.**

Sharp VC9700

This machine would work perfectly for about four hours. Hooking at the top of the picture would then start. Removing the covers cleared the fault of course, but no amount of board heating with a hairdryer would make it return. At this the covers were replaced and the machine was left to warm up. During a lull in the passing traffic we noticed a rubbing sound. This was finally traced to the head drum bearing – pricey . . . **P.B.**

Sharp VC8300

We've had quite a few of these machines that will load and eject a tape but do nothing else. If the bulb is o.k., the fault is usually a crack in the connector panel below the solenoids at the front of the deck. Amongst other things this panel connects the cassette-down switch with the system control microcomputer. It's necessary to remove the tape deck to repair the panel, but this isn't difficult. **M.P.**

Sanyo VTC5300

Intermittent failure to lace up or eject is generally caused by excessive resistance to travel of the loading ring. Clean the loading motor belt and sparingly lubricate the rollers that engage with the cam on the loading ring. If the fault persists, replace the reel/loading motor which probably has a dead spot. The reason for this is that it doesn't take kindly to being stalled: the commutator metal wears away, leaving exposed insulation – hence the dead spot. **M.P.**

Sanyo VTC5000

One of these machines came in with the complaint "intermittent lines on the picture on its own recordings". Sure enough the drum servo lost lock occasionally on record – it varied with picture content. A scope connected to pin 10 of the BA848 servo i.c. showed that there were twice as many pulses here as there should have been – the rate was 50Hz. The input to the sync separator in this i.c. (pin 13) seemed to be o.k. but there was a very small pulse midway between the field sync pulses. This wasn't present with a video input, the servo then working all right. While checking around the i.f. strip we noticed that the picture looked as though the a.f.c. was off tune. And that was it – not by enough to cause patterning, but enough to upset the sync separator action by emphasising h.f. transitions from peak white (on captions etc.). **M.P.**

Servicing the Grundig GSC100 Chassis

Denis G. Mott

During the past two-three years I've had to deal with a large number of these sets. This has enabled me to compile a faults list which I hope will be of help to other engineers. The chassis consists of a large, vertical main panel with a number of modules that take care of various circuit functions. The tubes are of the 90° in-line gun type while the line output stage is of the thyristor type. Unlike earlier Grundig colour chassis that employed a transductor for width/e.h.t. regulation, in this chassis a thyristor driven by a rather unusual circuit (more on this later) is used for the purpose. There are no less than six thyristors dotted around the chassis – e.h.t. regulator (Ty503), line scan and line flyback (Ty508 and Ty501), line generator start-up (Ty607), excess current trip (Ty615) and overvoltage trip (Ty2517).

Power Supply

We'll start with the power supply. Fig. 1 shows the basic power supply arrangement (in addition, 200V and 18·6V supplies, fused by Si629 and Si627 respectively, are derived from the line output stage). It's uncanny how many phone calls I get about this. As soon as people see a thyristor they throw up their hands in horror! In normal operation, a supply (+B13·5V) derived from the combi coil is used to power the line generator and e.h.t. control modules. So a start-up supply is required. This is provided by Ty607 whose anode is fed via the fusible resistor R607. The output is limited by the 10V zener diode Di607. Once the line timebase has come into operation, Di511 rectifies pulses developed across a secondary winding on the combi coil, feeding the Darlington series regulator transistor Tr635 via fuse Si511 and the fusible resistor R632. Assuming that there's no fault condition, the regulator circuit produces a 15V supply and Tr608 switches on, shorting the gate of Ty607 to chassis to disable the start-up system.

One of the most common conditions is no results due to R607 having sprung open. In this event, check the following: Ty607 short-circuit; Tr608 open-circuit or low gain; R608 high in value; R633 high or open-circuit; no 311V h.t. supply; no output from the line generator module; no drive to Ty503 from the e.h.t. control module; Si511 or Di511 open-circuit; Ty503 open-circuit; Di636 low voltage. This covers 90 per cent of faults causing R607 to ping. The cause of R621 in the h.t. supply being open-circuit is usually excess current trip operation due to a line output stage fault.

Excess Current Trip

The excess current trip module gives relatively few problems. If Ty615 has gone open-circuit there'll be no h.t. supply of course; if it's gone short-circuit there'll be no protection until R621 pings. The operation of this circuit is as follows. If a fault condition causing an increase of 100 per cent in the h.t. current occurs, the voltage developed across R621 will increase from approximately 9V to 13V plus. As a result zener diode Di619 will conduct, turning on Tr618 to short Ty615's gate-cathode junction so that it switches off. The time-constant of C618/R618 is approximately 120msec, so that the trip "oscillates" until R621 pings. To check the operation of this module, connect a 10kΩ resistor from the junction of R619 and D619 to chassis: the module should now oscillate at the trip frequency.

EHT Control Module

The e.h.t. control module (see Fig. 2) may come as a surprise. TTL in a line timebase! Very useful actually. Here's how it works. IC2511 is a monostable multivibrator which is triggered at pin 5 by pulses from the line generator module. The multivibrator's on time is set by the time-constant network R2514/C2513. It's output at pin 1 is capacitively coupled to Tr2506 which provides a transformer coupled drive to the regulating thyristor Ty503. Pulses from the line output transformer enter the module at pin 9 and are rectified by Di2521/C2522. The resultant supply controls transistor Tr2516 which in turn controls the supply to the monostable's time-constant network, thus providing e.h.t./width regulation. The same line output transformer derived pulses enter the module at pin 8. Under excess voltage conditions Di2517 and in turn Ty2517 conduct, shutting the whole operation down.

The usual fault conditions are as follows. C2507 changes value, reducing the drive to Tr2506 which gets hot and dies due to the slower turn-off time. Ty2517 goes short-circuit, with the result that the monostable doesn't trigger. Zener diode Di2502 goes low which upsets things because TTL devices like a supply of 5V or thereabouts.

If you can't adjust the set e.h.t. control R2523, change the 9·1V zener diode Di2516. Then set the control midway, reinsert the module, monitor tag b on the line output transformer with an AVO 8 or 9 and adjust R2523 for 49V d.c. This will give correct e.h.t. and width. If you wind the control too far Di2516 will snuff it, so be careful.

Line Output Stage

Thyristor line output stages are not the easiest circuits for fault finding. The problem is that it either works or it doesn't, no half ways. A very useful tool is the transistor/thyristor tester featured in the June 1981 issue, since this enables you to check the power devices in situ before substitution. If you don't have a tester, the following checks and observations are worth making.

R621 and maybe R607 in the power supply will usually

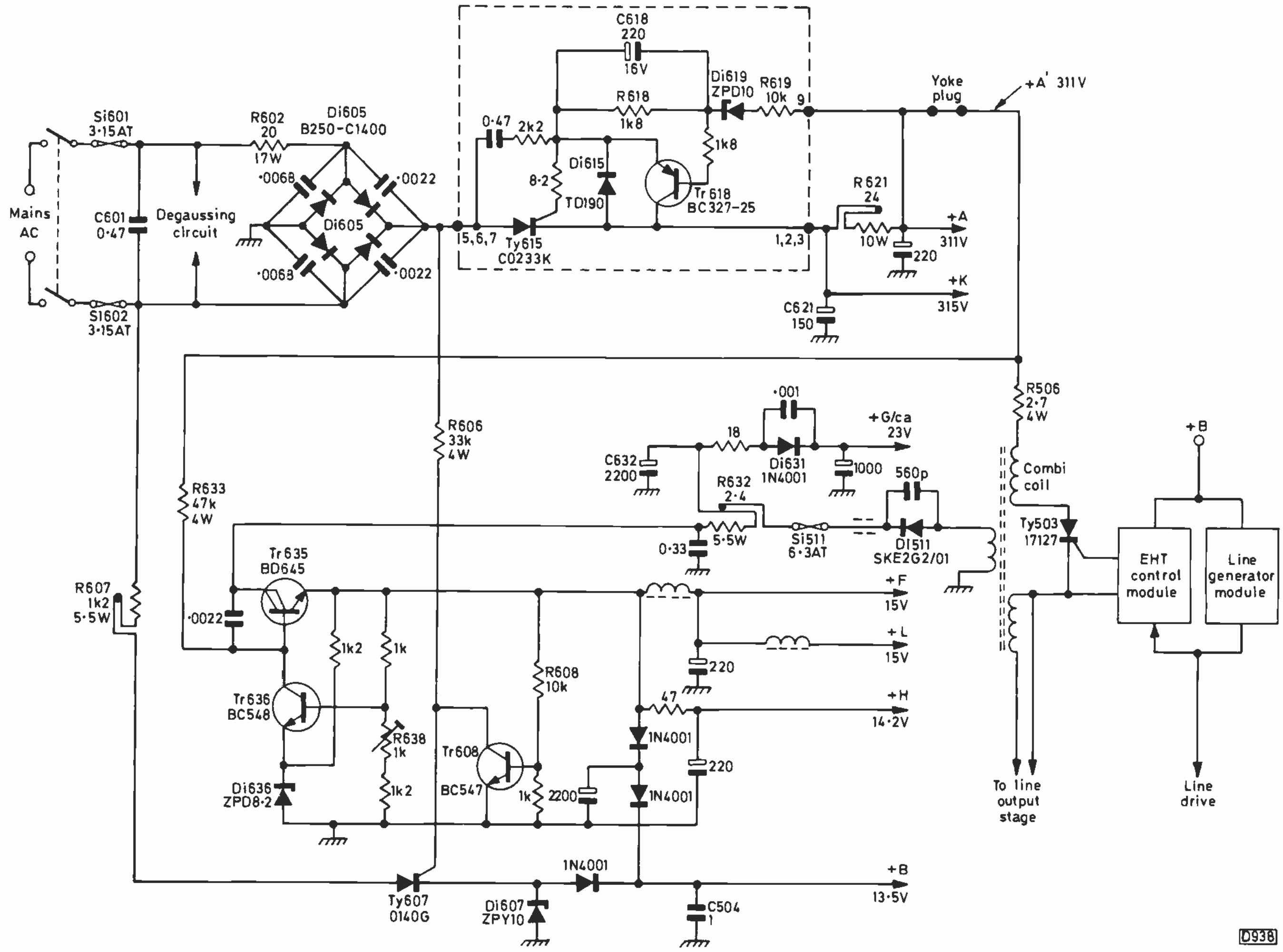


Fig. 1: Power supply arrangements used in the GSC100 chassis.

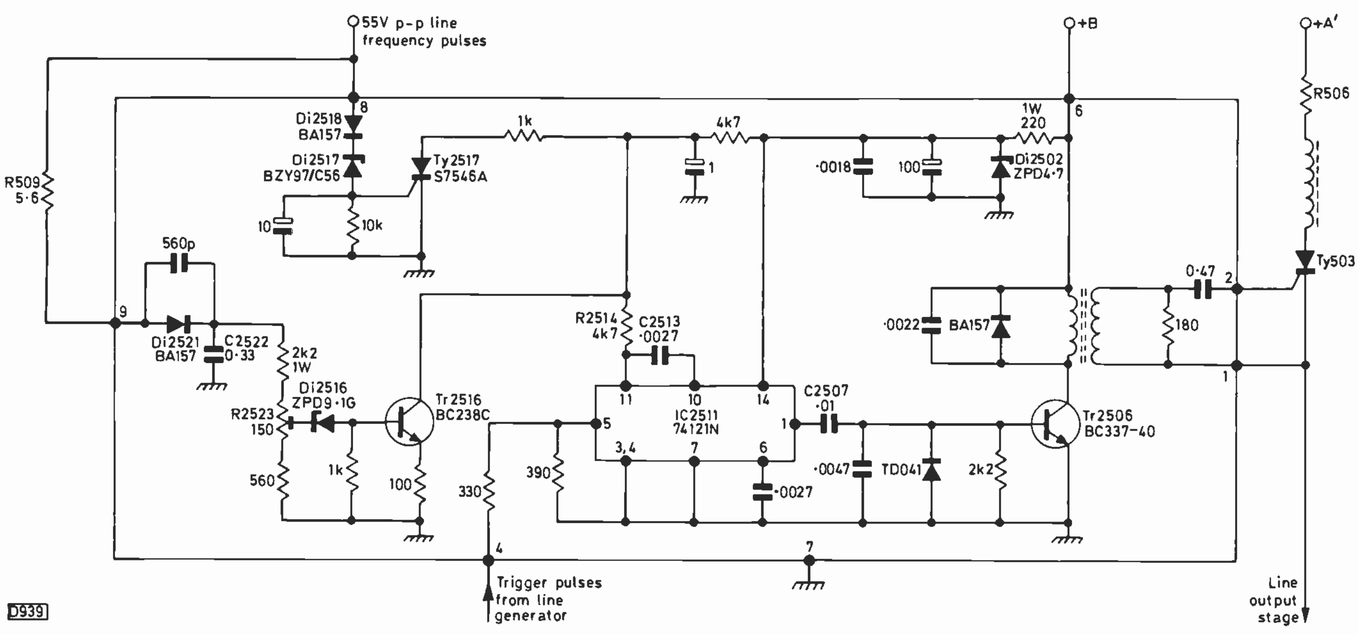


Fig. 2: E.H.T. control module circuit.

have pinged. When resoldered, the trip module will "plop" repeatedly, proving that excess current is flowing. If disconnecting the anode of the flyback thyristor Ty501 stops the tripping, it's probably short-circuit. If the set continues to trip, replace the scan thyristor Ty508 as it may be open-circuit. Also check the efficiency diode Di508. Try disconnecting the tripler. Check the continuity of the scan coils, and the scan-correction capacitor C526 (2·3μF). It's also worth inspecting the solder around R502 (180Ω, 11W) in the scan thyristor's gate drive circuit – it gets a bit hot and tends to get dry-jointed.

I always replace devices in this area with exact Grundig

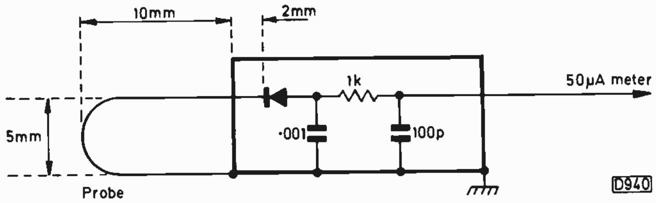


Fig. 3: Diode sniffer probe. Can be built on Veroboard.

replacements and not other types, though alternatives may be o.k. The line output transformer and combi coil don't readily fail, though I suppose some engineers will have found duff ones.

A useful tool, essential when running up a GSC100 line output stage, is a 2A variac. It saves on fuses and nerves.

Line Generator

The only problems we've had with the line generator module concern the TDA2591 chip. If the module fails to oscillate at start up the chip may be faulty – some are a bit funny about the voltage when cold.

The Field Timebase

The field timebase module employs a TDA1170 i.c. There've been some odd faults in this area. C441 (0·22µF) leaky causes poor field sync. Tr467 leaky causes funny field flyback blanking – sometimes almost anywhere during the field period. The field scan coupling capacitor C473 is on the main panel: when it's leaky or short-circuit the result is field collapse with the line shifting upwards to near the top of the screen.

Audio Module

There's little to report about the audio module apart from the TBA800 i.c. occasionally dying.

IF Module

The smoothing capacitor C2321 (10µF) on the i.f. module is a tantalum type and can go short-circuit, R607 eventually pinging. Don't forget that there are separate chroma and luminance outputs, with the chroma signal inverted. If you suspect that the SAWF is out of specification, the writer has access to a sweep generator especially designed for use with this module – contact is welcomed.

The Tuner

The tuner used by our company is of the v.h.f./u.h.f. type, part no. 29500. For many people, delving into tuners is taboo. If certain ground rules are observed however many common faults can be cleared.

Tuning drift or failure to tune is caused by one of the varicap diodes going leaky. These diodes normally have a very high impedance and any leakage at all will cause drift. The best method of tracing this fault is to connect a sensitive d.c. meter, switched to 50µA, in series with the varicap control line, disconnecting each of the diodes in turn until the current returns to zero. Replace these diodes with the exact type – no substitutes.

The r.f. amplifier transistor Tr118 tends to go sick after a thunderstorm. To confirm this, inject a signal via a loop into the output tuning area – some sort of signal should then be evident. To check that the mixer circuit is operating, use the diode sniffer shown in Fig. 3. Insert the probe near the tuning elements and check for r.f. from ch. 21 to ch. 68. If any component has to be replaced, observe exactly how the original was fitted before removing it. Fit the replacement in the same way, otherwise severe mistuning may occur.

RGB Module

The RGB module can present difficulties due to the feedback paths. If a number of panels need repairing it's worth finding a good one and fitting a 24-pin i.c. socket so that the TDA2800 i.c. can be proved before making further investigations. Most faults occur in the RGB output stages however. Here are one or two odd faults: no luminance, C907 (22µF) or the delay line (on the main panel) open-circuit; no luminance and low brightness, C977 (2·2µF) leaky.

There are obviously many internal faults that could occur in the i.c., causing obscure symptoms. Some less common faults we've had on the module are as follows. R1919 open-circuit, no contrast control. Zener diode D1948 open-circuit or L1920 high-resistance, uncontrollable brightness. Other faults depend on which output stage is involved. For the red output stage, R1904 open-circuit causes a tint of that colour on the background and loss of h.f. response; C1912 or C1914 leaky causes no red; R1911 open-circuit results in full beam current, as does T1908 going leaky or short-circuit; T1901 going short-circuit causes no colour. The relevant components in the blue and green output stages give analogous faults.

Chroma Module

Many chroma module faults are due to the two i.c.s (TDA2510 and TDA2521). There seem to have been difficulties with the TDA2521 as at least three versions were made, the TDA2521/3 being the latest. If there's no colour, check the colour burst level at pin 7 of IC861. It should be 0·5V peak-to-peak. Under fault conditions it may rise to 2·5V p-p and not be controllable with R827. Check C833 which could be leaky, IC861, and C823/832 which could be open-circuit. If there's still no colour, check the reference oscillator and its tuning. As with the RGB module, if you've many panels to look after it's worth fitting i.c. sockets to a known good one for use as an i.c. test bed. If the R − Y or B − Y signals are missing, suspect IC861 and either L854 or L857 for being open-circuit. If R828 has burnt up, check whether C831 is short-circuit. Di881 (12V zener diode) leaky causes green flashing lines while C809 causes weak flashing colours.

As mentioned in a letter (June issue) C843 must be changed to 0·0047µF if you have a colour locking problem with the Sinclair Spectrum microcomputer.

In Conclusion

I hope this article has shed light on the problems that can be encountered with the GSC100 chassis. Most of the comments also apply to the GSC200 chassis which differs in only minor respects from the GSC100 (vision i.f. module, tuning system and the inclusion of a relay board). The author is Service Manager of Network Industries (Haycliffe Lane, Wisbey, Bradford). Finally the editor wishes to apologise for an error in last month's next month box: the width/e.h.t. control system is not of the current-dumping variety as was assumed from a quick glance at the circuit.

Letters

THE DECCA 100 CHASSIS

I've bought a lot of Decca 100s in the past and thought I knew all there was to know about them. Recently however I bought two of them, cheaply, with the same fault. I was told that every panel had been changed in both sets.

The fault was as follows. Both sets had been fitted with regunned tubes and after being switched on produced perfect BBC-1 pictures but severe picture judder on BBC-2, ITV and the Welsh channels. The only way to clear the fault was to lift the chassis upwards about six inches from its downwards position. On lowering the chassis the fault reappeared.

My first thought was that there might be some interaction between the line and field, so a good deal of time was spent moving wires, checking plugs, etc., all to no avail. But why was BBC-1 all right?

The TCA270 vision demodulator i.c. plugs in, so replacing this was simple. Still the same. Next try the MC1349 i.f. amplifier i.c. A little bit more difficult as the iron has to be used. Start to remove i.f. panel with the set still on, grabbing C110 to hold panel. Lo and behold, the fault clears! Replace C110 and all is well. Do same with second set and the result is two good sets ready to go out on rental. C110 ($0{\cdot}01\mu F$) acts as a filter at the MC1349's a.g.c. input pin 5. I hope this warning about an obscure fault may help others.

Ted Lunt,
Great Sutton, South Wirral.

ECONOMICS OF SERVICING

A couple of recent items prompt me to write a few words on the economics of fault finding. The point that concerns me is how much time one should spend on a repair before starting to replace likely components, particularly with an intermittent fault. Take Malcolm Burrell's a.g.c. fault in the June issue. A very neat piece of detective work to arrive at C10 as the culprit, but the time spent setting up the biasing and connecting it to the various stages, also the equipment tied up, couldn't be justified in many firms where sets have to be turned around fairly quickly to avoid a backlog building up. There often comes a point where the fault is narrowed down to perhaps as many as a dozen or so components and the cost of replacing these en masse is less than the cost of the time that might be required to narrow down the cause of the fault further. You don't learn as much this way of course, so beginners in the trade should be encouraged to go the whole way – after all they're expected to take longer with repairs.

I freely admit that after a few quick checks, e.g. on supply lines and oscillators, and with signal faults a couple of scope waveform checks, I'll change a couple of likely items before making a more detailed study of the fault. I'm perhaps lucky in that we keep most spares in stock, including i.c.s, and that components don't seem to get damaged when removed, i.e. they can be replaced if the fault isn't cured. This may not be the most elegant way of doing repairs, but it gets results and in my experience achieves a higher repair turnover (with no more "bouncers" than with other methods). I think this must be particularly the case with intermittent faults. We all know that they never happen when you want them to, and having to tie up the only scope and maybe half the meters whilst waiting for the fault to appear can delay other repairs. You may say use two scopes, but they're expensive – and what happens when you get two sets with intermittent faults that tie up scopes? Do you go out and buy a third?

There will always be the occasional set that doesn't yield to this approach, but then you also get the occasional fault that seems to defy logical analysis. Obviously the "proper" repair method shouldn't be given up entirely. Do the occasional one in slack moments to keep your hand in – also stick to the full routine until you're confident that you can narrow the fault down to a particular component if necessary.

Derek Snelling,
Brownhills, Staffs.

CLOCKS AND FUNNIES

In July's VCR Clinic Derek Snelling mentioned an ITV teletext clock time discrepancy. I've also seen this from time to time (sorry!). I suspect that it's due to the insertion of local magazines in the national Oracle broadcasts when they are used in the regions. The time is derived from a local source and not taken from London, so either could be "out" by a few seconds.

There are other funnies with Oracle. Headers containing clear-page bits are quite often repeated several times per frame, which can confuse some decoders. Also some data lines occasionally disappear for no apparent reason!

Laurence Cook,
Appleby-in-Westmorland, Cumbria.

ELECTRONIC CUTOUT

I think that Ged's cutout (July) is an excellent idea but wonder whether its cut off delay isn't perhaps rather long. Since the current detector is only half-wave, overloads that occur on the undetected half cycle are not passed on to the comparator until the next half cycle. The relay drive then works quickly but the relay itself will take 20msec to operate. So three or four half cycles of overload current pass uninterrupted. This must be much longer than a TX9's mains fuse takes to blow when the crowbar trips, and could invite more damage. Ged didn't say whether he still had the fuse in circuit, but I presume not as it would probably blow first in a crowbar set. I'm tempted to build a cutout but would prefer to use full-wave detection and triac power switching so that the first overload half cycle is also the last.

G. M. Colebourn, Colebourn Electronics,
St Albans, Herts.

Ged Whitney comments: I considered using a bridge rectifier instead of the half-wave circuit but to be honest the reason why this was not adopted was simply that the cutout seemed to work just fine without it, so I left it at that. The unit has been tried with a large number of sets since it was built some months ago and on only one occasion has the set's mains fuse blown – I think this was due to my inadvertently setting the trip too high.

In use I set the cutout so that it operates just a little way above the normal running current. For a set that consumes 80W, this will be approximately 0·33A, so a setting for 0·4A would normally be o.k. and assuming that a 1·6A semi-delay fuse is fitted there should be adequate time for the trip to operate. Information gleaned from a number of sources reveals that a 1·6A semi-delay fuse takes about 60–80msec to rupture at ten times rating. As I don't have access to any transient recording equipment I accept Mr. Colebourn's estimate of a 20msec relay operating time.

A look at the TX9 circuit (PC1040 main panel version) shows that the crowbar thyristor CSR2 is connected in series with the mains fuse via the h.t. reservoir inductor L65, the regulator thyristor CSR1, the mains bridge rectifier and the mains filter coil L64, all of which should limit a surge current to some extent. If these components are damaged when the 1·6A mains fuse blows then the use of a crowbar arrangement appears to be dubious. Either way I think my unit would be preferable to say a thermal cutout wired across the fuseholder as suggested elsewhere in the July issue – as mentioned in my article, I tried this and it certainly didn't work for me!

I agree that a full-wave bridge rectifier would be an improvement. When I originally set down some thoughts on paper I roughed out a circuit with two operational amplifiers and a dual-gang potentiometer as the comparator, sensing the peak a.c. value directly without the use of rectifiers etc. The outputs from these operational amplifiers were to be summed and fed to a CMOS latch, then via an optocoupler to a triac. At the time this seemed to me to be too complex for what was being asked of it, so I settled for the transistor circuit. The relay was used because I wanted genuine isolation – and because it was convenient.

I'd be interested to see alternative designs. Any improvement on a basic idea is a good thing, and if we engineers can provide ourselves with better "mousetraps" our jobs will be that much easier.

GREAT PLUGTOP MYSTERY – CONT.

Some of the plugtops in use in my flat and the one in my workshop are never subjected to any kind of "waggling" (see letters July) yet their neutral pins still cook when cooking occurs. I've seen a vacuum cleaner wired up in the reverse polarity and although the negative lead enjoyed the mechanical isolation provided by the fuseholder it was still burnt. Perhaps Les's friend E.T. could point an enlightened finger for us? Ouch!

C. A. Burrows, Burrows Service,
Thornton Heath, Croydon.

Servicing the Sony KV2000UB

Part 2

David Botto

This month we'll deal with the rest of the timebase circuitry, the signals side and mention one or two odd faults.

Timebase Panel

As in other Sony TV sets, the field timebase circuitry is extremely reliable. But faults can occur! The 33V supply for the timebase is line output transformer derived – it leaves board E at pin 3 of connector E5 and arrives at pin 3 of connector D1. Absence of the 33V supply means no field timebase operation of course. The rectifier diode on panel E is D803 in earlier versions, D806 in later sets: the reservoir capacitor is C807/C812 (330μF, 50V).

We've never had to replace the CX157 field oscillator i.c. The field output transistors Q502 (2SC1663) and Q503 (2SA835) sometimes fail. In this event the driver transistor Q501 (2SC1670) should also be checked. There are several low-value resistors in this area. Check them all carefully, starting with the 1·2Ω, 1W resistors in series with the emitters of the output transistors. Nasty field foldover at the top of the screen means that the bootstrap capacitor C508 (10μF, 50V) is loosing capacitance or leaky. Replace it with a small 100V type.

If you've a picture that's curved in at the sides and the pincushion bias and amplitude controls have no effect, check the coupling capacitor C537 (10μF, 50V – C544 in later versions) first. Then check the two transistors Q512 (2SA733) and Q513 (2SC1124). These are Q508 (FRB829) and Q509 in later versions. The pincushion correction transformer T802 on board E can also fail.

Tuner

The tuner seems to lead a quiet life and seldom fails. If it does, the only reliable course is to replace it. There are two associated faults in earlier chassis: if the set drifts off tune, replace zener diode D111 (MZ12); if the set tunes all right but switching on the a.f.c. detunes it, replace IC202 (M5134P).

Mk. I A Panel

Now to the signals panels, starting with the A panel in the Mark I chassis. All sorts of nasty things can happen on the displayed picture if the transistor leads become corroded, though it must in fairness be said that this only seems to happen when the set is used in a steamy atmosphere such as the kitchen or near a paraffin stove.

Examine the first two i.f. transistors Q201 and Q202 (both 2SC1129) – the slightest leakage in either of them will bring problems. A quick check on the video output from the panel can be made with an oscilloscope connected via a 10:1 probe to pin 2 of connector A1. Before leaving this panel, carefully examine all the small signal transistors and the small electrolytics for any signs of deterioration. We've never had to replace the CX095 intercarrier sound i.c.

Mk. I B Panel

There are no i.c.s on the B decoder board used in the Mk. I chassis – but there are 29 transistors. If you've colour problems, start by connecting your scope via its 10:1 probe to the junction of R438 (150Ω) and VR301 (3·3kΩ). With a colour-bar signal you should see the colour bars. The passive subcarrier regenerator technique is used, i.e. the 4·43MHz crystal is driven by the bursts. With the scope connected to the junction of the driver transformer T303 and C316 (27pF) the burst should be seen. If it's missing or of less than 13V p-p, check the driver transistor Q303 (2SC403C). Its emitter decoupling capacitor C312 (4·7μF, 25V) can dry up and cause problems. The 4·43MHz reference signal can be checked at the collector of the following transistor Q304 (2SC403C). Adjustment of T303 is critical.

To override the colour-killer, connect the base of Q308 (2SC633A) to chassis. Check the bistable circuit by transferring the probe to the collector of Q312 (2SC633A) where a nice squarewave should be seen.

The luminance signal should be seen at pin 6 of connector B5 and the R − Y, G − Y and B − Y signals at pins 4, 3 and 2 respectively.

Strange green lines that vanish when the colour control is turned to minimum are due to failure of diodes D302/3 (1T40) – replace them both.

The main problem on this board is faulty transistors – but you'll find that the panel seldom gives trouble.

Mk. II A Panel

There's no B board in the Mark II chassis, the circuitry being included in the new A panel. Most of the signal handling here is done by i.c.s, making for even better reliability. IC201 is the vision i.f. i.c. Two different types have been used, CX100D and CX177. A scope at the junction of L301/R366 in the former case or L204/R314 in the latter should show the complete video waveform – chroma, luminance and sync pulses. At the junction of T301/R315 (earlier Mk IIs) or C311/R313 chroma alone should be seen. IC301 (CX108) contains the chroma and luminance amplifiers and the reference oscillator. Pins 4 and 8 are connected to the 4·43MHz coil which is linked to the 4·43MHz crystal via a 16pF capacitor (C325 or C317). With the scope probe at the collector of Q303 the 4·43MHz subcarrier should be seen at 1·2V p-p. IC302 (CX109) contains the chroma detectors, the G − Y matrix, the PAL switch, the a.c.c. and ident detectors plus one or two other bits and pieces. Two puzzling faults can be caused by this i.c.: wrong colour at the bottom one or two inches of the picture only, and sometimes an upright red bar on the left-hand side of the picture.

G − Y, B − Y and R − Y should be seen at pins 1, 2 and 3 respectively of connector A9 on this board, with Y at pin 4. To disable the colour-killer, unsolder pin 2 of IC302 and apply 4V to pin 2 of IC301 (you can use one of your PP9 batteries and a 5kΩ preset).

Miscellaneous Faults

Finally some odd faults. Nasty horizontal lines on the picture plus plenty of line whistle can be due to bad contact on power supply panel connector F3. This can also be caused by R640 (10kΩ – R639 in later Mk. II sets) or C628 (68pF, 500V – C623 in later Mk. II sets) going open-circuit.

There's a blanking circuit on board E. If the picture blanks out, the cause may be leakage in the transistors involved, Q802 (2SA677) and Q801 (2SC633A). Also test the two associated diodes D810 (1T40) and D809 (1T19-15B zener) and the values of R820 (22kΩ, 2W) and R821 (3·9kΩ, 1W). If R821 goes open-circuit you'll get ringing on the left of the picture. In later versions the resistors are R813 and R814 respectively, the zener diode is D811 (EQA01-16R), D810 is type 1TT600, Q801 type FRB829 and Q802 type FRB828B.

A disconcerting fault is the width varying in and out on odd occasions. While this can be due to the line output transformer, it's usually the scan coils playing up.

In conclusion, it's good to do two things to save yourself future headaches. Use only correct Sony replacement parts, including transistors, and spray a very thin coat of circuit varnish on any joints you've soldered.

Long-distance Television

Roger Bunney

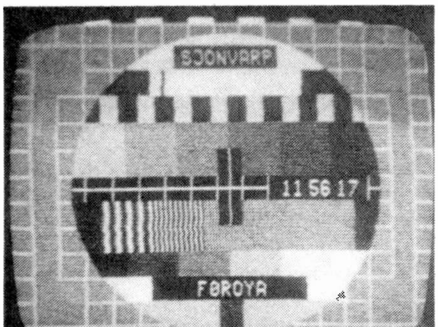
Despite a few quiet days there was some dramatic reception during June. Tropospheric activity was high on the 8th and 9th, with reception from Denmark, Norway, W/E Germany and the nearer continental stations. There were two unusual events on the 8th: Cyril Willis (Cambridge) received Denmark chs. E3 and E4 and Ryn Muntjewerff (Holland) received the new Faroe Islands service on chs. E6 and E9. The signals from the Faroes, over a long sea path, were of fair strength and were present between 0915-1045BST. Congratulations to Ryn on this European "first" – the photograph shows the quality of the reception. On the 9th a large number of Swiss Band III/u.h.f. stations were received as far as the central Midlands: during the evening strong Luxembourg ch. E7 signals were present till closedown.

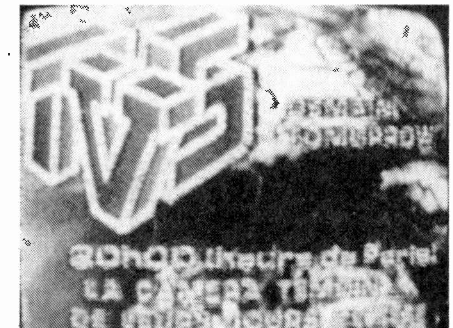
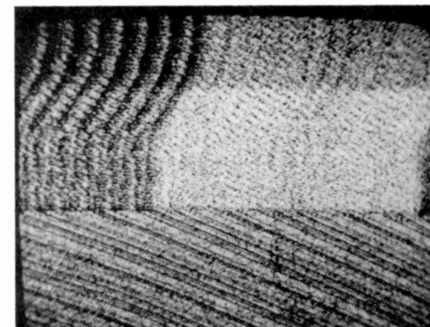
SpE also produced some dramatic reception. The following log collates reports from a number of UK DXers – unidentified signals have been omitted.

6/6/84 TVE (Spain) chs. E2, 3, 4.
7/6/84 TSS (USSR) R1, 2; RAI (Italy) IA; JTV (Jordan) E3 at 1710; EPT (Greece) E3; JRT (Yugoslavia) E3. An unidentified Arabic E2 station was logged at 1520-1635.
8/6/84 TSS R1, 2, 3, 4, 5, 6 (ch. R6 is in Band III); RTS (Albania) IC; RTVE (Spain) E2, 3, 4; ORF (Austria) E2a; +PTT (Switzerland) E2, 3; RAI IA, B; JRT E3; MTV (Hungary) R1, 2; DFF (East Germany) E4; Italian free station "Antenna Sicilia" (ch. not specified); CST (Czechoslovakia) R1, 2. An intense opening – also many unidentified signals!
9/6/84 TSS R1, 2; CST R1; TVP (Poland) R1, 2; MTV R1, 2; TVR (Rumania) R2; DFF E4; ARD (West Germany) E2; RAI IA; +PTT E2, 3; TVE E2, 3, 4; NRK (Norway) E2, 3; RUV (Iceland) E4.
10/6/84 JTV E3; JRT E3; RAI IA, B; TVE E3; TSS R1.
11/6/84 TVE E2, 3; RAI IA, B; ORF E2a; CST R1; SR (Sweden) E2.
12/6/84 TSS R1; SR E2; NRK E2; CST R1, 2; TVP R1, 2; JRT E4; RTP (Portugal) E2, 3; TVE E3, 4.
13/6/84 CST R1.
14/6/84 TVE E2; +PTT E2; TSS R1, 2.
15/6/84 TSS R1, 2, 3; TVP R1, 2; TVE E2; ZTV (Zimbabwe) E2 via TE.
16/6/84 CST R1; TVE E2.
17/6/84 RAI IA, B, C; JRT E3, 4; MTV R1, 2; ORF E2a, E3, E4; JTV Amman E3 (1305BST); ARD E2, 3; CST R1; NCT E3 (Italian free station – Udiñe).
18/6/84 TSS R1, 2; TVP R2; CST R1, 2; TVE E2, 3, 4; JRT E3; ORF E2a, E4; suspected Iran E2 FUBK test card with digital clock and white lettering at 1316BST; RAI IA, B, C; ARD E2, 4; ZTV E2 via TE.
19/6/84 TVE E2, 3, 4; TVP E3; RAI IA, B; JRT E3; MTV R1; ARD E2; ZTV E2 via TE; +PTT E2.
20/6/84 TVE E2, 3, 4; TSS R1, 2; TVP R1; RAI IA; RTP E2, 3.
21/6/84 NRK E2, 3, 4; SR E2, 3, 4; TSS R1, 2; ORF E2a; TVE E2, 3; RAI IA; TVP R1.
22/6/84 CST R1, 2; ORF E2a, 3, 4; RUV E4; TSS R1, 2: RAI IA; CBC Canada!
23/6/84 RTP E2, 3; TVE E3.
24/6/84 TSS R1, 2; NRK E2; SR E2.
25/6/84 TVP R1, 2; RAI IA; TSS R1; CST R1, 2; SR E2; EPT E3; unknown free Italian station "Studio 2 Italy".
26/6/84 TSS R1, 2; TVE E2 and TVE-2 E2; RAI IA.
27/6/84 RAI IA, B; TVE E3; +PTT E2; SR E2; TVP R2; Iran E2 at 0900, FUBK card with digital clock.
28/6/84 MTV R1; EPT E3; TVE E2.
29/6/84 RAI IA.
30/6/84 CST R1, 2; TSS R2; TVR R2; ORF E2a, 3; JRT E3, 4; EPT E3; RAI IA, B; TVE E2, 4; unidentified Arabic religious programme at 1100BST on chs. E2/4, possibly Egypt; CBC chs. A2/3 with weak video at 2120-2145, identified by programme sound.
4/7/84 RAI IA; EPT E3; TVE E3.
6/7/84 TVP R1; TSS R1, 2; TVE E2, 3, 4; RAI IA, B.

A remarkable log, with the once rare Greek ch. E3 (Akarnaika) becoming commonplace. This year certainly seems to be a good one for reception of Arabic stations: Iran was received in May and there've been a couple more possible sightings; Dhahran (Saudi Arabia) Aramco TV was logged by Ryn Muntjewerff on May 23rd – as a floater to JTV Amman between 1403-1550BST!

Perhaps the most dramatic reception was on June 22nd when system M, 525-line signals were received on chs. A2, 3, 4 between 1545-1605BST. Don Bassnett (Glasgow) received all three channels; Paul Barton (Harrogate) received ch. A3, which was undoubtedly the best signal – "Sesame Street" followed by the CBC news and at the end of the headlines the identification "this is CBHT Halifax". I've heard Paul's sound cassette and the quality is remarkable. A second Canadian signal is present but unidentifiable. The ch. A2 signal provided the identification caption "NTV" at 1600, but my WTFDA guide gives no clue as to its location. Can anyone help with this one? The ch. A4 signals were much weaker and couldn't be



Left: Torshavn, Faroe Islands ch. E6 received by Ryn Muntjewerff (Holland) on June 8th via tropospheric propagation. Centre: Typical ECS/TV5 reception at 12GHz by Chris Wilson using the set-up shown in Fig. 1. Right: Appearance of home computer interference with programme, as radiated in Band I (photo from Robin Crossley).

identified. Don uses an Hitachi Model CMT2060 with PAL/SECAM/NTSC-system M switching: Paul uses a more conventional 625-line receiver and locked the video with reduced height. Congratulations to them both!

With Band III SpE on the 8th, the Faroe Islands via tropospheric propagation and Arabic signals in abundance, a very rewarding month! My thanks to the following for sending in reports of their reception. Graeme Wilson (Nunthorpe), Don Bassnett (Glasgow), Paul Barton (Harrogate), Cyril Willis (Cambridge), J. Bray (St. Neots), Simon Hamer (Powys), Bill Cotterill (Tipton), Tony Privett (Basingstoke), Iain Menzies (Aberdeen), Arthur Milliken (Wigan), Hugh Cocks (Sussex), Dave Shirley (Hastings).

News Items

South Africa: Bop-TV, the Bophuthatswana TV service, is now operating with reduced coverage. The authorities were displeased about enthusiastic reception in Soweto and Johannesburg – the programmes are uncensored and include American films and national/international news.

France: Three free TV stations are in operation in the Paris area – Canal 24, TIME and Antenne 1. The transmission times are irregular and the technical details unknown to us at present. French Canal Plus signals have been logged on ch. E29, thought to be from either Maubeuge (3·2kW e.r.p.) or Dunkirk (200kW e.r.p.) and causing co-channel interference with Goes, Holland. The identification "CDM BCH" on the French test pattern indicates origination from the main switching station at Butte Chaumont, Paris.

DX Publications: Mention of a booklet by Simon Hamer was made in the July column. This and the journal of the North England Radio Club International are no longer available.

Eire: New radio and TV transmitter lists are available on request from RTE, Reception Investigation Department, Dublin 4. The new Band III channel J (vision 223·25MHz, sound 229·25MHz) is at present being used by two low-power relays (Rosscarbery and Listowel) for RTE-2. It will also be used by the 100kW Kippure main transmitter which is undergoing tests and is expected to be brought into service by mid-1985.

EBU Listings

W. Germany: Neumuenster ch. E28 NDR-1 now 500kW e.r.p.

Belgium: Profondeville ch. E49 H RTBF-2 200kW e.r.p.; Brussels ch. E56 H RTBF 1kW e.r.p. – this station carries the TV5/ECS French language downlink signals.

From our Correspondents . . .

Robin Crossley (Dunstable) now works for a well-known UK satellite firm. Using a SAT-TEL receiver, he's successfully received all the available 12GHz downlink channels from ECS and Intelsat. This receiver is quite popular, its microcomputer control system being able to select the different bandwidths, audio subcarriers and pre-emphasis systems at present in use. Following a move, Robin has renewed his DX aerial system. This now consists of an Antiference XG14W with Schrader tunable head amplifier, an eight-element wideband Band III aerial and a three-element wideband Band I array. Like others, Robin is suffering from computer interference.

Nick Harrold (Rochford) is making good progress with

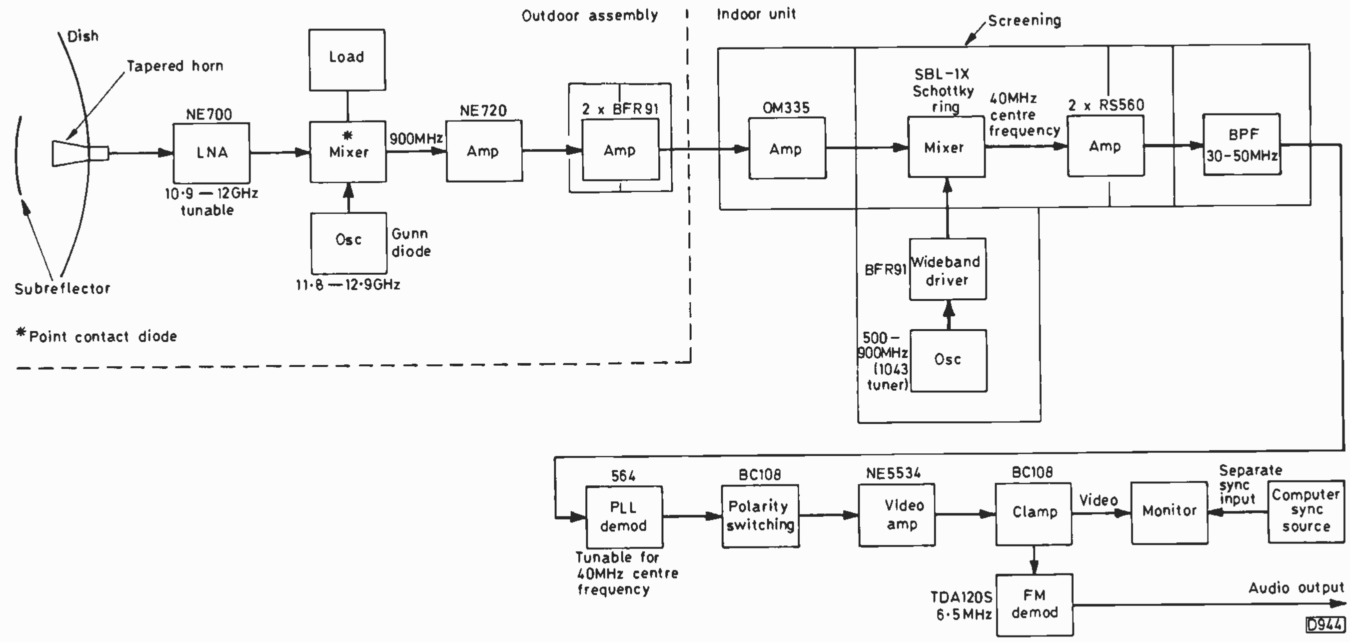


Fig. 1: Block diagram of Chris Wilson's present 12GHz satellite receiver system.

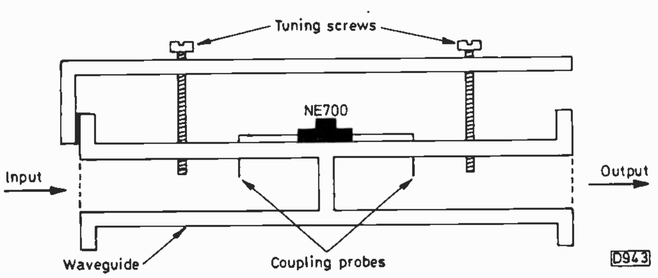


Fig. 2: Outline of the single-stage LNA.

his 12GHz receiver system, using a 10ft dish and no LNA. Six ECS transponders have been identified – Sky Channel, PK5, RAI, Teleclub, TV5 and ZDF.

Interference

Several enthusiasts have sent in reports indicating that interference from home computers is a growing problem. We are still awaiting replies from Sinclair and other firms/organisations approached. A local Spectrum here can be resolved, over a distance of 120ft via my aerials at 53ft, sufficiently well to be able to recognise and identify specific programmes being displayed and activity thereon – the video information is positive-going. The output is particularly high at 78·4MHz – try this if you wish to view information displayed on neighbouring Spectrums! I'd appreciate any further reports and observations on this problem.

Another problem that causes heartache in some areas is the 49MHz cordless phone. One version operates at 1·6/49MHz (1·6MHz base unit). The situation could become worse: apart from the DTI's proposal for a "low-power device band", the US FCC has approved a new type of cordless phone operating in the 46/49MHz band. The 1·6 MHz type is to be withdrawn since the FCC intend to extend the medium-wave band to 1·705MHz. In the UK we could well find 1·6/49MHz units being dumped at cheap prices. The 46/49MHz equipment will have ten base frequency channels between 46·61-46·91MHz with a matching ten handset channels between 49·67-49·97MHz and a predicted range of "three blocks", though larger aerials would increase this. The new channels are to come into operation on October 1st. Five of them correspond to the cheap walkie-talkie unit channels. New models are already appearing, one manufacturer claiming a 1,500ft range with indoor aerials extending to much greater distances with external ones.

David Moller (Eastbourne) has written in about another source of interference. The problem started with streaking on his ch. E37 pictures from Boulogne – regular bursts of streaking flashing on and off throughout the day and night. The source of the trouble was found to be radar pulses used for coastal surveillance. It can be largely eliminated by using a ch. E36 notch filter. Radar interference in the Southampton area originates from two sources, one at St. Boniface (high on the down above Ventnor, Isle of Wight) and the other at an airfield at Boscombe Down near Salisbury. The latter operates during daylight/flying times only.

12GHz Receiver System

Chris Wilson has sent in an impressive shot of TV5 reception via ECS and has provided details of his present receiver set-up (see Figs. 1 and 2). A 1·8m diameter fibreglass dish with focus at 70cm is used, with a subreflector and a five inch tapered feedhorn (this arrangement gives a 4dB gain compared to a "normal" system with the horn at the focal point of the dish). The dish is on a polar mount which can be swung from 60°E to about 35°W. The LNA and first converter are mounted at the rear of the dish. The LNA consists of a single stage using an NE700 gallium arsenide f.e.t. mounted on WG18 waveguide. The Gunn diode oscillator operates above the signal frequency, an arrangement that seems to be better when an LNA is used. The output from the head unit is at 900MHz.

The indoor section is fairly conventional except perhaps for the second conversion to 40MHz. The incoming sync is phased with a computer sync source to provide improved locking – a ZNA234 sync chip is awaited to replace the computer derived sync pulses. At the time of writing (late June) reception includes Sky, RAI, West Germany, Teleclub and PK5 (RAI and Teleclub with sound). The coverage is 10·9-12GHz.

Service Bureau

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RANK T22 CHASSIS

There's severe EW distortion, the sides of the raster being bowed in. An earlier fault was no raster due to one of the EW modulator diodes 5D6 being short-circuit. The fault may have been present before this was replaced.

The area in which the fault lies can be determined by disconnecting 5L2 to remove the EW drive. If the fault remains, check the EW modulator diodes 5D6/7, ensuring that neither is leaky. If the width decreases, check the EW driver transistors 4V17/18 and if necessary find out why they are hard on.

MITSUBISHI CT200B

The fault consists of a line of increased brightness that moves slowly up or down the screen. Otherwise the set works well.

This sort of thing is normally caused by a 50Hz hum waveform getting into the signal stages. While there could be a fault in the power supply (smoothing etc.) it's more likely to be coming in on a high-impedance tuning line, i.e. via the a.f.c. or programme selector circuits. This can be proved by using a capacitor of say 0·1μF to decouple the tuner's tuning voltage pin. Hum can also be picked up by badly-dressed leads or cableforms.

BUSH A640 CHASSIS

This set is plagued by intermittent instability: every few minutes the vision signal is lost (raster o.k.) and the sound signal is severely reduced. This is accompanied by a whining noise that starts at a low frequency and rises over a second to a constant high pitched sound. Light tapping around the i.f. stages clears the fault for a while but won't instigate it.

Make sure that the earth bonding of the i.f. panel is good and that the mounting screws are tight. Clean the system switch contacts or solder them in the 625-line position. If necessary check the earth bonding of the i.f. lead from the tuner to P/S1 then check the decouplers associated with each i.f. stage – 2C18, 2C19 and 2C27.

G8/VCR COMPATIBILITY

The problem with this Philips G8/Ferguson 3V23 VCR combination is buzz on sound, with no effect on the picture, i.e. no sound on vision. It gets worse the longer one watches. The problem arises with prerecorded tapes or tapes recorded on the machine. Slight improvement can be obtained by fine tuning the VCR, but the colour drops out.

This is a common problem when a G8 is used with a VHS machine. If retuning the sound detector coil in the set fails to provide a cure the VCR's modulation level will have to be reduced.

SONY SL8000UB

The original fault was failure of the keys to latch. This was cured by replacing a broken drive belt. The problems now are that the record key won't press down with play, the clock is stuck at 12·00 and the timer LED is flashing.

For the record fault, check that the safety tab activator is operational. If it's jammed, the machine will think the cassette has had the recording safety tab knocked out. The clock problem could be due to the timer control i.c. (IC3101, μPD552C-011) but is more likely to lie in the timing switch system, e.g. D3104 in the clock set line or a panel problem.

ITT CVC40 CHASSIS

The fault on this set is wavy verticals affecting only the top three inches of the screen. It's most noticeable with a lamp post, telegraph pole etc. which will have a kink at the top. Turning down the brightness, colour or contrast control setting straightens the lines but the brightness is affected. The lines also straighten on picture fade outs.

There seems to be something wrong with the e.h.t. regulation. The trouble could well lie in the earthing of the tube's Aquadag coating – this is done via the base panel. Alternatively check R39A (220kΩ) in the beam limiter circuit. If necessary check the value of the sync separator bias resistor R703 (2·2MΩ) on the sync/line oscillator module (CMS40).

GEC 2028

The fault with this hybrid, dual-standard colour set is foldover (a shadow) that extends about half-way across the screen from the left-hand side. It was intermittent to start with but is now permanent. The linearity does not seem to be affected.

Start by disconnecting the line shift coil L5. If this cures the problem it probably has short-circuit turns. If not, check the line oscillator supply smoothing electrolytic C68 then the shape of the line drive waveform. If these and the PL509 line output valve are o.k., the line output transformer could be faulty. Before condemning it, check the tuning capacitor C83 (200pF) and the damping components C82 (180pF) and R59 (1·5kΩ).

HITACHI NP8C CHASSIS

There's sound distortion, of an intermittent nature. Bass or loud passages are badly affected while some newsreaders, especially female, are at times barely intelligible.

Slight adjustment of the quadrature coil L402 might well clear the problem. If not, check whether the 11V zener diode ZD401 in the audio coupling network is

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leaky. Alternatively the audio output stage thermal fuse TF401 could have developed high internal resistance.

GRUNDIG 6011

The field scan is distorted, with bowing at the top and bottom – the top curvature is greater than that at the bottom.

A very common cause of this symptom is failure of C475 (0·27μF) in the NS correction circuit. If necessary check for dry-joints around the NS correction transductor PTC1 and its associated components.

TEST CASE

261

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

It's some years now since the TV setmaking division of the Rank Organisation shut its doors for the last time. Many of their products are still with us however, and it's interesting to speculate about what RRI would have been up to had they survived. Bush and Murphy TV sets are not difficult to service (we refer of course to the original Rank products) though some of our field technicians are none too familiar with them. Those we service are "adopted" as it were, since we never had a Bush or Murphy dealership. Hence this month's saga . . .

The cry for help came via the telephone, to the effect that a Bush Model BC6340 (T20A chassis with 22in. tube) had failed completely after several stop-and-start sessions over the previous week. After a hurried conflab between the Resident Workshop Sage and the lucky field man assigned to the job, he was sent off with a circuit diagram, the means of making a 910Ω resistor, some BYX71 diodes and a TBA950 chip. In the event, none of this was of any use whatsoever! On site he found 200V at one end of the h.t. fuse 5FS1 on the line output stage panel and nowt at the other.

His first move was to insert a meter switched to the 0-1A d.c. range across the fuseholder, disconnect the tripler and switch on – then off again quickly as the meter's pointer hit the right-hand stop! The performance was repeated after open-circuiting the line driver transistor's fusible collector feed resistor to remove the line drive. Again there was a high current reading. A resistance check across the BU208A line output transistor then revealed that it was virtually short-circuit. Thinking that his troubles were over, our technician replaced the fuse and the transistor and reconnected the link on the fusible resistor. Switching on with a flourish, he was mortified to hear a momentary "squegging" noise from the line output stage followed by a resounding silence . . .

Meter checks showed that the fuse was this time intact, with normal voltage at the collector of the BU208A. The EW modulator diodes were removed and tested but proved to be o.k. The not-to-be-recommended strategem of disconnecting the protection transistor 5VT2 made no difference to the symptom. A scope check at the collector of the line output transistor produced a trace of a decaying burst of line-rate waveform at the output transistor's collector at each switch on. It's at times like these that a man resorts to his radio-telephone (swank!) and consults his Resident Workshop Sage. Summoned to the reception office where the RT base station lives, RWS spoke thus: "Connect a 10W, 5·6kΩ resistor across the kick-start capacitor 4C19, then check the oscillator, driver and output stages with your scope – look out for fireworks if you leave the overvoltage protection disconnected."

There were no fireworks, but there was now some line drive. Pulses at the TBA950's output pin and pulses at the collector of the line driver transistor. No line output transformer activity though, and no current through the line output stage h.t. fuse. There was 200V at the collector of the line output transistor but not a bean at its emitter.

The diagnosis was made without any further reference to the RWS, but the technician had to return to the stores to obtain the necessary spare part. Not something you use every day, but something he should have taken along with him. What was it?

ANSWER TO TEST CASE 260
– page 561 last month –

The tale related last month is typical of many caravan TV installations we encounter during the holiday season. The set in question, a JVC CX500GB, is rated at 17W when operated from a 12V d.c. supply, representing a current drain of just under 1·5A. Between the car's battery and the TV set's 12V supply point there were three sets of plugs and sockets, two fuses and two sets of switch contacts. The caravan's internal wiring had been extended and adapted by somebody, using 2A mains flex. All these added up to a series resistance of perhaps 1·5-2Ω, insignificant in most mains installations but crucial in a low-voltage circuit. Two ohms will produce a voltage drop of 3V at 1·5A, and this is quite enough to upset the operation of the voltage stabiliser within the set. Unusually for a colour set, the CX500GB's series regulator produces an output at 10·7V.

Meg's tap incorporated an electric pump to raise water from the floor-level tank, and this took a fair gulp of power via the same path as the TV set. This and the lighting system between them drew sufficient current virtually to stop the TV set from working.

The cure was to reduce the series resistance by rewiring the caravan properly with 60A cooker cable, and perhaps to provide separate leads for the various appliances. We also sold Andra one of those wideband TV aerials with a sucker mount and universal joint – the one he had on the pole was a group B type, rigidly vertical and quite useless for Heathfield or Walmington.

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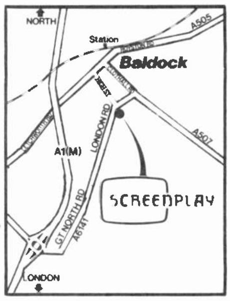

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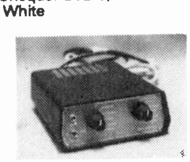

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Thorn 8800, 9000, 9600, touch tune sets etc.	£25	£40
Bush 720's, Philips G11, ITT CVC 35	£50	£70
Pye 18", 22"	£16	£26
GEC Solid State, all types	£16	£28
Japanese, Hitachi, National Panasonic	£15	£28
ITT CVC 5/8/9	£14	£28
Decca Broadford	£10	£20
GEC/Pye Hybrid	£5	£10

Mono in batches of 20 at £200
SPECIAL OFFER! Thorn 3500 26" £5
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Other makes available on request. Discount for quantity.
★ Tubes tested all sizes at £8.00 each
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T.V. PANELS T.V. PANELS T.V. PANELS T.V. PANELS

MAKES	POWER W	POWER N/W	LINE W	LINE N/W	TIBASE W	TIBASE N/W	VIDEO W	VIDEO N/W	DECODER W	DECODER N/W	CONVERG W	CONVERG N/W	IF W	IF N/W	TRIPLER WORKING
Thorn 3500	6	3	6	3	4	1.50	4	1.50	3	1.50	4	1.50	4	1.50	2.50
Philips G8	6	2.50	12	6	6	3			6	3	6	4	4	2	2.50
Pye S/S	8	6	15	10	5	3			10	5	6	3	10	5	3.00
GEC S/S	6	4	11	8	5	3	5	3	5	3	4	3	10	8	3.00
Decca (H)	6	3			6	3			8	4	4	2	3	1	2.50
Pye (H)	8	4	8	4	4	2			6	3	4	2	3	1.50	2.50
GEC (H)	6	3			6	3			6	3	4	2	3	1	2.50

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IN 4004 4p
IN 4005 4p
IN 4006 4p
IN 4007 5p
IN 4148×40 £1
IN 4448×40 £1
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IN 4751 10p
IN 5235 10p
IN 5254 10p
IN 5349 10p
IN 5392 10p
IN 5928B 10p

IAV 30 10p

IM 72Z55 10p

IR 106a 20p
IR 3051 10p

IS 164 10p
IS 921 10p
IS 3011a 10p
IS 3072a 10p
IS 5024a 50p
IS 5030 50p

ITT 921 10p
ITT 923 10p
ITT 1075 10p
ITT 2001 10p
ITT 2002 10p
ITT 4150 10p

ZE 1.5 10p

ZF 3, 3.3, 4.3, 10, 11, 12, 15, 33, 43, 47, 82 10p

ZPD 3.9, 4.7, 5.6, 10, 47 10p

ZPY 8v2, 12, 16, 24, 43, 47, 56 10p

ZTK 22 10p
ZTK 33 10p
ZTK 33a 10p

ZW 13 12p
ZW 27 10p
ZW 4-3 10p
ZW 310 10p

ZX 68 30p

ZY 47 10p
ZY 72 10p

AA 113 10p
AA 119 8p
AA 144 10p

BA 102c 10p
BA 157 8p
BA 159 8p
BA 173 8p
BA 182 8p
BA 201 8p
BA 202 8p
BA 243 8p
BA 248 8p
BA 316 5p
BA 318 5p

BAV 10 10p
BAV 21 10p

BAW 21 10p

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BB 105A×12 £1
BB 105B×12 £1
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BB 121a 10p

BRC 83c13 10p

BZX 46c22 15p
BZX 61 9-1 6p
BZX 61c110 6p
BZX 61c20 10p
BZX 61c30 10p
BZX 61c220 10p
BZX 70c6v2 8p
BZX 70c12 20p
BZX 70c33 8p
BZX 79c3v9, 4v7, 5v1, 5v6, 6v2, 6v8, 7v5, 11, 12, 30, 47 10p each
BZX 83c4v3, 5v6, 8v2, 12, 13, 24, 27, 33 10p each
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R 2265 50p
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R 2306 50p
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R 2396 50p
R 2461 80p
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TIP 29 20p
TIP 30 35p
TIP 30A 35p
TIP 30B 40p
TIP 30C 45p
TIP 31 30p
TIP 32 25p
TIP 33B 50p
TIP 33C 70p
TIP 34A 50p
TIP 34B 60p
TIP 34C 70p
TIP 35B 50p
TIP 35C 70p
TIP 35D 80p
TIP 36 50p
TIP 36C 70p
TIP 41B 40p
TIP 41D 70p
TIP 42/BRC 6109 30p
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TIP 57 30p
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TIP 102 30p
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TIP 125 35p
TIP 130 30p
TIP 131 25p
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SENDZ COMPONENTS

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- 8000/8500/9000 chroma panel £15
- 8800 convergence panel £6
- 8500 convergence panel £6
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- 4000 Chroma £20
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5×3	50 ohm	50p
5×3	35 ohm	70p
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7×3	16 ohm	£1.00
5" dia	16 ohm	£1.00
5" dia	8 ohm	£1.50
6½" dia	4 ohm	£1.50
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2¾" dia	8 ohm	75p
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KT3 speaker		75p
3" dia	15 ohm	60p

K30
- OF-550 10p
- OF-513 10p

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- BY 133 10p
- BY 134 10p
- BY 164 50p
- BY 176 25p
- BY 179 40p
- BY 184 25p
- BY 187 10p
- BY 190 40p
- BY 196 30p
- BY 198 10p
- BY 204/4 8p
- BY 206 8p
- BY 208/800 8p
- BY 210/400 5p
- BY 210/800 10p
- BY 223 60p
- BY 224/600: 4.8A/600v bridge 50p
- BY 226 15p
- BY 227 15p
- BY 228 20p
- BY 229/400 30p
- BY 237 5p
- BY 238 15p
- BY 254 10p
- BY 255 30p
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- G11 Scan Coils £5.00
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- KT3 line OSC transformer £1
- KT3/K30 infra-red receiver head £3
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- KT3 receiver panel £8
- KT3 line driver transformer 50p
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- BTW 30/50 50p
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- BTW 92/800R £3
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- Field + Jungle panel for GEC 3133/3135 £1.50
- GEC 2110 line panel with transformer £7.00
- GEC 2110 tuner unit + IF Panel £12.00
- Pye/Chelsea Line op panel £12.00
- Pye 713 IF panel and tuner £7.00
- Pye 713 Chroma £10.00
- Pye/Chelsea Timebase panel with LOPTI £10.00
- Pye 731 Frame Panel £5.00
- Pye 731 Convergence Panel £5.00
- Pye 731 line O/P panel with transformer + tripler £12.00
- Pye 731 Chroma £10.00
- Pye 731 IF panel + tuner £10.00
- Pye 607/205 Line panel with transformer £10.00
- Pye CDA/205 panel £6.00
- GEC portable chassis + LOPTI 2114 New £4.00
- Thorn 1613/1713 chassis 9.75
- Hills 520 multimeter + case. 20,000Ω/volt, fuse diode protected + logic test facility. 10meg/1200 volt £19.50

NEW MULLARD TELETEX
- Decoder Panel (VM6230) £15.00
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- Panel 6330 £15.00
- G8 Tuner Unit + Panel £6.00
- G8 Convergence Panel (late type) £12.00
- G8 Line O/P Panel £12.00
- G8 Power Supply £6.00
- G8 6 Sloping PBU £8.00
- G8 IF & Chroma £12.00
- G8 Chroma £6.00
- G11 IF Detector £3.00
- G11 Selector gain module £3
- Complete CVC 825 Chassis (both panels) £40.00
- AEC V/Cap Resistor Unit UHF with IC SAS660 SAS670 £3.00
- Z714 RANK IF Panels 6MHz 1 I.C. SL437F £3.00
- Z909B RANK IF Panels Export 5.5MHz 2 I.C.'s TBA1205B TCA2705Q £2.50
- Z743 RANK IF Panel Export 5.5MHz 3 I.C.'s TBA750+SC9504P+SC9503P £1.50
- Pye G11 Front panel with transducer, pots, tuner pots, 6 pb switch+lead £5.00
- GEC V/cap VHF/UHF tuner and IF+ sound O/P PC 706B3 (Export) £12.00
- GEC Line O/P PC 659B3 £6.00
- GEC Power Supply (Export) £10.00
- G11 dynamic correction panel £6
- CVC 20 Front panel with sliders + mains input panel £4
- CVC 40 PUSH BUTTON ASSY with sliders: complete with lamp assy + pots £14
- CVC 5 Mains on/off + 5 pots £2
- Universal Focus. Fits Pye, Thorn and Decca Units.
- Large Type 75p
- Decca Small 75p
- KT3 Focus Unit 75p
- K30 Focus Pot 75p
- CVC 32 Focus Unit
- Focus Rod 25p
- G11 focus £2.00
- ITT Small for use with Split Diode 50p
- TV11 50p
- Remo TV12SP 50p
- TV13 50p
- TV14 50p
- TV18 60p
- TV20 £1.00
- TV45 50p
- Thorn 14/1500 rec stick 5p
- 16 Button Key Pad 1 to 0 + * + #+ 4 blank (Cherry) £3.00

TELETEX DECODER
- I.C. SAA 5051
- I.C. SAA 5042
- I.C. SAA 5030
- I.C. SAA 5020 etc. £18.00

DISPLAYS
- 4040 Clock £1
- 7seg Red LED 50p
- 2 digit LED 8.8 50p
- 2 digit LED ÷1.8 with panel + MC14511 £1.00

Condensers
- 470/16 6p
- 1500/16 20p
- 3300/16 20p
- 10000/16 25p
- 15000/16 50p
- 3300/18 20p
- 47/25 5p
- 470/25 5p
- 680/25 5p
- 1000/25 Radial 10p
- 1500/25 10p
- 3300/25 20p
- 4700/25 25p
- 5000/25 25p
- 3500/30 20p
- 470/35 6p
- 2200/35 25p
- 100/40 5p
- 220/40 5p
- 400/40 20p
- 1250/40 20p
- 1500/40 20p
- 2500/40 25p
- 1000/50 20p
- 1250/50 25p
- 2000/50 20p
- 3000/50 25p
- 3300/50 25p
- 4700/63 £1.50
- 250/64 10p
- 3300/70 50p
- .1/100 5p
- 1/100 × 10 30p
- 22/100 10p
- 4.7M/100 5p
- 470/100 20p
- 2000/100 70p
- 4700/100 75p
- 47/160 10p
- 800/160 50p
- .1/250 Pulse 5p
- G11 0.47/250 10p
- 2.2 250v 10p
- 3n3/250 A.C. 10p
- .33/250V 20p
- .39/250V 15p
- 4n7/250 tested 5KV 25p
- .91/250 35p
- .91/400 30p
- 22/250 15p
- 47/250 10p
- 100/250 20p
- G11 470/250V £1.75
- GEC600/250 60p
- 700/250 £1
- 800/250 40p
- 32/300 20p
- 4/350 5p
- 8/350 8p
- 12/300 10p
- 4.7M/350v 10p
- 16/350 25p
- 33/350 20p
- 50/350 10p
- 220/350 30p
- 300/350 40p
- 400/350 50p
- 10/375 10p
- 22/375 15p
- 220/385 75p
- 330/385 CVC 820HT 60p
- 0.1/400 15p
- KT3 E/W .39/400 20p
- .56K/400v 20p
- 4700pf/400 10p
- .22/400 10p
- 8/400 15p
- 33/400 20p
- 400/400 40p
- 394K/400V 20p
- 220/450 40p
- .47/500 25p
- 0.1/600 15p
- .047/600 15p
- 0.047/1000 10p
- 0.01/1000 10p
- 0.1/1000 10p
- .15/1000 20p
- .47/250V A.C. 10p
- .001K/1250 10p
- 0.0047/1500 10p
- .005/1500 10p
- .0105/1500 10p
- 1n8/1500 15p
- 2n0/1500 15p
- 2n2/1500 15p
- G11.11000/1500 15p
- .01/1600 15p
- G11.8200/2KV 15p
- 0.1/2KV 20p
- 10n/2KV 15p
- 3n9/2KV 15p
- 0.0015/2KV 10p
- 5n2/2KV 10p
- 6n2/2KV 15p
- 2n0/2KV 15p
- 2n2/2KV 10p
- 7500pf/2KV 10p
- 4n7/2KV 15p
- 8n2/2KV 15p
- 0.0082/2500 15p
- 150/3500 10p
- 1800/4KV 5p
- 4.7nf/5KV 10p
- 170/8KV 10p
- 180/8KV 10p
- 210/8KV 10p
- 1000/10KV 10p
- 210/12KV 10p
- 1000/12KV 10p
- 1200/12KV 10p

Switches and Miscellaneous
- Infra Red and Ultrasonic G11 Teletext Decoder Panel £30
- RANK & ITT Mains Remote On-Off Switch (720R) £1.50
- RANK & ITT Mains Remote Switch 2865 ohm £1.50
- RANK & ITT Remote Switch 2800 ohm £1.50
- G11 Mains Switch 50p
- 4 amp Mains Switch 25p
- GEC Mains Switch 4 amp 30p
- KT3 Mainswitch £1.00
- THORN Rotary Mains Switch 50p
- G8 Mains Switch 75p
- Thyristor 600/4 amp C106/2 24p
- G11 Preh Red LED P/Button for C.H. Change 20p
- RANK TOSHIBA Transducters TPC-2011 50p
- CVC 5 Mains on/off +250K+100K+500K+50K+500K Pot on Panel £2.00
- Thorn 12 or 24 volt battery convertor for portable colour T/V £12.00 Post £1

Multi-Caps
- 470/250 G11 10 for £15
- Thorn 3500
- 175/100/100/350v £1.75
- KT3/200/25/25/385v £1.00
- 300+300+150+100+50MFD 350V £2
- 47/220/350v 60p
- 150/150/100/100/100/320v £2.00
- 2500/2500/63v 50p
- 470/470/250v 50p
- 150/200/200/300v 70p
- 400/400/200v £1.70
- 300/100/100/16/275v £1.50
- 100/200/325v 40p
- 150/150/100/375v £1.50
- 300/300/100/32/32/300v 2.00
- 1500/2000/30v 50p
- Jelly pot Thorn 00D4/013 £3
- 150/150/100/100/320v £2.00
- 100/350 + 300/200/100/16/275v £2.00
- 300+300/300 £1.00
- 225+25/380 70p
- 200/100/100/350v £1.50
- 500/500/25v 50p
- 150/150/100/300v 75p
- 200/150/150/300v 1.00

ITT Panels
- ITT 8 & 6 Push Button Unit £1.00
- CMA 10 £2.00
- CMA 11 £2.00
- CMA 30 £2.00
- CMA 40 £1.50
- CMC 10/2 £5.00
- CMC 16 £4.00
- CMC 38 £8.00
- CMC 45 £1.50
- CMC 47 £1.00
- CMC 52 £15
- CMC 57 £6.00
- CMC 58 £8.00
- CMC 59 £8.00
- CMC 67 £3.75
- CMC 67/2 £4.00
- CMC 68 £4.00
- CMD 12 £10
- CMD 32 £5.00
- CMD 33 £5.00
- CMD 40 £5.00
- CMD 41 £5.00
- CMF 25 £2.00
- CMF 26 £2.00
- CMF 40 £2.00
- CMH 10 £1.50
- CMH 31 £1.00
- CMK 12 (untested) £4.00
- CMK 30 (untested) £4.00
- CMN 20 £1.50
- CMN 21 £1.50
- CMN 40 £1.00
- CMN 45 25p
- CMP 10 £2.00
- CMP 11 £4.00
- CMP 40 £2.00
- CMS 11 £2.00
- CMS 40 £2.00
- CMU 12 £10.00
- CMU 14 £8.00
- CMU 30 £7.00
- CMU 45 £7.00
- CMZ 30 £5.00
- GMA 90 £5.00
- GMC 120 £2.50
- GMR 64 £5.00
- TMN 2 £2.00
- VCA 20 £10
- VCA 21 £10.00
- VMC 26 £3.00
- VMC 34 £5.00
- VMC 44 + 45 £4.00
- VMC 51 £5.00

Hand Sets
- Transducer Hand Set Insert, crystal, transducer, SAA 1124 & lead £3.50
- 8 C.H. Ultrasonic GEC Full Remote C2014H/C2219H £15.00
- New Replacement for G11 Ultrasonic Full Remote £15.00
- Thorn 4000 insert with 7 buttons £5.00
- Decca RC 11 £14.00
- Decca RC 12 £14.00
- G11 Infra-red full teletext £19.00
- C11 Ultrasonic full teletext for G26c 674/02 and G22c 66/02 £16.00
- Philips, 2 button £8.00
- Rank, Infra-red £10.00
- Dynatron-Full remote CTV 62, 63, 64 £19.00
- Hitachi infra red handset £18
- Philips full remote KT3, 16C928/20C934; 7228/7324; K12 26C 797/1ST 66K 1826 £12.00
- G11, Full remote top button assy. £12.00
- G11, Full remote repair service (exchange unit) £12.00
- Philips infra red full remote 9 channel for 60 CP2605 £6.00
- Philips infra red full remote 12 channel for 60 CP2605 £12.00
- KT3-30 Push Button Kit £3.00
- KT3/K30 T/Text £15.00
- KT3/K30 Full remote £15.00
- KT3 Power supply £4.00
- Hitachi 8 button unit with resistor unit. Last year mod. £7.00
- GEC infra-red 2236-2026 £4.00
- GEC push pad hand set button blobs 10p each

SENDZ COMPONENTS

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Tuner Units

GEC or Hitachi 6 push button unit 2110 Conversion	£12
GEC 2110 V/Cap	£6
ELC 1043/06 (AEG)	£6
ELC1043/05 Mullard	£6.00
ELC1043 (Ex Panel)	£3.75
ELC1042 ,,	£5.00
ELC2000 ,,	£7.00
ELC2004	£10.00
ELC2006	£10.00
GEC Tuner V/Cap Hitachi After 1979 ET548, ET547	£10.00
U322 (UHF) ,,	£4.00
V314 (VHF) ,,	£5.00
U321	£6
U341 UHF	£7.00
U411 UHF	£7.00
U.V. 411 Tuner	£10.00
ELC1043/05 Thorn	£5.90
Small V/Cap Mitsumi UHF ,,	£4.00
VHF ,,	£3.00
G8 Tuner	£6.00
Portable & rotary Tuners Sanyo & Mitsumi UHF	£5.00
6003 Bush V/Cap Tuner	£10.00
NSF-UHF/VHF Varicap (old type)	£8.00
Mosfit UHF/VHF (new type)	£8.00
SONY 1400KV Tuner unit	£3.50
Thorn Tuner PANEL with 6×100K pots + cursors NO TUNER	£1.00
U321 on panel	£6.00
Tuner unit VHS Sylvania GTR Videon MTS 900	£2.50
Mullard Video Modulator. Application, video tape recorders, TV cameras, video games, closed circuit T/V, C.C.I.R. system. Data supplied.	£10.00
VT 100 Sound Tuner Kit. TV. Viosound. The latest design in low noise fitted with DNR, RF output and audio	£30.00
Sylvania UHF VHF F6013 (Fits Rank)	£6.00
Sylvania F6003	£6.00
Sylvania UHF F4720B	£6.00
Sylvania VHF 900	£6.00
Decca Bradford Tuner 5 Button	£4.00
Small Tuner DX 175-220MHz Auto Changeover	£5.00
9000 Thorn Tuner on Panel	£7.00
D.P.D.T. switch Black knob: Chassis or PCB mount	4p each or 40 for £1.00

THORN 1400 4P.B. Mech. Tuner	
THORN 1500 4P.B. Mech. Tuner	
THORN 1590 4P.B. Mech. Tuner	
THORN 3500 4P.B. Mech. Tuner	
THORN 8000 4P.B. Mech. Tuner	
THORN 8500 Mech. Tuner	£4.00 each

Delay Lines	
DL20A 80p	DL600 £1.00
G8 (Old Type)	£1
DL700	£1.00
UDL11	30p
KT 3 Luminence	75p
Luminance Delay Line (CVC 45)	
10×630ma fuse	25p
10×2A fuse	50p
10×3.15 fuse	50p
10×500mA	80p
10×1 amp	80p
10×1.6 amp	80p
20 3.15 AS Fuses	£1.70
Co-Ax Joint	15p
Co-Ax Belling Lee Plug	12p
Co-Ax Splitter	£1.00
UHF Modulator CCIR	£3.00
Infra Red Emitting Diode	20p
NE286H Small Neon Lamps GEC & Philips	5p
Mullard 5 Watt Amps. LP1162 New	75p

T.V. Tubes

12" A31/300 Hitachi	£10
15" A38/170W Hitachi	£8
18" Hitachi PIL tube with scan coils 470 KCB22-TC03	£25

Integrated Circuits

AC76003	£1.50
AM25LS23PC	10p
BAV40	40p

BFR39	15p
BFR52	7p
BFR79	15p
BFR81	15p
BFR87	10p
BFS60	10p
BRC-M-200	40p
BRC-M-300	50p
BRC 1330	75p
BTT822	£1.00
BTT6016	£1.20
BTT6018/ML237B	£1.50
BTT6218	£1.50
BTT8124	£1.00
BTT8224	£1.00
CA270AE	50p
CA270CW	50p
CA270CE	50p
CA920AE	£1.00
CA1310	50p
CA3065Q	50p
CA3089Q	50p
CA3094AE	50p
CA3123	40p
CA3146	£1.00
CA3189	40p
CBF16848	50p
CD4510	30p
DM7492	50p
HA1196	40p
HA1370	£2.00
HA11223	40p
HEF4001	10p
HBF4011AF	10p
HEF4053B	30p
M913	£2.00
M1024=SAA	£2.00
M1025=SAA	£2.00
MC476p	£1.00
MC1307	75p
MC1312	
MC1330	75p
MC1349	50p
MC1352	£1.00
MC1358	£1.00
MC14002	15p
MC14013	25p
MC14016	25p
MC14066	30p
MC14514	50p
MC1748	80p
MCM2114	75p
MEM4956	£1.00
ML231	£2.50
ML236E	£1.50
ML237B	£1.50
ML238B	£4.00
ML239	£3.00
MM5387	£1.00
MM5611	£1.00
MM5840	75p
N64100	£1.00
NE545B (Dolby)	75p
NE555P	60p
NE555	60p
IL-1	20p
OPT600	20p
OPT601	20p
SAA611	50p
SAA661	£1.75
SAA1020	£4.00
SAA1021	£4.00
SAA1024	£2.50
SAA1025	£2.50
SAA1073	£3.00
SAA1074	£3.00
SAA1075	£3.00
SAA1124	£2.00
SAA1130	£2.50
SAA1174	£3.00
SAA1176	£3.00
SAA1250	£3.00
SAA1251	£4.00

SAA1272	£3.00
SAA1276	£3.00
SAA5000	£1.50
SAA5000A	£1.50
SAA5012A	£5.00
SAA5020	£3.50
SAA5030	£5.00
SAA5040	£3.50
SAA5040A	£4.40
SAA5050	£3.50
SAF1032p	£2.50
SAF1039	£2.00
SAS560	£2.00
SAS660	£1.00
SAS670	£1.00
SL901B	£5.00
SL918	£6.20
TA7122	£1.15
TAA320A	50p
TAA470	£1.50
TAA570	75p
TAA611B	£1.50
TAA621	£2.00
TAA661	£1.75
TAA641	£1.50
TA7117	50p
TA7120P	50p
TA7315AP	50p
TA7607AP	40p
TA7609P	50p
TBA120A	40p
TBA120AS	50p
TBA120SA	40p
TBA120B	40p
TBA120SB	40p
TBA120SQ	£1.00
TBA120U	75p
TBA120Q	30p
TBA120C	40p
TBA1441	£1.00
TBA231	75p
TBA395Q	50p
TBA396Q	£1.00
TBA396	75p
TBA440P	£1.00
TBA1440C	£1.00
TBA480Q	£1.00
TBA520	£2.00
TBA530	£2.00
TBA540	£1.00
TBA550Q	£1.75
TBA560CQ	£2.00
TBA570	£1.50
TBA625	50p
TBA641	£2.00
TBA651	£2.00
TBA673	£1.00
TBA720A	£1.50
TBA750Q	£1.50
TBA780	£1.50
TBA800	50p
TBA810AS	60p
TBA810S	60p
TBA820	60p
TBA890	£1.00
TBA900	£1.50
TBA920	£1.50
TBA920Q	£1.50
TBA950	£1.50
TBA990Q	£1.00
TMS1000NL	£4.00
TMS1943 (clockchip)	£1.00
TMS9980	£4.00
TMS9901	£1.00
TMS2716JL	£1.00
TMS3529	£1.00
TMS4014	70p
TX-012	£1.00
TMS9902	£1.20
ULN2216	75p
SN29848	50p
SN29770BN	£1.00
SN29771BN	£1.00
SN29772BN	£1.00
SN7402N	£1
SN7472N	£1
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SN7472N	20p
SN75108AN	£1.00
SN76001	£1.00
SN76003	£1.00
SN76013ND	£1.50
SN76018	£1.00
SN76008	£1.00
SN76023N	£1.50

SN76033	£1.50
SN76110N	£1
SN76115AN	50p
SN76131	50p
SN76141N	£1.00
SN76226	£1.00
SN76227N	60p
SN76228N	£1.00
SN76270	£1.00
SN76532N	50p
SN76544N	£2.00
SN76545	£3.50
SN76546	£1.00
SN76550	30p
SN76552	30p
SN76570	£1.00
SN76620	50p
SN76650	50p
SN76660N	40p
SN76620AN	50p
SN76666	£1.00
SN76705N	£1
SN76707N	75p
SN76708AN	75p
SN76720	£1.00
UA783P3C	40p
BT100A/02	40p
BT138/10A	70p
BT146	30p
TBA540Q	£1.50
TCA270	£1.00
TCA270Q	£1.00
TCA640	£1.00
TCA660	£1.00
TCA270S	£1.00
TCA270SQ	£1.00
TCA740	£1.00
TCA800	£2.00
TCA830	£1.00
TCEP100	£2.25
TCE120CQ	£1.00
TDA440Q	£1.00
TDA1003A	£1.00
TDA1010	£1.00
TDA1060A	£1.50
TDA1072	£1
TDA1151	30p
TDA1170	£1.00
TDA1190	£1.00
TDA1327A	£1.00
TDA1412	50p
TDA2003	80p
TDA2004	£2
TDA2010	£1.00
TDA2140	£3.50
TDA2030	£2.00
TDA2525	£1.00
TDA2640	£2.00
TDA2522	£1.00
TDA2530	£1.50
TDA2532	£1.00
TDA2540	80p
TDA2541	£1.00
TDA2571AQ	£2.50
TDA2575A	£1.00
TDA2581	£2.50
TDA2590	£1.00
TDA2593	£1.00
TDA2560	50p
TDA2600	£5.00
TDA2611	£1.00
TDA2653	£1.00
TDA2002	£1.00
TDA2640	£2.00
TDA2680	£1.00
TDA2690	£1.00
TDA2593	£1.00
TDA3190	£1.00
TDA3560	£4.00
TDA3571Q	£1.50
TDA9403	£3.00
TDA3651AQ	£3
SN74LS 125AN	30p
SN74LS 248	50p
SIL4516	50p
SN16861NG	50p
SN16862AN	£1.00
SN16964AN	50p
SN29764AN	£1.00
UA721	40p
UA7300	40p
RGP30G	10p
MPSA14	10p
MPSA43	10p
MJ13005	30p
MJE51T	25p
MJE340	28p
MJE660	25p
MJE661	25p
MJE3055	£1.00

MJE2801	30p
MJE2955	50p
MJE13005	30p
Sanikron Diode SKE2G2/04	30p

Transistors

A1222	15p
A1223	15p
AC106	15p
AC121	15p
AC124	15p
AC128	15p
AC137	15p
AC151	15p
AC131	15p
AC138	15p
AC152	15p
AC153K	15p
AC142K	15p
AC169	15p
AC176	15p
AC176K	15p
AC178K	15p
AC179	15p
AC186	15p
AC187K	15p
AC188	15p
AC188K	15p
ACY21	25p
AD143	50p
AD149	50p
AD161/162	pair 40p
AF139	25p
AF181	£1.00
AF239	25p
AF367	25p
AL102	£1.75
BC161	30p
BD507	50p
BD509	30p
BD510	30p
BD517	30p
BD519	30p
BD534	30p
BD535	30p
BD544D	30p
BD562	30p
BD610	40p
BD646	50p
BD676A	30p
BD678	50p
BD681	25p
BD807	20p
BD826	50p
BD948	30p
BDX75	20p
BDX32	£1.25
BF115	20p
BF121	20p
BF127	20p
BF137	20p
BF157	20p
BF160	20p
BF161	20p
BF164	60p
BF179	30p
BF180	20p
BF181	20p
BF182	20p
BF184	20p
BF194	10p
BF195	10p
BF196	10p
BF197	12p
BF198	10p
BF199	10p
BF200	20p
BF222	10p
BF224	15p
BF238	20p
BF240	16p
BF244	40p
BF245b	20p
BF256	10p
BF257	20p
BF258	25p
BF262	15p
BF263p	25p
BF264	15p
BF271	10p
BF273	10p
BF274	10p
BF324	25p
BF337	50p
BF355	30p
BF362	20p
BF363	15p
BF367	15p
BF391	15p
BF394	10p
BF419	30p
BF423	15p
BF448	30p
BF450	20p
BF458	30p
BF459	30p
BF468	30p
BF469	30p
BF470	20p
BF480	50p
BF594	10p
BF597	10p

BF694	10p
BF758	30p
BF760	30p
BFT34	15p
BFT43	10p
BFT84	8p
BFW11	20p
BFX29	30p
BFX84	25p
BFY50	15p
BFY52	20p
BFY90	25p
BLY49	25p
BPW41	25p
BRC116	25p
BRX43	15p
BRX48X	10p
BRY56	30p
BSS68	10p
BSY79	10p
BSY95a	10p
BTY80	20p
BSX19	17p
BSX20	17p
FT3055	30p
TCE82	30p
2N930	5p
2N2221	8p
2N2222	8p
2N2906	10p
2N3055	40p
2N3566	10p
2N3702	10p
2N3711	10p
2N3583	50p
2N3904	15p
2N4355	10p
2N4442	£1.00
2N4444	£1.00
2N5296	40p
2N5983	30p
2N6099	40p
2N6109	40p
2N6130	50p
2N6133	20p
2N6348	20p
2N6399	10p
2X 2N6099 on heat sink	50p
2SA437	20p
2SB407 Sanyo TO3	10p
2SB474	30p
2SB566	10p
2SC381	10p
2SC458	50p
2SC515	10p
2SC732	10p
2SC733	10p
2SC1030	£1.00
2SC1172A	10p
2SC1173	10p
2SC1419	20p
2SC1546	20p
2SC1725	20p
2SC2068	20p
2SC2073	8p

2SC2122A	£1.00
2SC2229	15p
2SC7350	15p
2SD180 TO3 80v/6A	15p
2SD200	£2.00
2SK30A	10p
BC107	10p
BC108	10p
BC109	5p
BC113	10p
BC114	10p
BC115	10p
BC116	10p
BC117	20p
BC119	20p
BC125	10p
BC126	10p
BC139	10p
BC140	30p
BC141	25p
BC143	25p
BC147	10p
BC148	10p
BC149	10p
BC153	10p
BC154	10p
BC157a	10p
BC158	10p
BC159	10p
BC160/16	25p
BC171	10p
BC172	10p
BC173	10p
BC174	10p
BC183	10p
BC184	10p
BC204	10p
BC207	10p
BC212	10p
BC213	10p
BC214	10p
BC237	10p
BC238	8p
BC239	10p
BC250	8p
BC251	10p
BC252	10p
BC262	10p
BC263b	20p
BC294	30p
BC298	10p
BC300	30p
BC301	10p
BC303	30p
BC307	7p
BC308	7p
BC309	10p
BC327	10p
BC328	10p
BC328/338 pair	15p
BC337	10p
BC338	10p
BC347	10p
BC349b	10p
BC350	20p

BC365	10p
BC384	10p
BC394	10p
BC413	10p
BC414	10p
BC416	10p
BC440	30p
BC454	10p
BC455	10p
BC456	10p
BC460	25p
BC462	10p
BC463	10p
BC478	10p
BC527	10p
BC532	10p
BC546	10p
BC547	10p
BC548	10p
BC556	10p
BC557	10p
BC558	10p
BC559	10p
BC635	10p
BCX31	25p
BCX32/36 Pair	75p
BCX32	25p
BD116	25p
BD124	50p
BD124 (metal)	60p
BD130Y	25p
BD131	30p
BD132/238	30p
BD135	25p
BD136	30p
BD138	30p
BD176	25p
BD182	£1.00
BD183	70p
BD202	60p
BD204	60p
BD221	20p
BD222	30p
BD228	30p
BD226	20p
BD233	30p
BD235	30p
BD239	15p
BD243c	30p
BD244	50p
BD250a	30p
BD252	20p
BD253B	50p
BD331	20p
BD332	20p
BD373b	20p
BD416	25p
BD433	25p
BD437	25p
BD439	50p
BD501	30p
BF761	30p
BF858	30p
BF871	30p

Filters

5-5MHz	15p
6MHz	30p
BFU455K	5p

Thyristors

TD3F800	£1.50
BT106 Plastic	30p
BT106 Metal	£1.20
BT119	£1.00
BT120	£1.00
BRC4443	75p
G11 Thyristor	60p
Decca 80-100	60p
2N4444	£1.00

Thermistors

VA1104	50p
ITTP7266312	15p
PTH451 AOR	15p
PT37P Fits Pye & PT34	20p
Degausing Thermistor (fits most sets)	20p
GEC Double Thermistor	75p

BLY49	50p
I.C. Heat Sink	20 for £1
20×TO5 Heat Sink	£1.00
CVC 9 power supply board	£1.50
CVC 20/2 mains panel	£2.00
ITT Mains Filter .1/250v/	
CVC 20 to 45 chassis	50p
Pots 10 k with Switch	25p
Pots 47 k with Switch	25p
Mullard Surface Wave Filter RW 153P Colour TV Filter	40p
Mullard Surface Wave Filter RW 154 Colour TV Filter	40p
G11 Line Scan P.C.B.	£1.00
G11 Power Supply P.C.B.	£2.00

TV Crystals

4MHz
4.433-619
6MHz
8.867238
Large or small 50p each

GEC Power Panel	
TV106 Thermistor	
PT34 New	£1.00

I.C. Holders

DIL – DIL		DIL – QIL	
40 Pin × 4	£1.00	16 Pin × 10	£1.00
42 Pin × 5	£1.00	18 Pin × 10	£1.00
28 Pin × 5	80p	28 Pin × 4	£1.00
16 Pin × 10	70p	8 Pin × 10	50p
24 Pin × 5	75p	16 Pin G11	each 10p
14 Pin × 10	70p		
18 Pin × 10	80p		