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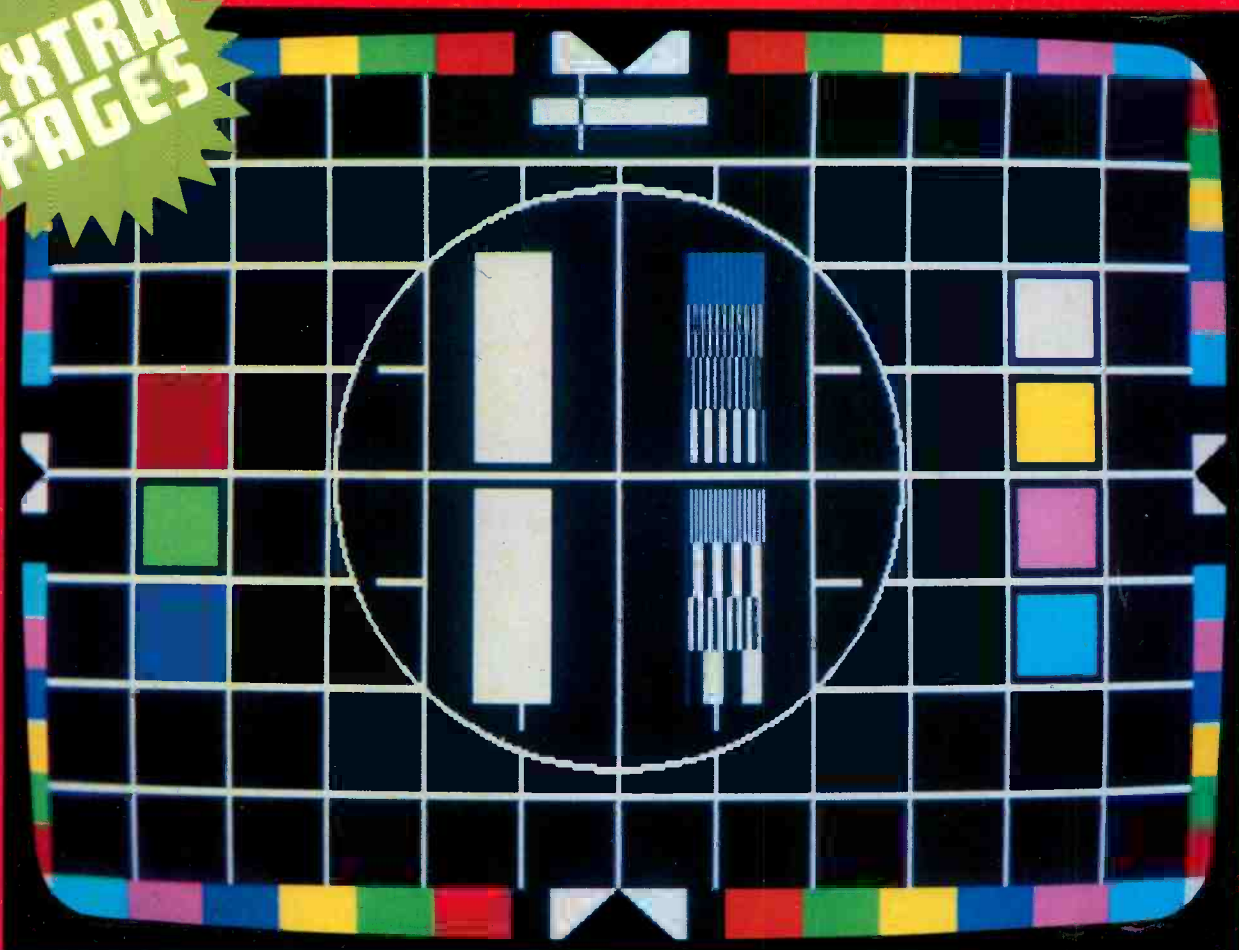
TELEVISION

SERVICING·PROJECTS·VIDEO·DEVELOPMENTS

NEW PROJECT
COLOUR TEST PATTERN GENERATOR (Part 1)

EXTRA PAGES



PROBLEMS WITH OLDER VCRs

CLASSIFICATION OF OSCILLATORS

VCR CLINIC • SERVICE BRIEFS

VINTAGE TV: THE MYSTERIOUS MULLARD

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THORN "VIDEOSTAR" 3V25/26 Nicad pack. Type VA214. Also suitable for J.V.C. etc. Brand new and boxed. **£20 each, 3 for £50.**

THORN "VIDEOSTAR" Nicad packs. Same as above but secondhand, untested. Contain **10 "C" size Nicads (HP11)** which can be replaced if necessary. **£10 each, 3 for £25.**

High quality **COAX PLUGS,** silver plated pin, grub screw fixing. **5 for £1**
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No more messy soldering. 24 pin I.C. sockets for **SL901** etc.
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0v7, 2v7, 4v3, 4v7, 5v6, 6v2, 6v8, 7v5, 27v, 30v. ALL 400mw.

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1.3 watt, 12v, 13v, 18v, 47v	
10 of one value	£1.00
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2.2µf 63v	20 for £1.00
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10µf 25v	20 for £1.00
22µf 16v	20 for £1.00
100µf 25v	20 for £1.20
160µf 25v*	20 for £1.50
330µf 25v	10 for £1.00
400µf 40v*	8 for £1.00
470µf 25v	10 for £1.00
470µf 35v	8 for £1.00
1000µf 35v	6 for £1.00
1000µf 40v*	5 for £1

*Axial. All others are Radial.

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100 Assorted Mullard C280's Cosmetic imperfects etc.	£2.00
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PACK OF EACH	£5.00

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1000µf 100v	60p
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2,200µf 63v	70p
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Comprises: Red and black meter leads with 12 interchangeable probes, clips, points, plugs etc with screw threads. **ONLY £2.95**

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Small **90p** Large **£1.20**

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PHONO PLUGS, metal with plastic tops. Red, grey or black.

20 of ONE colour	£1
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SS106 (BT106) **75p each** 3 for **£2.00**, 10 for **£5.50**

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5Ω, 10Ω, 20Ω, 30Ω, 50Ω, 100Ω, 200Ω, 1K. **8 of one type £1.00, 8 of each type £6.00.**

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¾" diam. Ideal for TV or Hi-Fi.
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TELEVISION

May 1984 **Vol. 34, No. 7 Issue 403**

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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this month

OUR NEXT ISSUE DATED JUNE WILL BE PUBLISHED ON MAY 16

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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

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
38 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

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		4028B	64	4070B	22	4512B	72	4541B	96
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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	40788	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
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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
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ECC81	1.08	EL34	3.50	PCF802	1.12		
ECC82	98	EL84	1.05	PCF805	1.80	PY88	81
ECC83	1.07	EL90	82	PCF806	1.30	PY500A	2.30
ECC84	80	EY86/7	68	PCF808	1.63	PY800/1	69
ECC85	98	EY500A	1.50	PCH200	1.45	UCH81	2.25
ECC88	1.35	EZ80/1	56	PCL82	1.20	UCL83	1.82
ECF80	80	GY501	1.45	PCL84	1.20	UY85	1.35
ECF82	88	GZ34	3.50	PCL86	92	PL802T	4.00
ECH81	1.60	KT66	8.50	PCL805	1.09	40KD6	5.30
ECH84	1.66	KT88	12.00	PD500	2.93	21LU8	3.00
ECL80	84	PC92	3.00	PFL200	1.86	17DW4A	1.60
ECL82	1.30	PC97	1.65	PL36	1.87	3AT2B	5.00
ECL86	1.99	PCC85	85	PL81	94	12BY7A	3.75
EF80	95	PCC805	1.40	PL83	1.43	12HG7	3.20
EF86	1.96	PCF80	1.00	PL84	84		

THER-MISTORS

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	10p
	0.1mF	
	0.22mF	
400V	0.01mF	10p
	0.1mF	
	0.22mF	

TANTALUM CAPACITORS

6.3V	47mF	38
	100mF	82
16V	10mF	20
	22mF	25
	47mF	94
25V	22mF	42
35V	0.1mF	12
	0.22mF	12
	0.47mF	12
	1mF	12
	2.2mF	15
	4.7mF	24
	10mF	52

CONVERGENCE POTS

3W/5R-6R8-10R-15R-20R 50R-100R-200R-500R — 60

METRIC CONVERGENCE POTS

PHILIPS G8 5R-10R-15R-20R-50R — 60

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DECCA 1700	9.00
DECCA 1730	8.58
DECCA 2230	8.58
GEC 2110	9.45
GEC 2040	9.50
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ITT CVC 1-9	10.85
ITT CVC 25/30/32	8.65
ITT CVC 20	8.60
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THORN 3000 SCAN	7.95
THORN 8000	11.33
THORN 8500	11.33
THORN 9000	10.65
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THORN 1691	9.68
THORN TX10	12.50
THORN 1615	9.75
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THORN 9800	23.00
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B+O (3000 EHT)	18.90

RECTIFIER TRAYS

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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)	2.07
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 (800/300V)	2.31
RBM A823 (2500/2500/30V)	1.66
RBM A823 (600/300V)	2.83
RBM Z148 (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
PHILIPS 320 400/400/200V	2.74
THORN 1591/1691 4700/25V	1.20

CAPACITORS AXIAL

Volts	Mfd	Price			
6V3	33	9	*63V*	1	12
10V	22	10		2.2	12
	47	10		4.7	12
	100	10		10	11
	220	15		15	12
	470	20		22	13
16V	33	11		47	19
	68	11		100	23
	220	16		220	37
	1000	27		470	49
	3300	53		1000	58
				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	66	*2000V*	0.0052mF	1.20
	0.47mF	98			

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	43.00
25" A63/200X	55.00
26" A66/120X	57.00
26" A67/120X	58.00
22" A56/500X	58.00
A51 570X	63.00
A56 510	58.00
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

SERVICE MANUALS (Zero VAT)

THORN 1590/1	3.00	VIDCO 3V22	22.50	PHILIPS G8 550	2.50
1615	2.50	3V29/30	32.00	G9	3.50
1640/1	4.50	DECCA 30	2.50	G11	3.00
9000	7.50	80	4.75	K30	3.00
9800	6.50	70/90	3.00	KT3	3.00
Tx9	15.50	100	4.00		
Tx10	18.50	110	3.50		

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

LOTS OF NEW ADDITIONS IN THIS ISSUE

P. V. TUBES

PLEASE NOTE OUR NEW ADDRESS – COME AND SEE US
104 ABBEY STREET, ACCRINGTON, LANCS.
TEL: 0254 36521/32611

HOW TO ORDER
ADD 65p per order P+P (U.K.). Heavier parcels e.g. cable, service aids, degaus. coils please allow £1.20 P+P (U.K.). Export orders charged at cost. First Class Mail is used whenever possible.

Goods are despatched on the day we receive your order. If for any reason we are out of stock we will try to inform you as quickly as possible. We try our best to give a speedy, fair and efficient service. As our regular customers know, orders telephoned in before 4 p.m. will be despatched the same day. V.A.T. invoice on request. Give us a ring – we'll give you service. Please ask if what you need is not listed – we will try to help. Prices are subject to change without notice.

SEMICONDUCTORS

AC107	35
AC126	30
AC127	32
AC128	32
AC128K	40
AC141K	39
AC142K	38
AC176	35
AC176K	35
AC186	41
AC187	38
AC187K	38
AC188	35
AC188K	39
AD143	82
AD161	54
AD162	54
AD161/62 MP	1.15
AF106	49
AF114	89
AF118	1.20
AF121	75
AF124	46
AF125	46
AF126	46
AF127	38
AF139	58
AF178	1.54
AF239	60
AL102	2.00
AU106	2.50
AU107	2.00
AU113	2.00
BC107	20
BC108	20
BC109	20
BC114	12
BC115	17
BC116A	16
BC117	30
BC118	24
BC119	36
BC139	28
BC140	32
BC141	26
BC142	30
BC143	31
BC147	13
BC148	9
BC149	12
BC157	16
BC158	16
BC159	15
BC160	25
BC161	28
BC170B	15
BC171	15
BC172	15
BC173	12
BC174	10
BC177	27
BC178	26
BC182L	9
BC183L	12
BC184L	14
BC186	18
BC187	18
BC204	10
BC208	13
BC209	10
BC212	9
BC212L	13
BC213	13
BC214	10
BC237	14
BC238	14
BC251A	18
BC252	12
BC261	18
BC262	18
BC300	50
BC301	53
BC303	33
BC307	20
BC308	25
BC323	99
BC327	18
BC328	18
BC337	18
BC338	18
BC461	30
BC547	13
BC548	13
BCX32	30
BCX34	27
BC549	8

BC550	7
BC557	8
BC558	9
BCY72	13
BD115	45
BD116A	65
BD124P	79
BD131	50
BD132	49
BD133	60
BD135	38
BD136	38
BD137	38
BD138	35
BD139	35
BD140	44
BD144	1.70
BD150	60
BD159	65
BD160	1.90
BD166	52
BD179	70
BD182	1.20
BD183	75
BD201	85
BD202	91
BD203	80
BD204	99
BD222	46
BD223	56
BD225	47
BD232	68
BD233	60
BD234	63
BD235	60
BD236	65
BD237	57
BD238	65
BD243	85
BD244	85
BD410	79
BD434	74
BD437	86
BD438	94
BD507	52
BD508	85
BD509	56
BD510	60
BD278A	81
BD517	60
BD520	75
BD526	62
BD535	82
BD536	91
BD696A	1.49
BD697	1.24
BD695	1.39
BD698	1.50
BD707	95
BDX32	2.10
BF115	38
BF117	36
BF125	26
BF127	47
BF154	23
BF158	18
BF160	27
BF167	24
BF173	22
BF177	52
BF178	46
BF179	28
BF180	39
BF181	39
BF182	36
BF183	29
BF184	36
BF185	36
BF194/394	16
BF195	16
BF196	16
BF197	16
BF198	18
BF199	21
BF200	35
BF224	25
BF225	20
BF241	25
BF256	55
BF257	28
BF258	25
BF259	35
BF262	84
BF263	75
BF271	24
BF273	24

BF274	24
BF336	36
BF337	41
BF338	41
BF355	56
BF362	68
BF363	72
BF371	30
BF392	35
BF422	34
BF423	46
BF435	35
BF457	35
BF458	43
BF459	43
BF460	86
BF462	86
BF469	46
BF470	66
BF597	10
BF757	54
BF758	54
BFR39	27
BFR40	30
BFR79	85
BFR90	1.74
BFT42	39
BFT43	39
BFW10	60
BFX29	40
BFX84	42
BFX85	30
BFX86	30
BFX88	46
BFY50	30
BFY51	30
BFY52	24
BFY90	95
BR100	34
BR101	45
BR103	83
BRC4443	94
BRC4444	98
BRX46	40
BRY39	56
BRY55	45
BRY56	57
BSW67	68
BSV57B	72
BT100	1.65
BT101	1.20
BT102/500	1.20
BT106	1.60
BT107	1.69
BT108	1.69
BT109	99
BT116	1.21
BT119	3.66
BT120	3.66
BT151/800	1.20
BU104	2.00
BU105	1.58
BU108	1.80
BU124	1.90
BU126	1.75
BU204	1.50
BU205	1.42
BU206	1.80
BU208	1.60
BU208A	1.65
BU208/02	2.10
BU326A	1.75
BU407	1.70
BU426A	3.07
BU500	2.30
BU526	2.46
BU508	3.20
BU806	1.40
BU807	2.94
BUW84	1.45
BUW91A	3.84
BUX84	1.50
E1222	40
MCR101	45
MCR220	1.50
MEO411	20
MJE340	68
MJE520	50
MJ3000	1.98
MPSA92	35
MR814	45
MR854	55
MR475	2.46
MR479	2.60
ON447	99
ON448	99

OT112	1.91
OT121	1.91
R2008B	1.90
R2010B	1.92
R2265	1.50
R2322	62
R2323	67
R2461	1.50
R2540	2.80
RCA16334	90
RCA16029	99
RCA16039	99
RCA16091	2.95
RCA16092	99
RCA16040	96
RCA16041	84
RCA16334	90
RCA16335	90
RCA16799	99
RCA16957	2.88
TIC45	90
TIC46	60
TIL32	65
TIL78	46
TIP29C	43
TIP30A	47
TIP30C	43
TIP31C	55
TIP32C	42
TIP33B	75
TIP34B	1.06
TIP41C	47
TIP42C	50
TIP47	70
TIP120	65
TIP2955	90
TIP3055	63
TIS91	21
TU106/02	1.80
2N696	21
2N918	82
2N2904	51
2N2905	28
2N3054	60
2N3055	60
2N3702	11
2N3703	10
2N3705	10
2N3706	10
2N3708	17
2N2904	30
2N5294	48
2N5296	48
2N5298	69
2SB337	1.86
2N5496	53
2N6107	75
2N6109	81
2SA715	1.98
2SC495	1.10
2SC496	1.31
2SC643A	1.50
2SC1096	1.72
2SC1172Y	2.20
2SC1173Y	1.69
2SC1306	2.73
2SC1307	3.00
2SC1449	1.67
2SC1520	68
2SC1678	2.67
2SC1909	2.90
2SC1953	1.44
2SC2028	1.82
2SC2029	2.60
2SC2078	2.90
2SC2091	1.34
2SC2166	2.73
DEC1	2.20
DEC2	2.20
THY15/80	2.20
THY15/85	2.20
BU208B	2.20

We will try to supply the original part when we can. Under certain circumstances we may have to supply an equivalent.

INTEGRATED CIRCUITS

AN214Q	3.91
AN240	3.84
AN318	3.98
AN262	2.45
AN301	5.15
AN715Q	3.97
AN6340	7.85
AN6341	4.45
AN6341N	5.10
AN6344	7.85
BA521	2.80
BA536	3.00
CA555	46
CA566	84
CA741	25
CA748	45
CA3065	1.80
HA1124	1.65
HA1151	3.89
HA1322	2.65
HA1342	2.49
HA1306N	2.60
HA1366WR	2.80
HA1392	3.95
HA11219	2.49
LA4031P	3.21
LA4032P	2.90
LA4102	3.37
LA4250	3.57
LA4400	3.05
LA4422	3.28
LC7130	5.93
LC7120	5.87
LC7137	5.50
LM1011	3.25
LM1340T	75
LM1303N	2.63
MB3712	1.95
MC1307	1.99
MC1310P	1.60
MC1327	1.70
MC1351P	2.93
MC1330P	90
MC1349	1.99
MC1350	1.50
MC1352	1.75
MC1358P	1.50
MC1495L	3.00
MC13002	3.90
MC14011BCP	66
MC14049UB	43
MC7742	1.35
MC7812	1.35
ML231	2.20
ETTR6016	
ML232	2.20
ML236	5.35
ML237	2.50
ML238	6.00
ML239	2.50
ML920	4.12
ML922	3.29
ML926	2.18
ML928	2.18
MM5387ANN	4.15
MM5402N	6.65
MRF475	2.50
MRF477	10.00
MSN5807	7.87
MS1513L	2.80
MS1515L	3.28
SAA1025	4.40
SAA1124	2.50
SAA1250	3.94
SAA1251	4.90
SAA5000	4.39
SAA5010	6.30
SAA5012	6.50
SAA5020	5.90
SAA5030	8.25
SAA5050	8.50
SAA3210	2.93
SAS560S	1.89
SAS570S	1.89
SAS660	3.25
SAS670	3.25
SAS580	2.90
SAS590	2.90
SL901B	5.50
SL917B	6.50
SL1310	1.80
SL1327Q	1.20
SL1430	1.25
SL1432	3.36
SL76544	2.05

SN76003N	2.49
=SN76013N	
SN76023N	2.00
SN76110N	1.15
SN76115N	2.27
SN76131N	2.00
SN76226DN	2.00
SN76227N	1.18
SN76532N	1.50
SN76533N	1.70
SN76033N	2.49
SN76544N	2.35
SN76650N	1.05
SN76660N	80
SN76666N	80
SN76530A	1.47
STK015	6.25
STK032	13.25
STK043	11.05
STK433	5.65
STK435	9.06
STK436	5.50
STK437	7.85
STK459	8.20
STK441	8.10
STK461	9.60
STK463	14.30
SW153	2.74
TA7050P	95
TA7051P	95
TA7063P	2.20
TA7074P	1.00
TA7108P	3.43
TA7120P	2.43
TA7129AP	3.76
TA7130P	1.93
TA7141P	95
TA7146P	4.67
TA7193P	5.67
TA7171P	1.85
TA7172P	1.85
TA7173P	1.85
TA7176P	2.50
TA7202P	4.27
TA7204P	3.77
TA7205AP	3.72
TA7208P	3.40
TA7210P	6.60
TA7222	2.42
TA7223P	3.74
TA7227P	5.98
TA7228P	5.98
TA7310P	2.78
TA7609P	4.39
TA7611AP	2.92
TAA300	58
TAA310	2.83
TAA320	2.00
TAA350A	60
TAA550	55
TAA630	3.90
TAA8400S1	1.96
TAA661B	1.20
TBA120A	80
(A),(S),(AS),(SA).	
TBA120B	1.30
TBA120SB	1.37
TBA120T	95
TBA120U	1.10
TBA395	1.20
TBA396	80
TBA440N	2.75
(TBA1441)	
TBA440P	2.50
TBA480Q	1.50
TBA510	3.00
TBA520(Q)	1.68
TBA530(Q)	1.38
TBA540	1.68
TBA550(Q)	1.58
TBA560Q	1.59
TBA570	1.79
TBA690	1.50
TBA641BX1	3.50
TBA673	2.45
TBA700	2.12
TBA720	2.64
TBA750	2.98
TBA800	1.62
TBA810AS	1.10
TBA820	1.70
TBA820M	1.25
TBA890	3.94
TBA920(Q)	3.00
TBA950(2X)	3.05
TBA970	4.09

TBA990	1.90
TBA14406	2.44
TCA160	1.20
TCA760	2.30
TCA270SQ	2.50
TCA800	3.10
TCA830	2.44
TCA830S	1.75
TCA900	2.20
TCA910	2.20
TCA940	1.95
TDA440	2.20
TDA1002	1.95
TDA1003A	5.50
TDA1004A	3.35
TDA1006A	2.50
TDA1005	3.60
TDA1010	1.54
TDA1035	4.70
TDA1037	2.95
TDA1044	4.37
TDA1060A	4.44
TDA1062	1.56
TDA1083	1.68
TDA1170S	3.00
TDA1190	3.50
TDA1180	2.91
TDA1200	2.95
TDA1220A	2.12
TDA1270	3.95
TDA1327	1.70
TDA1352B	1.60
TDA1412	1.20
TDA1415	1.40
TDA1470	4.67
TDA1770	4.80
TDA2002	2.80
TDA2003	1.20
TDA2004	2.52
TDA2006	1.78
TDA2010	2.00
TDA2140	5.95
TDA2150	2.22
TDA2190	4.70
TDA2020	4.66
TDA2030	2.80
TDA2521	4.17
TDA2522	2.40
TDA2523	3.40
TDA2524	2.25
TDA2525	3.64
TDA2530	2.70
TDA2532	2.56
TDA2540	3.84
TDA2541	3.84
TDA2560	3.50
TDA2571	2.56
TDA2576	3.75
TDA2576A	3.75
TDA2577	3.25
TDA2581	3.30
TDA2582	2.60
TDA2590	3.25
TDA2591	2.95
TDA2593	2.95
TDA2600	5.30
TDA2610	3.20
TDA2611A	1.95
TDA2640	2.92
TDA2652	3.96
TDA2680	3.40
TDA2690	1.35
TDA3190	2.00
TDA3500	6.90
TDA3560	6.00
TDA3561	6.50
TDA3571	3.75
TDA3651	6.50
TDA3950	3.15
TDA4420	4.22
TDA4600	2.95
TDA9503	2.50
TEA1002	3.50
TEA1009	1.37
UPC554	1.34
UPC566H	2.95
UPC575C2	3.40
UPC576H	1.90
UPC587C2	1.60
UPC1025H	2.95
UPC1028H	2.52
UPC1032H	64
UPC1042C	1.56
UPC1156H	4.26
UPC1158H	78
UPC1163H	98

UPC1167C2	94
UPC1168C	1.28
UPC1176C	1.46
UPC1177H	1.56
UPC1178C	1.28
UPC1180C	1.84
UPC1181H	1.62
UPC1182H	2.95
UPC1183H	1.38
UPC1185H	3.66
UPC1188H	2.20
UPC1190G	1.20
UPC1197C	1.06
UPC1198C	84
UPC1200V	1.18
UPC1211V	2.70
UPC1212V	1.34
UPC1215V	1.66
UPC1216V	1.20
UPC1217G	1.13
UPC1218H	1.80
UPC1223C	2.20
UPC1225H	2.00
UPC1226C	1.50
UPC1227V	1.20
UPC1228H	54
UPC1230H	3.95
UPC1238V	1.16
UPC1245V	1.35
UPC1350C	4.15
UPC1353C	1.92
UPC1365C	6.38
UPC1356C2	2.08
UPC1367	2.08
UPC1378H	2.70
UPC1358H	1.88
UPC1360C	2.20
UPC1363C	2.16
UPC1366C	1.84
UPC1368H2	2.15
UPC1370C2	2.58
UPC1382C	1.08
UPC1384	3.78
UPC1447H	58
UPC41C	2.80
UPC5743	38
UPC577H	2.46
UPC585C	1.28

DIODES

AA119	9
BA102	17
BA115	13
BA145	17
BA148	17
BA154	6
BA155	14
BA156	15
BA317	26
BAX13	4
BAX16	8
BB105B	30
BB105G	30
BY126	12
BY127	11
BY133	15
BY164	45
BY176	85
BY179	63
BY182	87
BY184	55
BY199	28
BY206	14
BY210/600	28
BY210/800	33
BY223	90
BY227	28
BY298	22
BY299	22
BYX10	20
BYX36/10	30
BYX36/600	35
BYX55/600	30
BYX71/600	90
OA47	9
OA90	10
OA91	10
OA95	6
OA202	11
IN914	4
IN4001	4
IN4002	4
IN4003	4
IN4004	5
IN4005	5
IN4006	5
IN4007	6
IN4148	2
IN4448	10
IN5401	12
IN5402	14
IN5403	12
IN5404	12
IN5405	13
IN5406	16
IN5407	16
IN5408	20
ITT44	4
ITT2002	11
Y969 – Disc.	
REP BZX85 30V	
BZY15-24R	1.18
BZY15-12R	1.18

SPECIAL DIODES

SKE 49	£1.09
SKE 5F	£1.19
Y723	£1.30
Y827	£1.42

ZENER DIODES

BZX61 Range (1.3W)	20
BZX79 Range (400mV)	10
BZY88 Range (400mV)	10
BZY93, 90 (18V)	1.18

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VALVES | **TRANSISTORS + DIODES**

Type	Price (£)
DY802	0.88
DY86/87	0.75
ECC81	0.95
ECC82	0.65
ECC83	0.75
ECC84	0.65
ECC85	0.90
ECC88	0.95
ECF80	0.95
ECH81	0.75
ECH84	0.75
ECL82	0.75
ECL86	0.98
EF80	0.65
EF86	1.60
EF183	0.75
EF184	0.75
EH90	0.94
EL34	2.50
EL84	0.69
EL509	5.50
EM87	2.55
EY86/87	0.67
EY500A	1.65
PCC84	0.50
PCC85	0.65
PCC89	0.74
PCC189	0.85
PCF80	0.75
PCF86	1.25
PCF200	1.95
PCF801	1.45
PCF802	0.85
PCF806	1.20
PCL82	0.90
PCL83	2.50
PCL84	0.90
PCL86	0.98
PCL805/85	1.35
PD500	3.75
PFL200	1.35
PL33	1.50
PL36	1.45
PL81	0.85
PL82	0.75
PL83	0.65
PL84	0.75
PL95	2.00
PL504	1.20
PL508	2.40
PL509/519	5.95
PY88	1.80
PY500A	2.40
U26	1.90
UCH81	0.90
UCL82	1.70
6J5GT	1.75
6SJ7	2.20
30FL12	1.60

Type	Price (£)
AC127	0.30
AC128	0.30
AC128K	0.34
AC132	0.55
AC141	0.26
AC141K	0.40
AC142	0.26
AC142K	0.48
AC151	0.45
AC152	0.45
AC176	0.28
AC176K	0.46
AC187	0.26
AC187K	0.40
AC188	0.28
AC188K	0.40
ACY40	0.88
AD142	1.10
AD143	1.10
AD149	0.96
AD161	0.42
AD162	0.42
AD161/AD162	0.98
AF106	0.48
AF114	2.10
AF115	2.10
AF116	2.10
AF117	2.10
AF118	0.85
AF121	0.62
AF124	0.48
AF125	0.48
AF126	0.48
AF127	0.48
AF139	0.68
AF178	0.68
AF239	0.68
AF279S	0.75
AL100	2.50
AL102	1.88
AL113	2.20
ASY80	1.75
AU110	1.40
AY102	4.32
BA102	0.34
BA110	0.67
BA121	0.40
BA129	0.38
BA148	0.16
BA154	0.08
BA155	0.10
BA156	0.08
BA157	0.28
BA164	0.14
BB104B	0.52
BB105B	0.30
BB105G	0.48
BB110B	0.42
BC107	0.10
A or B	0.12

Type	Price (£)
BC108	0.10
A,B or C	0.12
BC113	0.14
BC114	0.12
BC115	0.12
BC116	0.15
BC117	0.22
BC118	0.17
BC119	0.30
BC125	0.12
BC140	0.28
BC141	0.42
BC142	0.30
BC143	0.30
BC147	0.08
A or B	0.10
BC148	0.08
A or B	0.10
BC149	0.09
BC157	0.10
BC158	0.10
BC159	0.10
BC160	0.30
BC161	0.30
BC168B	0.12
BC169C	0.10
BC170	0.14
BC170B	0.12
BC171	0.10
BC171	0.10
A or B	0.08
BC172	0.08
A or B	0.12
BC177	0.20
BC178A	0.22
BC182	0.09
A,B or C	0.09
BC182L	0.09
A,B or C	0.09
BC183	0.09
A,B or C	0.10
BC183L	0.08
A,B or C	0.12
BC184L	0.10
A,B or C	0.10
BC207	0.15
BC208	0.16
BC212	0.09
A,B or C	0.10
BC212L	0.08
A,B or C	0.10
BC213	0.09
A or B	0.10
BC213L	0.10
A or B	0.10
BC237	0.11
BC238	0.12
BC239C	0.14
BC251	0.12
A,B or C	0.14
BC301	0.30

Type	Price (£)
BC302	0.32
BC303	0.32
BC307	0.10
BC308A	0.10
BC323	0.99
BC327	0.14
BC328	0.14
BC337	0.12
BC338	0.12
BC350	0.14
BC440	0.30
BC441	0.32
BC461	0.32
BC547	0.12
BC548	0.12
BC549	0.12
BC550	0.18
BC550C	0.18
BC557	0.12
BC558	0.12
BCX34	0.27
BCY70	0.15
BCY71	0.17
BCY72	0.18
BCZ10	1.68
BCZ11	1.45
BD124P	0.80
BC130Y	0.68
BD131	0.34
BD132	0.34
BD131/BD132	0.95
BD135	0.32
BD136	0.36
BD137	0.36
BD138	0.38
BD139	0.38
BD140	0.38
BD144	1.60
BD145	1.82
BD150A	0.51
BD159	0.65
BD160	1.65
BD165	0.45
BD175	0.60
BD182	1.00
BD183	1.10
BD184	1.20
BD201	0.72
BD202	0.87
BD204	0.80
BD222	0.80
BD225	0.86
BD232	0.45
BD233	0.60
BD234	0.62
BD235	0.63
BD236	0.63
BD237	0.65
BD238	0.56
BD241	0.60
BD243A	0.80

Type	Price (£)
BD244A	0.65
BD375	0.32
BD410	0.76
BD434	0.68
BD436	0.68
BD437	0.76
BD438	0.75
BD439	0.68
BD507	0.48
BD508	0.53
BD509	0.54
BD510	0.48
BD517	0.56
BD520	0.66
BD699	1.25
BD707	0.88
BDX18	2.35
BDX32	2.10
BF115	0.32
BF117	0.54
BF119	0.82
BF120	0.38
BF123	0.40
BF125	0.42
BF127	0.38
BF152	0.16
BF154	0.23
BF157	0.40
BF158	0.22
BF159	0.24
BF160	0.23
BF167	0.30
BF173	0.25
BF177	0.42
BF178	0.30
BF179	0.32
BF180	0.35
BF181	0.35
BF182	0.32
BF183	0.32
BF184	0.32
BF185	0.32
BF194	0.08
BF195	0.10
BF196	0.10
BF197	0.10
BF198	0.14
BF199	0.16
BF200	0.26
BF222	0.48
BF224	0.20
BF224J	0.16
BF240	0.20
BF241	0.20
BF244	0.26
BF244A	0.28
BF244C	0.24
BF245A	0.28
BF254	0.15
BF256	0.40
BF257	0.32

Type	Price (£)
BF258	0.30
BF259	0.32
BF262	0.30
BF263	0.30
BF270	0.30
BF271	0.26
BF273	0.18
BF274	0.32
BF323	0.92
BF336	0.26
BF337	0.26
BF338	0.26
BF355	0.42
BF363	0.82
BF367	0.24
BF371	0.27
BF422	0.38
BF450	0.38
BF457	0.33
BF458	0.36
BF459	0.44
BFR39	0.22
BFR40	0.22
BFR41	0.22
BFR51	0.30
BFR61	0.32
BFR62	0.28
BFR88	0.34
BFR90	1.72
BFT41	0.38
BFT43	0.38
BFW10	0.79
BFW44	0.76
BFX29	0.28
BFX30	0.30
BFX80	3.56
BFX84	0.24
BFX85	0.26
BFX86	0.26
BFX87	0.26
BFX89	0:65
BFY50	0.21
BFY51	0.21
BFY52	0.21
BFY57	0.40
BFY90	0.90
BFY90S	1.34
BR100	0.20
BR101	0.44
BR103	0.58
BRC4443	1.76
BRY39	0.38
BRY56	0.42
BRY61	0.86
BSS17	0.56
BSS27	0.92
BSX19	0.34
BSX20	0.34
BSX59	0.62
BSX76	0.29
BT100A/02	0.94

Type	Price (£)
BT101/300	1.15
BT101/500	1.25
BT102/300	1.35
BT102/500	1.65
BT106	1.50
BT108	1.30
BT109	1.18
BT116	1.25
BT119	3.62
BT120	3.60
BT121	3.02
BT138/600	1.30
BT151/560R	0.90
BT151/300R	1.15
BTY79/400R	2.80
BU100A	2.30
BU104	2.00
BU105	1.20
BU105/02	1.56
BU108	1.80
BU124	1.75
BU126	1.25
BU133	1.80
BU204	1.35
BU205	1.30
BU206	1.70
BU208	1.55
BU208A	1.63
BU208/02	2.05
BU326S	1.75
BU407	1.65
BU407D	1.80
BUX80	3.70
BUY20	1.75
BUY69A	2.60
BUY69B	1.98
BY101	0.48
BY118	1.10
BY122	0.68
BY126	0.12
BY127	0.10
BY133	0.16
BY135	0.25
BY164	0.44
BY179	0.66
BY182	0.87
BY184	0.40
BY187	0.72
BY189	4.75
BY198	0.44
BY199	0.47
BY206	0.24
BY207	0.24
BY210/400	0.25
BY210/600	0.26
BY210/800	0.30
BY223	1.20
BY227	0.26
BY229	0.30
BY238	0.68
BYX10	0.24

Type	Price (£)
BYX36/150	0.22
BYX36/600	0.28
BYX48/300	0.72
BYX49/300	0.47
BYX55/350	0.29
BYX55/600	0.33
BYX71/600	1.18
BYZ12	0.42
C106D	0.80
E1222	0.40
E5024	0.30
GET872	0.48
ITT44	0.04
ITT2002	0.11
ME0402	0.20
ME0404/2	0.24
MEU21	0.60
MJ400	1.25
MJ2955	0.90
MJ3000	1.98
MJE240	0.60
MJE340	0.54
MJE370	0.88
MJE520	0.48
MJE2955	0.99
MJE3055	0.70
MPSLO1	0.28
OA47	0.10
OA90	0.08
OA91	0.09
OA95	0.18
OA200	0.06
OA202	0.15
OC25	2.10
OC26	1.70
OC28	1.50
OC29	2.47
OC35	1.75
OC36	1.75
OC42	0.72
OC42K	1.40
OC44	0.72
OC45	0.58
OC71	0.50
OC72	0.52
OC81	0.68
OC200	2.46
OC202	2.20
ORP12	0.85
R2008B	1.50
R2010B	1.52
SHG1.5	0.40
TAG1/100	1.40
TAG3/400	1.78
TIC44	0.40
TIC45	0.45
TIC46	0.48
TIC47	0.70
TIC106A	0.70
TIP30A	0.46
TIP31C	0.54

Type	Price (£)
TIP32	0.40
TIP32C	0.60
TIP33A	0.63
TIP34A	0.72
TIP41C	0.46
TIP42A	0.52
TIP47	0.60
TIP110	0.88
TIP2955	0.60
TIP3055	0.60
TIS43	0.32
TIS88	0.40
TIS90	0.25
TIS91	0.28
ZTX108	0.12
ZTX109	0.12
ZTX212	0.28
IN4001	0.05
IN4003	0.05
IN4004	0.06
IN4006	0.07
IN4007	0.07
IN4148	0.05
IN5400	0.12
IN5402	0.15
IN5405	0.16
IN5406	0.18
IN5408	0.20
IS920	0.08
2N697	0.55
2N706A	0.33
2N2904	0.28
2N2906	0.24
2N2926G	0.10
2N3053	0.22
2N3054	0.56
2N3055	0.45
2N3702	0.10
2N3704	0.10
2N3708	0.10
2N3772	1.90
2N3773	2.70
2N3904	0.16
2N3906	0.16
2N5294	0.48
2N6107	0.71
2N6126	0.68
2SB337	1.60
2SC1172Y	2.90
2SC1173Y	0.82
2SC1302	1.40
2SC1226	0.84
2SC1279	0.50
2SC1306	0.92
2SC1307	1.40
2SC1413A	2.70
2SC1444	1.45
2AC1449	0.63

Type	Price (£)
2SC1507	0.63
2SC1678	1.06
2SC1758	0.68
2SC1909	1.20
2SC1923	0.30
2SC1945	2.88
2SC1953	0.74
2SC1957	0.76
2SC1969	2.88
2SC2028	0.73
2SC2029	1.00
2SC2078	1.05
2SC2091	0.73
2SC2098	2.90
2SC2122A	3.20
2SC2166	1.20
2SC2314	0.80
2SC2335	1.50
2SC2749	2.70
2SC2752	0.60
2SD234	0.64
2SD348	3.30
2SD986	0.62
2SK134	3.80
2SK135	1.90
3N126	1.90
3N201	2.52
3SK45	0.76

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10nF 500V AC	80p
15nF 300V AC	30p
22nF 300V AC	32p
100nF 1000V DC	46p
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AN715Q	2.90	SN76650N	1.05
CA3065	1.75	SN76660N	0.75
CA4031P	2.88	SN76666N	0.80
CA4102	3.30	STK015	6.50
CA4250	3.50	TA7108P	3.20
CA4400	2.98	TA7120P	2.20
CA4422	3.07	TA7129AP	3.65
LC7120	5.33	TA7130P	1.65
LC7130	5.26	TA7172	1.80
LC7137	5.16	TA7193	5.50
LM380N	0.80	TA7172P	1.80
LM1303N	2.52	TA7176	2.50
HA1151P	3.12	TA7202P	4.18
MC1307P	1.85	TA7204P	1.86
MC1310P	1.85	TA7205AP	1.50
MC1312P	2.25	TA7208P	3.27
MC1327P	1.25	TA7210P	6.50
MC1330P	0.83	TA7222P	1.88
MC1349P	1.85	TA7223P	3.68
MC1350P	1.20	TA7227P	5.60
MC1351P	2.50	TA7310P	1.80
MC1352P	1.50	TA7609P	4.28
MC1357P	2.88	TA7611AP	2.88
MC1358P	1.30	TAA263	2.46
MC1496L	1.15	TAA310A	2.68
ML231B	2.10	TAA550	0.50
ML232B	2.10	TAA570	1.99
ML237B	2.30	TAA611A12	3.50
NE555	0.25	TAA630S	3.90
C-mos 555	0.88	TAA661B	1.70
NE556	0.80	TAA700	2.80
SAA1024	5.35	TAA840	3.38
SAA1025	8.40	TAD100	2.80
SAS560A	2.50	FM FILTER	1.20
SAS560S	1.85	TBA120 AS,	
SAS570S	1.85	S,SA,SB	1.30
SAS580	2.85	Q,T,U,UQ	1.32
SAS590	2.82	TBA120B	1.30
SC9503P	1.10	TBA231	1.45
SL432A	4.00	TBA281	2.65
SL901B	5.20	TBA395	1.20
SL917B	6.25	TBA480Q	1.50
SL1327Q	1.10	TBA400	2.30
SN76003N	2.44	TBA510	2.60
SN76013N	1.90	TBA510Q	2.60
SN76023ND	2.90	TBA520/Q	1.60
SN76033N	2.45	TBA530/Q	1.30
SN76110N	1.12	TBA540/Q	1.40
SN76115N	2.00	TBA550/Q	1.52
SN76131N	1.65	TBA560C	1.70
SN76226DN	1.80	TBA560CQ	1.60
SN76227N	1.10	TBA570	1.50

TBA641BX1	4.50
TBA673	2.40
TBA700	2.85
TBA750	2.80
TBA800	1.60
TBA810P	1.10
TBA810S	1.20
TBA820	1.60
TBA890	3.88
TBA920/Q	3.00
TBA950/2A	3.05
TBA970	4.05
TBA990	1.88
TCA160C	3.90
TCA270S	4.00
TCA270SA	4.02
TCA800	3.10
TCA940	1.90
TDA440	3.80
TDA1002	1.90
TDA1003A	5.50
TDA1004A	2.90
TDA1006A	2.40
TDA1035S	4.50
TDA1044	4.30
TDA1170S	3.00
TDA1190	3.50
TDA1200	2.98
TDA1270Q	3.70
TDA1327A	1.66
TDA1352A/B	1.56
TDA1412	1.20
TDA2002	2.80
TDA2020	4.60
TDA2030	2.78
TDA2140	5.90
TDA2521	4.10
TDA2523	3.50
TDA2530	2.70
TDA2540	3.80
TDA2541	3.80
TDA2560	3.50
TDA2571A	2.50
TDA2581	3.20
TDA2590	3.20
TDA2591	2.98
TDA2593	2.98
TDA2610	3.20
TDA2611A	1.94
TDA2640	2.90
TDA2680	3.40
TDA2690	3.50
TDA3950A/B	2.60
UPC554C	1.32
UPC557H	0.90
UPC566H	2.95
UPC575C2	3.20
UPC1018C	1.10
UPC1025H	2.90
UPC1032H	0.90
UPC1156H	4.20
UPC1158H	0.76
UPC1163H	0.98

UPC1181H	1.60
UPC1185H2	3.75
UPC1212C	1.30
UPC1230H	3.90
UPC1350C	4.25
UPC1367C	3.40
UPC1378H	4.40
UPC2002H	2.80

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Excel Polish	0.76
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Solda Mop (L/Gauge)	0.72

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18 pin	0.14	1.60/10
22 pin	0.21	1.95/10
24 pin	0.25	2.25/10
28 pin	0.30	2.75/10
40 pin	0.34	3.10/10
Dil to Quil		
14 pin	0.30	2.75/10
16 pin	0.32	2.90/10
18 pin	0.34	3.10/10
Quil to Quil		
14 pin	0.30	2.75/10
16 pin	0.34	3.10/10

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	1400	150+100+100+100+150/ 320V	2.70
	1500	150+150+100/300V	1.50
	3000	1000/63V	0.56
	3500	175/400V+100+100/350V	1.70
	8000	400/350V	2.10
	8000/8500	2500+2500/63V	1.35
	8000	700/250V	2.10
		1000/70V	0.58
	9000	400/400V	2.25
Timer Amp		4700/25V	0.70
DECCA	10/30	400+400/350V	2.45
	1700	200+200+400/350V	3.52
GEC	2047	2048 2083 2084 2104	
		200+200+150+50/300V	2.32
		600/250V	1.50
ITT/KB		200+200+75+25/350V	2.15
		220/100V	1.95
PHILIPS	G8	600/300V	1.70
	G8 G9	600/300V	1.50
	G11	470/250V	1.50
	G9	2200/63V	1.26
EKCO	T148	125+200+100+32/275V	2.65
	691 Series	200+300/350V	2.15
		600/300V	1.80
RANK		300+300/300V	2.05
	A823	2500+2500/30V	0.98
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01/	0.28
02/	0.28
E298CD	
/A258	0.25
E298ED	
/A258	0.22
/A260	0.22
/A262	0.22
/A265	0.22
/P268	0.22
E298ZZ	
/05	0.25
/06	0.22
E299DD/P116-P354	all 0.23
E299DH	
/P230	0.72
VA1015	0.92
VA1026	0.79
VA1033/34/38/39/40/53	all 0.20
VA1055s/56s/66s/67s	all 0.23
VA1074	0.20
VA1077	0.31
VA1091	0.29
VA1096/97/98	all 0.20
VA1103	0.32
VA1104	0.66
VA1108/09/10/11/12	all 0.24
VA8650	1.20
2322 554 02221	0.59

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1¼" Quick Blow. 100, 150, 250mA **£1.30**. 1, 1.25, 1.5, 2, 2.5, 3, 10, 15A **55p**. **1¼" Time Delay**. 100mA **£3.50**. 150mA **£2.25**. 250, 300, 500, 600, 750, 850mA **£1.84**. 1, 1.25, 1.5, 1.6, 2A **£1.84**. 2.5A, 3.15, 3, 5A **£2.82**. **20mm Quick Blow**. 100, 125, 160, 200, 250, 315, 400, 500, 630, 800mA, 1, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3A. **40p**. **20mm Time Delay**. 100, 125, 160, 200mA **£1.80**. 250, 315, 400, 500, 630, 800mA. **£1.00**. 1, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3A **85p**. **1" Mains**. 2, 3, 5, 7, 10, 13A **85p**.
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13 amp 4-way Extension Socket. White fused with neon light.
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1W 10R to 2M2 (E12 Range)	7p each. 65p/10. 6.00/100
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GEC2010	8R + 15R + 17R + 70R + 63R + 188R	0.95
GEC 2018	10R + 15R + 19R + 70R + 188R	1.15
Philips G8	2.2R + 68 R	0.80
Philips 70	6R + 124R + 84R	0.68
Philips 300	118R + 148R (with link)	0.85
Philips 300	30R + 125R + 2.85K	1.08
RRI A640	250R + 14R + 156R 50W	1.05
RRI A816	302R + 70R + 6.2R	0.78
Thorn 1500	350R + 20R + 148R + 1.5K + 317R	1.34
Thorn 3000/3500	6R + 1R + 100R Fused	0.93
Thorn 8000	56R + 1K + 47R + 12R	0.95
Thorn 8500	1K5 + 40R + 50R	1.28

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¼W pack 10 each value E12 – 10R to 1M 610 pieces	4.80
¼W pack 5 each value E12 – 10R to 1M 305 pieces	2.75
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TELEVISION

Quality o.k., production lagging

There are at last some signs of economic recovery in the UK. Industrial production figures are quoted (in the *Financial Times*) as 101·8, 102·9 and 103·6 respectively for last November, December and January (1980 = 100). Hardly the sort of thing of which booms are made, but then who wants one of those, with the inevitable bust to follow? One industry that's been doing well for some time is the TV/video industry. Not well enough however. The buoyant demand for colour sets in the UK last year had to be met to a substantial extent by imports – in fact nearly fifty per cent of deliveries consisted of imported sets. It's not easy to understand why this should be so. The usual explanation given is that the greatest increase in demand has been for small-screen sets. But these have been in quantity production in UK plants for some time. It seems however that with UK setmaking the larger screen models continue to predominate, with some emphasis on sets with various extras – remote control, fancy tuning systems, teletext, stereo and monitor facilities. One possible reason for this is that large screen tubes are produced in Europe (and the USA) while the smaller sizes are mainly produced in the Far East. It makes sense to produce sets close to tube sources rather than have tubes shipped one way across the globe and completed sets the other way. What we seem to need is for one of those helpful Japanese companies to start up a tube plant in the UK.

Though total UK CTV production leaves something to be desired at present, the reliability problem has been pretty well licked. A "fact report" issued by the Consumer Electronics Economic Development Committee presents some interesting information on the progress made in recent years. Back in 1975 the situation was bad: according to a *Which?* survey quoted in the report, over fifty per cent of UK produced colour sets then required at least one service call during their first year. The situation with continental TV sets was slightly worse, but nearly 90 per cent of Japanese sets achieved 100 per cent first year reliability. By 1982, the first year reliability of Japanese sets had reached 100 per cent while UK manufactured sets had achieved a 93 per cent reliability figure, with the corresponding figure for the rest of Europe 75 per cent. According to data collected by the major retail chains, the number of first year calls required by UK produced sets fell from five per set in 1977 to 0·58 per set in 1982. The 1982 figure doesn't in practice show the true position with UK manufactured sets, 37 per cent of which (in the larger tube sizes) were equipped for teletext reception, since the figure includes calls to adjust the aerial and controls and to replace the battery in remote control units (incorrect aerial alignment leads to teletext errors of course).

Two basic reasons for increased reliability are given in the report – improved manufacturing technology and better quality components. Reliability was poor indeed if you go back to the days of hand soldering and horrible things like waxed paper capacitors. We are still troubled by dry-joints in some new sets, but this problem was endemic with some earlier chassis. The strange thing is how long it has taken for manufacturing techniques to improve – there probably wasn't much incentive during periods like the Barber boom of 1973, when every set that could be got out of factories was snapped up by a colour receiver hungry public. That much quoted wonder of modern production, automatic component insertion, was used by Thorn as long ago as 1958 – in the production of the 406T, a 17in. Band I/III receiver. Apparently Thorn dropped the use of this early equipment, which used a line of auto insertion heads with precision controlled pneumatic rams to move the boards along from one head to the next, because it reduced manufacturing flexibility. You need to be able to switch from one model to another as demand varies. Computer control has overcome this drawback. Sophisticated production technology has been around for many years then, but it took the spur of competition from Japanese manufacturers to exploit the possibilites fully.

Probably the most dramatic cause of improvement however has been in component reliability. In 1977 the failure rate of UK made i.c.s used in colour sets was 37,000 per million. By 1982 the failure rate had fallen to 1,500 per million, a 25-fold improvement. With tuners the improvement was even greater – 37 fold. Tube failures have fallen from over 25,000 per million in 1980 (1977 figures not available) to 6,000 per million in 1982, a figure that's a lot better than it seems since it includes yoke defects. The failure rate for UK made signal diodes was 1,740 per million in 1977: by 1982 the failure rate for power diodes was down to 15 per million – signal diodes were no longer quoted. For preset controls the failure rate has fallen from 1,100 per million to 180 per million. I recollect asking a TV production engineer back in 1977 why the failure rate for those notorious mains filter capacitors was so high. The rather surprising reply I got was that UK capacitor manufacturers didn't know how to make them – despite having turned out capacitors for the purpose since the early thirties if not before. That too has changed.

In 1977, an average of 2·5 faults per set were found on UK TV set assembly lines. By 1982 the number of on-line faults had fallen to an average of 0·4 per set. This doesn't include component faults arising during post-production soak testing. In 1977 a typical soak test took thirty hours, during which an average of five faults per hundred sets were found. By 1982 the time required for soak testing had fallen to ten hours while the number of component failures had fallen to an average of one in every hundred sets.

UK produced TV sets are now as reliable as those made anywhere – more reliable than those from most sources. The prospects look good, but for some reason total production figures have failed to take off in the way one might have hoped.

COVER PHOTO

Please note that the pattern shown on our front cover was produced by an early version of the pattern generator featured in this issue. The EPROMS used were subsequently reprogrammed to produce a pattern more akin to those used by broadcast authorities.

Teletopics

VCR PRODUCTION

Sharp is the latest Japanese VCR manufacturer to establish a production base in the UK. Work on the plant, at Wrexham, North Wales, has already started and will involve an investment of £15 million. Production is expected to start next February, at an initial rate of 60,000 machines a year, creating some 240 jobs. Output by 1990 is planned to reach 240,000 machines annually. Initial production will be from kits, with the local content rising to 45 per cent by the end of 1985 to meet the EEC/MITI requirement for the machines to be accepted as of European origin and thus exempt from import quotas. The plant will be run as a production subsidiary of Sharp Electronics (UK), which is at present a marketing company.

Between 1979 and 1983 the UK CTV market increased from two to three million sets a year (rising in total value from £600 million to £840 million) while the VCR market rose from 200,000 to two million machines (in value terms from £110 million to £800 million). The unsettling effect of price rises following the EEC/MITI agreement led to a fall in the rate of growth of the VCR market in 1983, but with a market penetration of 25 per cent at present there's still considerable potential for VCR sales in the UK – especially as the working life of a VCR is considered to be much less than that of say a colour set. Once the present UK VCR plants (Mitsubishi, Sanyo, Sharp, Toshiba and JVC in conjunction with Thorn) attain maximum planned production levels the total output will still be less than half the current market requirement.

The local content of the VCRs produced by the J2T (JVC/Thorn/Telefunken) plants in Newhaven and W. Berlin is expected to reach 45 per cent by the end of this year, an increase of 12 per cent on the present figure. J2T will thus have reached the required EEC/MITI level a year ahead of schedule. At present, most of the local content parts are low-value items such as case and chassis fittings etc., but several board assemblies are to go into production in Europe by the end of the year. The tape deck mechanism is produced in France from a kit of Japanese components.

Philips, who obtained a manufacturing licence from Matsushita late last year, have announced that their VHS machines will be sold in the UK once production starts. There are no plans at present to sell Philips VHS machines in other European countries. It's understood that Philips V2000 format machines account for one per cent of the current UK market. The problem for both Grundig and Philips has been that demand for V2000 series machines has been insufficient to provide adequate factory load levels. Hence the decision by both firms to manufacture VHS machines.

Matsushita and W. German automotive components and electrical manufacturer Robert Bosch are considering a joint venture to produce VCR and TV components at their Oskrode plant, which at present assembles VHS VCRs. The plant is owned 65/35 per cent by Matsushita and Bosch respectively. Matsushita plans to start component manufacture by this September: Bosch has yet to decide whether to take a stake in this development. Bosch VCRs are sold under the firm's Blaupunkt brand name.

Sony, announcing much improved first quarter results, mentions that VCR production in its plants is currently running at a rate of three million units a year, representing 90 per cent of plant capacity. VCRs and video tape account for 43·2 per cent of Sony's profits at present. Sony recently announced an agreement to set up a Betamax VCR manufacturing plant in China.

PHILIPS TAKES CONTROL

Philips has taken control of Grundig following agreement by the two companies to the conditions laid down by the W. German Federal Cartels Office. Under the terms demanded by the Cartels Office, Philips will sell its 15 per cent interest in W. German TV setmaker Loewe Opta and Grundig will sell its Stenorette dictating machines operation, both sales to take place by the end of 1985. Herman Koning, previously head of Deutsche Philips, has been appointed as chairman of the Grundig board of management in succession to the company's founder Dr. Max Grundig.

GEC-HITACHI JOINT PRODUCTION ENDS

Joint ownership of the CTV plant at Hirwaun, S. Wales by GEC and Hitachi has come to an end. The joint venture at the previously GEC owned plant started in 1979. Hitachi has bought out GEC's 50 per cent interest and will continue to run the plant, which has a production capacity of 300,000 sets a year. GEC will continue to market domestic TV equipment and for the time being will continue to buy sets from Hitachi. Joint operation of the plant never seems to have been very successful.

THOMSON TAKES CONTROL

The French state-owned electronics concern Thomson, which bought a 75 per cent interest in Telefunken from AEG when the latter faced bankruptcy just over a year ago, has acquired the remaining 25 per cent. The deal involves a share swap whereby AEG is expected to receive a three per cent stake in Thomson's consumer electronics subsidiary Thomson Grand Public, which already owns NordMende, Saba and Dual.

TRADE DEFICIT

The TV trade figures for 1983 make dismal reading. Nearly half the CTV sets delivered during the year were imported – a total of 1,424,100 (value £219,695,000). Monochrome set imports were 953,300 (£33,416,000). We imported 2,467,400 VTRs (£587,751,000). TV exports totalled 293,400 (£60,039,000) colour sets and 35,700 (£1,776,000) monochrome receivers.

TV CHIPS

SGS-Ates has started small scale production of a 250V RGB amplifier chip, the first such device in the world to reach this stage. About a thousand chips a month are being supplied to a small Italian TV company, and samples are being tested by Grundig, Philips and Thomson. Characteristics include a bandwidth of typically 5MHz, 100nsec rise and fall times and an output voltage swing of 180V peak-to-peak. Flashover protection is built in and the device incorporates black-current control and a grid voltage generator.

The Siemens TDA4292 i.c. has been introduced for audio signal processing in TV sets with stereo sound. In addition to making provision for user controls (treble, bass, volume, loudness and balance) the chip incorporates stereo wide and synthesised stereo circuitry and the necessary switching.

The TDA1027 i.c. available from MCP Electronics is intended as a low-cost video signal analogue-to-digital converter. A video input with a bandwidth of 5MHz is converted to a seven-bit digital signal. The i.c. gives either true or inverted TTL compatible outputs in either binary or offset twos complementary coding.

JVC's SERVICE SCHOOL

JVC (UK) have opened a training school for video and hi-fi equipment service engineers at the company's North London head office – the Manpower Services Commission was involved in initiating the scheme and will fund six of the first intake of twelve students. The full-time course lasts for ten months and students are expected to have a grounding in electronics to start with. By the end of the course the students should be knowledgeable in servicing work, though no guarantee of employment is given. JVC's technical director Arjon Verdonkschot thought up the idea, fearing a lack of suitable engineers to handle the ever growing quantity of consumer electronics equipment in people's homes.

TV SET NEWS

Philips' latest introduction is the Matchline system, which is intended to offer a simple solution to the explosion in TV technology confronting the viewer. Initially there are three models, the 20in. V6620, 22in. V6720 and 26in. V6820. Each set is fitted with two SCART sockets as standard for permanent connection of equipment such as a VCR and a computer at audio/video frequencies. For improved contrast and minimum reflection, a lightly tinted glass plate covers the screen. The built-in 15W per channel stereo amplifier feeds two side-mounted speakers at the rear of the cabinet behind adjustable, hinged flaps for sound direction – alternatively a pair of separate Matchline hi-fi speakers can be used or the sound can be replayed through the existing domestic audio system. There's also a headphone socket, with the added facility of splitting a dual channel sound source, i.e. feeding one channel via the speakers and the other via the headset. There's automatic tuning and teletext is standard, with the Philips' Supertext facility that enables twenty pages to be stored in the set's memory for access at the touch of a button. Another feature is remote control which, via the SCART socket, can control a V2000 VCR, LaserVision disc player or hi-fi system. The sets are based on the KT4 modular chassis. Suggested prices are in the range of £500-£650 depending on tube size and £70 for the Matchline speakers – these prices are inclusive of VAT.

Sanyo showed a three-inch screen colour set with LCD display at the Japan Electronics Show late last year. The set is due for release this autumn at a price of around $425.

Introduction of Fidelity's new CTV chassis has been delayed following the discovery that one of the i.c.s it had been intended to use is unreliable.

S. Korean consumer electronics concern Samsung is following the pattern established by Japanese manufacturers in setting up in the USA. The plant, at Roxbury, New Jersey, will have a production capacity of 450,000 colour sets annually (also 300,000 microwave ovens) and is expected to be in operation by the end of the year.

Michael Davis, chairman of cable company Windsor Television, predicts that cable will lead to a great increase in business for security firms – the idea would be to use the interactive feature of cable TV to link homes to a security company. Windsor Television will be offering a cable security option.

Electrohome of Canada, a pioneer in the development of display systems for use in arcade/pub TV games units, has now adapted projection TV for data display purposes. The ECP1000 colour data projector uses a single lens system for ease of setting up and incorporates a flexible interfacing system to enable most computers and video terminals to be connected to the unit. The image on the screen can be varied in size from five to seven feet (diagonally) without moving the projector itself.

The new, remote-controlled version of the Thorn TX90 portable CTV chassis differs in several respects from the initial version. While the main vertically-mounted PC1140 panel is basically the same as the PC1130, it has been re-engineered to provide pluggable interfacing with the remote control receiver and voltage synthesis tuning section. The two extra boards required are mounted on the floor and front of the cabinet. These are the PC1139 remote/tuning and PC1138 infra-red preamplifier boards respectively. The heart of the remote control system is a TMS1000 microcomputer chip (Thorn house number T9005N). The SL486 chip used in the preamplifier incorporates a.g.c., photodiode gain tracking (by means of a gyrator feedback loop), internal supply regulation and a pulse stretching circuit.

VIDEO DISC SYSTEMS

In a move to stimulate sales, Philips have reduced the price of their LaserVision video disc players by £100 – the cheapest model should now be available at about £230, less than half the price when the system was launched two years ago. Sales of both the LaserVision and Hitachi CED players (the latter system was launched late last year) have been slow. Some estimates suggest that around 5,000 of each type have been sold to date. Hitachi's current sales promotion scheme is based on the offer of five free discs with each player. Both Philips and Hitachi have found that the main interest with discs lies in watching music items. The music content of the catalogues is being increased and Philips is to launch an 8in. disc costing around £8 later in the year.

Pioneer have introduced a laser disc player in Japan using a solid-state laser instead of the helium-neon type previously employed. Since this eliminates the need for a complex power supply system, a substantial reduction in the price of the players has been achieved.

The coin-operated video jukeboxes we mentioned last month use VHD discs and players produced by Thorn-EMI. The VeeJay videodisc jukebox is fitted with two players and a control unit – it's hoped to instal the jukeboxes in 1,000 pubs and clubs throughout the country.

PANASONIC NAME CHANGE

National Panasonic (UK) have now dropped National from their name – from April 1st the correct name is Panasonic U.K. Ltd. The brand name National is being phased out on all products. The parent company is Matsushita Electric.

SIGNAL SCRAMBLING

Signal scrambling techniques to prevent the unauthorised reception of DBS signals were described by BBC and IBA engineers at a recent IEE conference on secure communications. The MAC-C system proposed for UK DBS transmissions already introduces a degree of scrambling since the signals cannot be received by current TV sets without a good deal of additional processing – in the MAC-C system the line period carries first the sync and audio signals, then chrominance and finally luminance, both in compressed form. To increase the signal security, the first part of the line would be transmitted as an encrypted digital signal while the chrominance and luminance sections would be independently scrambled by splitting each section into two at some point and reversing the two parts for transmission. This split can be made at any of 256 points during the time duration of that section of the line and the point changed in pseudo-random fashion from line to line. To reconstruct the picture, the receiver would need information on this pseudo-random sequence. The required information could be transmitted in encrypted form during the sync/audio part of the line and decoded in conjunction with a key number sequence held in the receiver and rewritten periodically, say once a month. This rewriting could be done by broadcast transmission.

SCOPEX SERVICE BACK-UP

Scopex Electronics Ltd., 63-65 High Street, Skipton, N. Yorkshire BD23 1EF announce the availability of an extensive range of spares for all Scopex instruments from current models right back to the very first – even front panels and individual components. In addition, Scopex oscilloscopes can be factory serviced or repaired – instruments returned for service or repair will be tested to ensure compliance with the original specification, and a six-month guarantee will be given.

ACCOLADE FOR UK CTVs

Colour TV sets manufactured in the UK are now amongst the most reliable in the world, though Japanese produced sets still have a slight edge, according to the Consumer Goods Economic Development Committee of the National Economic Development Organisation. The Committee is so impressed with the progress made by UK setmakers over the last five years that a lavishly illustrated, twelve-page review of the subject has been produced – with export markets much in mind. The review adds that the repair call-our rate would be lower still but for the fact that 37 per cent of sets are equipped for teletext reception. Firms mentioned in the report are Fidelity, GEC-McMichael, Panasonic, Rediffusion, Sanyo, Tatung, Thorn and Toshiba.

ATV MICROWAVE REPEATERS

Licences for five ATV repeater stations in the 1·2-1·3GHz band have been granted. Details are as follows:

Station	*Location*	*Channel*
GB3GV	Leicester	RMT1
GB3TV	Luton	RMT2
GB3UD	Stoke-on-Trent	RMT2
GB3UT	Bath	RMT1
GB3VR	Worthing	RMT2

Channel frequencies are as follows: RMT1 1·2765GHz vision in, 1·3115GHz vision out; RMT2 1·249GHz vision in, 1·3185GHz vision out. Sound frequencies 6MHz higher in each case. The RTM1 stations will receive a.m. or f.m. signals, transmitting with a.m. only; RTM2 stations will probably be f.m. only. Aerial polarisation is horizontal.

NEW CCTV TUBES

Mullard announce the introduction of two new CCTV tubes, a ½in. vidicon and ½in. Newvicon, both with much reduced heater power consumption. The XQ1600 vidicon is suitable for routine visible light applications: the XQ1601 Newvicon has a sensitivity enabling it to be used at down to twilight conditions. There is also a version of the Newvicon, type XQ1602, made of radiation-resistant quartz glass. The tubes weigh 12g, are electrostatically focused, have a resolution of 450 lines and a power consumption of 300mW.

Letters

DEALING WITH UNKNOWN PANELS

Since the introduction of printed circuits many years ago now, constructors and service engineers have been required to work on two interconnected planes and to develop what could be called a mirror mentality. This is, sadly, quite beyond some people – as you may observe from their efforts to reverse a car into a tight parking space.

As components get smaller and PCBs become much more crowded it can be quite a problem tracing out a circuit, particularly when the panels are not marked with component reference numbers. Even when these are provided, it's not unusual to discover that they are incorrect, that various items have been deleted, and sometimes that quite radical modifications have been made. Having encountered this problem in TV sets and other items of consumer electronics, I've devised a procedure which, though more thorough than quick, will give you what you need to know without wasting too much time. It applies where you don't have any official data.

The first step is to reproduce the printed panel on tracing paper. Some sort of transparent grid is helpful. Examine the panel one square inch at a time, reproducing each section on the tracing paper. With a very crowded panel it's useful to scale up the reproduced image to twice or three times the size of the original. After drawing the panel outline to the selected scale, note and identify all flexible connections, marking the soldering points on the paper. Finally insert the tracks. To clarify the image, I colour the paths with an orange-coloured felt pen. This colour doesn't obscure the other details.

Having completed the track layout, turn both the panel and the tracing over. At this stage it's helpful to have available a decently sized mirror and a source of light to shine through the panel. A magnifying glass can also be helpful. Care is needed for the next step – marking the various components on the rear side of the tracing. In the interests of clarity it's best to use symbols rather than physical outlines. The main thing is to ensure that the component leads and tags coincide with the appropriate points on the print – this is where the mirror and light come into play. While doing this it will save time to include component values and identify the windings of coils and transformers, using a resistance tester and noting the values. It's best to insert these so that they can be read from the print side of the tracing, as testing will normally be done from that side of the panel. There may be occasions where it's necessary to remove screening cans to inspect the internal arrangements, but if the alignment might be affected this should be done only as a last resort.

On completion of the drawing, check all connections to

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Tube Base Socket Thorn 3000/8000 etc	50p
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Large IC Extractor	50p
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EHT Lead & Cap for Split Diode Lopt	90p
Anode Cap	47p
Sanyo Anode Cap Assy + Lead. 12TCD-CT-1G	65p
Degause Thermistors. PT37P. ITT/GEC	35p
Degause VDR E299D/HP230 3000/8000	25p
Casters Set of 4	1.90
Double Fuse Holder on Small Pax Board 20mm type	10p
Single Fuse Holder on Small Pax Board 20mm type	5p
Direct Panel Mounting 20mm Fuse Clips	(pair) 15p
Single Fuse Holder on Small Pax Board. As per early 3000 mains input	6p
EHT Cable	Metre 25p
13A Plugs	12 for 4.80
BF259 with Heatsink	14p
TIP110 with Heatsink	40p
L129/130/131 Coil	10p
6MHz Ceramic Filter	25p
DL700 (Philips) Chroma Delay Line	1.00
DL50 Chroma Delay Line	1.00
T9006A Lum Delay Line	1.00
8K5/9K Lum. Delay Line	65p
Plastic Cover for 3K5 SP8385	5p
TX9 Back Ground Control 10K	15p
TX9 Gain Control 100R	15p
1500 Metal Chassis Supports Pair	40p
Thorn 8K5 Focus Pot	2.40
Thorn 4000 Focus Pot	2.75
Thorn 18Ω 9W (3K5) R752	30p

SERVICE AIDS

Ambersil MS4 Silicone Grease	12oz	2.15
Ambersil Freezer	12oz	1.99
Ambersil Amberlube	6oz	1.89
Ambersil Ambertron	16oz	1.95
Ambersil Anti-Static Screen Cleaner	7oz	1.95
Ambersil 40+ Protective Lubricant	14.1oz	2.15
Ambersil Amberclens Foaming Cleaner	13oz	1.26
Ambersil Circuit Lacquer	14oz	2.15

THICK FILM RESISTOR UNITS

3500 Thorn (5 Pin Connection) video	1.70
4000 Thorn (4 Pin Connection)	1.90
725/731 Pye (6 Pin Connection)	2.20
713 Pye (6 Pin Connection)	2.20

FUSES

20mm		1¼"	
50MA	10 for 70p	250MA	10 for 65p
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3.15A	10 for 1.00	50A	10 for 50p

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Thorn EHT TX 3000/3500	6.00
Thorn LOPT 9600	12.00
Thorn LOPT 1615	7.25
Thorn LOPT 1590/91	7.25
Thorn LOPT 1690/91	7.25
Thorn LOPT 8000	9.80
Thorn LOPT 8500	9.80
Thorn LOPT TX9	9.85
Pye LOPT 713	10.00
Pye LOPT 725	9.85
Pye LOPT 731	10.18
Philips LOPT G9	8.80
Philips LOPT G11	13.75
GEC LOPT 3113	7.40
Diode Split LOPT AT2076/35	14.75
Sanyo LOPT AM-WM-21	6.75
Sanyo LOPT AM-WM-4	7.30
Philips LOPT G8	7.80
Sanyo LOPT (CW21) 4-2751-44700	5.00
ITT LOPT CVC5-9	9.60
ITT LOPT CVC30	8.75
ITT LOPT CVC45	9.75
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						BF167	24	BFR62	28	NKT276	20
						BF173	29	BFR81	29	NKT453	1.65
AC128	39	BC171	9	BC558	10	BF179	32	BFR87	25	OT112	1.92
AC131	40	BC172	9	BC559	8	BF180	33	BFR90	1.74	OT121	2.08
AC138	40	BC174B	23	BC595	8	BF181	30	BFR91	2.08	R1038	80
AC141K	39	BC177	24	BCX33	22	BF184	30	BFT42	30	R1039	80
AC142K	38	BC182LB	12	BCX34	11	BF185	30	BFT43	30	R2008B	1.40
AC153	39	BC183L	12	BD115	49	BF194	16	BFX38	40	R2010B	1.10
AC176	33	BC184L	13	BD131	30	BF195	16	BFY50	30	R2030	70
AC176K/		BC187	24	BD132	46	BF196	16	BFY51	34	R2265	1.30
AC128K	93	BC204	15	BD133	59	BF197	15	BFY52	34	R2305	80
AC188	38	BC208	9	BD139	36	BF198	19	BRC116	1.50	R2322	50
AD142	1.18	BC212L	9	BD140	38	BF199	15	BRC1693	1.43	R2443	25
AD143	1.08	BC213L	12	BD144	1.70	BF223	18	BU105	1.00	RCA16446	30
AD149	98	BC237	12	BD163	98	BF224	19	BU126	1.10	RCA16599	1.25
AD161	32	BC238B	8	BD201	74	BF238	20	BU207	1.05	RCA16600	1.40
AD162	32	BC238L	8	BD203	78	BF240	9	BU208	1.15	RCA16799	1.13
AD263	1.05	BC250A	15	BD204	99	BF241	21	BU208A	1.15	RCA16800	1.42
AF127	45	BC251	8	BD222	48	BF255	10	BU326A	1.30	RCA16802	1.38
AF139	38	BC252A	20	BD225	52	BF256S	20	BU407	1.70	S1299	2.25
AF239	41	BC294	37	BD232	50	BF257	28	BU408	2.76	S28000	1.25
AU113	2.10	BC301	32	BD233	60	BF259	28	BU500	2.30	S6080A/B	3.50
BC107	15	BC303	31	BD234	60	BF271	25	BU526	2.46	T6050V	1.30
BC108	15	BC307	10	BD237	55	BF274	11	BU807	2.94	T6052V	1.30
BC109	15	BC308	8	BD238	65	BF337	29	C1129	9	T9003V	1.25
BC115	16	BC309	14	BD241	59	BF338	34	C1172B	9	T9010V	1.45
BC117	21	BC327	18	BD244	85	BF355	40	E5386	54	T9053V	1.30
BC125	26	BC328	18	BD278A	81	BF362	50	E9003	28	T9054V	1.00
BC126	23	BC337	17	BD386	68	BF391	21	E9005	25	T9039V	1.10
BC139	27	BC338	17	BD433	71	BF394	16	ME0404	10	TIC45X	50
BC141	34	BC347	8	BD437	83	BF422	47	ME0412	10	TIC46	48
BC142	30	BC394	8	BD592	1.20	BF423	53	ME6002	10	TIC106C	40
BC143	31	BC454	8	BD589	1.20	BF450	43	MJ2501	2.36	TIP29	42
BC147	12	BC455	8	BD677G	1.35	BF453	53	MJ3001	2.21	TIP30	42
BC148	12	BC456	10	BD707	95	BF458	37	MJE182	47	TIP31	35
BC149	12	BC460	40	BD708	95	BF459	40	MJE340	50	TIP32	43
BC153	16	BC463	22	BDX10	93	BF461	59	MJE520	50	TIP33	61
BC1540R	16	BC546	8	BDY20	1.09	BF556B	35	MJE2955	1.40	TIP41	42
BC154YL	16	BC547	12	BDY82	99	BF596	15	MJE3055	1.50	TIP42	45
BC157	12	BC548	12	BF137	20	BF694	16	NKT241W	8	TIP110	61
BC158	12	BC549	8	BF153	20	BF757	62	NKT241G	8	TIS91	25
BC159	15	BC557	10	BF154	25	BFR52	31	NKT241Y	8	ZTX550	30

INTEGRATED CIRCUITS

BRC1330	1.40	SN76013ND	1.80	TBA530	1.26	TDA2030	2.10
BRC3064	1.00	SN76023N	1.80	TBA540	1.00	TDA2522	2.10
BRC/M/200	1.00	SN76033N	2.00	TBA550Q	1.82	TDA2530	2.61
BRC/M/300	1.00	SN76115	2.00	TBA560C	1.50	TDA2540	3.50
CA3060	1.58	SN76131N	1.58	TBA641	2.05	TDA2560	3.50
LM1303P	1.48	SN76226N	1.25	TBA651	2.50	TDA2581	3.00
ML231B	2.20	SN76227N	1.00	TBA720A	2.49	TDA2591	1.96
ML237B	2.00	SN76530P	1.30	TBA750	2.20	TDA2611A	1.95
ML239B	2.86	SN76622N	1.00	TBA800	1.62	TDA2640	2.90
MC1327AP	1.25	SN76660N	80p	TBA920	2.08	TDA2690A	1.50
MC1358P	1.30	SN76666N	75p	TBA950	1.95	TDA3560	6.00
MC1455P	18p	SN76744	1.92	TBA1440	1.92	TDA9503	2.90
MC14516BCP	60p	TA7117P	1.00	TCA270SA	1.05	TCEP100	3.48
SAA1025	7.20	TA7109AP	2.80	TCA270C	1.05	TEA1009	1.95
SAA1124	4.50	TAA611	1.40	TCA270CQ	1.05	MC14426P	4.80
SAA5010	6.00	TBA120B	1.20	TDA1004A	4.00	MC14429P	4.50
SL432A	1.80	TBA120C	1.20	TDA1035T	3.50	MC14514	5.00
SL1430	2.50	TBA120CQ	70p	TDA1037	2.72	UA758PC	2.50
SN15846N	60p	TBA120S	70p	TDA1170S	1.50	UA1008A	2.66
SN74123N	65p	TBA120U	1.00	TDA1200	2.42	ULN2165	1.30
SN74154N	1.40	TBA395	1.00	TDA1270	2.76	ULN2216A	1.25
SN76001N	1.40	TBA480Q	1.40	TDA1327	2.53	UPC1365C	5.75
SN76110N	1.14	TBA510	1.90	TDA2002	2.80	SC9488P	1.40
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Thorn 8/8K5 ex equip panels untested

PSU	2.88
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Thorn 9K6 ex equip panel untested

Decoder	5.75

Thorn 3/3K5 ex equip panels untested

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Thorn 4000 PSU panel ex-factory	2.50
Thorn 3K5 beam limiter board new	1.75
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Thorn 3K5 IF panel new	3.00
Thorn 3/3K5. EHT & scan TX + R2008B on alum chassis ex-equip	1.80
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Thorn 128+16+1K7+116+462+126	50p
Thorn 120+72+300	50p
RBM 250+14+58 (TV161)	63p
Pye 3R5+15+45 (713)	90p
Philips 2R2+682	90p
Philips 47R	52p
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Thorn 3000 Metal	1.45
Thorn 8/8500 Plastic	1.45

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Pye 713 5 lead	5.97
Pye 725	6.35
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220+47	350V	65p
200+150+50	350V	60p
200+200+100	325V	54p
32+32+16	275V	52p
200+200+100+32	350V	70p
100+50+150	350V	58p
400+400	200V	72p
32+32+16	350V	52p
200+32+300+100	350V	70p
225+25	350V	50p
200+200+100	350V	70p
200+100	325V	65p
16+16	450V	45p
200+100+100+50	350V	60p
200+200+100	350V	55p
200+200+75+25	350V	60p
50+50+8	300V	55p
100+50+100	350V	55p
16+16	350V	45p
100+150+50	350V	55p
2500+2500 (Thorn 8K)	63V	1.20
150+150+100	300V	1.80
200+47	250V	65p
500+500 175V Thorn TX9		1.00
175+100+100 350V Thorn 3K5		2.25
400 400V Thorn 9K		2.50
470 250V Philips G11		1.50

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0.2MF 250V	50p
2MF 250V	50p
22MF 275V	50p
50MF 275V	50p
100MF 150V	65p
100MF 250V	70p
100MF 450V	75p
220MF 400V Thorn 9K	1.30
220MF 450V Thorn 4K	1.30
400MF 350V Thorn 8K	1.00
800MF 250V Print type	80p
800MF 250V	70p
1250MF 40V	50p
1250MF 50V	50p
1500MF 70V Thorn 3K	1.00
1500MF 100V	1.05
2000MF 30V	50p
2200MF 40V Thorn 4K	95p
2500MF 35V	65p
2500MF 40V	65p
3000MF 30V	65p
3300MF 16V	50p
3300MF 25V	60p
4700MF 16V	72p
4700MF 40V	75p

Thorn/Decca/GEC On/Off Switch. Push to make	75p
Philips G11 On/Off Switch. Push to make	75p
ITT CVC8 On/Off Switch	65p
ITT CVC9 On/Off Switch + Relay	90p
Philips G8 On/Off Switch	75p
Thorn 3/3500 A1 Switch	50p
Thorn 4000 A1 Switch	50p
Korting Shift Pot 50Ω	65p
2·5A Push to make on/off switch	15p

DIODES

AA112	8p	IN4003	4p
AA119	8p	IN4004	5p
AA143	8p	IN4005	5p
BA115	8p	IN4006	5p
BA154	8p	IN4007	6p
BB103	8p	IN4149	6p
BB105B	30	IN4742A	8p
BR303	46p	IN5254B	8p
BT106	1.50	IN5349	14p
BT116	1.00	IN5400	12p
BT119	2.56	IN5401	12p
BT120	2.82	IN5402	14p
BT151 650	1.00	IN5404	12p
BY127	12p	IN5406	16p
BY188	16p	IN5408	16p
BY204	26p	IS025	8p
BY206	16p	IS131	8p
BY207	16p	IS1658	8p
BY208/800	38p	MR854	35p
BY223	95p	SKE1/02	20p
BY225	1.20	MCR106/1	1.00
BY227	28p	MCR406	35p
BY298	22p	2N4444	1.50
BYX22/400	30p	Y827	80p
BYX55/600	30p	Y969	75p
BYX71/350	80p	ZX150	12p
BZV15 C12R	1.16	OA91	5p
BZV15 C24R	1.16	MCR106/7	1.00
IN60	8p	MCR106/8	1.50
IN2070	8p	TD3F800H	2.80
IN4001	4p	TD3F800R	3.00
IN4002	4p	BY255	30p

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MC1358P	1.60	TBA750Q	2.45
MC1330P	.90	TBA800	.80
ML231B	1.95	TBA810AS	1.15
ML232B	1.70	TBA820	1.40
ML237	2.50	TBA890	2.95
ML238	4.22	TBA920Q	1.50
SAS560S	1.83	TBA950/2X	2.65
SAS570S	1.90	TBA990	1.55
SAS580	2.40	TCA270SQ	1.30
SAS590	2.40	TCA800	1.95
SL901B	4.80	TCA940	1.55
SL917B	6.95	TDA1002A	1.50
SN76003N	2.05	TDA1003A	2.80
SN76013N	1.80	TDA1004A	2.70
SN76023N	1.80	TDA1035	3.20
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The final stage is to draw out the circuit diagram. This is best done roughly to start with, commencing at the signal input and working through to the output and power supplies. It may then be possible to rearrange the circuit diagram to produce one with a more logical layout.

Bob Walker,
Aberdeen.

PHYSICAL REPAIR PROBLEMS

Your TV fault finding articles tend to concentrate on diagnosis rather than repair. It's the latter aspect that often presents the main problems however. Television sets seem to have become more difficult to deal with in recent years, what with components glued in, the number of i.c. pins it's necessary to unsolder to extract the device, and in particular subassembly boards soldered into the main board at right angles. The construction of some sets from the Far East is so poor that it's impossible even to test them without stripping the set down.

It all sounds so easy – all one has to do is to use a soldering iron and a solder sucker. Until one tries it, that is. We're not all dextrous with our hands, and inevitably we break some components and lift some print due to the flimsy and awkward layout so often found.

The designers of many sets should be sentenced to six months' removing faulty components in the sets they've laid out!

K. J. Treeby,
Plymouth.

DRIFT FAULT

I had an awkward tuning fault recently on a Thorn set fitted with the 9600 chassis. Every time the set was switched on there was only grain on the screen with noise on the sound – except for Ch. 4. Retuning was necessary with all the other channels, and within a few minutes the set would slowly drift again or suddenly drop out. The tuner was blamed, but why was Ch. 4 o.k.? A new Mullard tuner was fitted – I've had some problems with Thorn tuners, curing three with nothing more than a soldering iron around the joints – but the same thing happened a day later. Replacing the TAA550 voltage stabiliser made no difference.

I had a go at the tuner, putting the soldering iron round it, but did more harm than good. After fitting another tuner the set was found to be firmly locked to the channel five position, with no picture and the sound motor-boating. The BTT6018 touch-tuner chip was pushing 34V out of every pin. Getting a new chip was a bit of a problem – they kept sending BTT6218s, which is apparently the correct replacement. After this was fitted I still had the mistuning problem, which was eventually traced to the 1S44 diode in series with the tuning slider in the Ch. 4 position. When checked for reverse leakage it was found to behave like a leaky capacitor, slowly shorting out. Replacing this finally restored normal operation.

J. D. Stephens,
Wigan, Lancashire.

OSCILLOSCOPE PROBLEMS

My experiences with a Safgan Model DT420 scope may be of interest to other users. The problem began with a blown fuse. Replacement appeared to clear the fault, but no! About a week later the same thing happened again, only this time with disastrous consequences. It appeared that a 6·3V heater winding had leaked to chassis: the transformer had burnt out several resistors and, worst of all, had blown the tube heater. I was able to get in touch with Brimar, who still had D10-239GH tubes in stock and were willing to supply one. Whilst waiting for this I investigated the scope with a view to preventing any further problems.

The first step I decided to take was to fit a separate heater supply. This was done as follows. A separate PCB was made to hold an RS 3VA 6V printed circuit mains transformer, a mains fuse, and a 1Ω resistor in series with the secondary winding to limit the switch-on current. Two spare tags were included to isolate the old 6·3V winding. As I never use the scope's Z modulation, I connected one side of the heater to the cathode, then replaced the other damaged components. The secondary of the new transformer is thus at 1·5kV, which is within the RS specification: a check revealed that all was o.k. This transformer need not be fitted if the original is not suspect for leaks, but be warned!

Secondly, the tracks of both the brightness (intensity) and focus controls are at about 1·5kV with the bodies at chassis potential, which seems a poor arrangement to my mind. I moved them out of the way to the back of the scope, which wasn't such a problem as there was no tube in the unit at the time. To carry out this modification, remove the tube then the rear tube support by drilling out the two rivets on the back and withdrawing the screw on the top support. Drill two new 2BA holes on the upright of this support to mount another PCB (without copper) to these two holes and refit the bracket. I used two new potentiometers with long plastic spindles, 250kΩ linear and 1MΩ logarithmic.

I decided not to use a mains switch as the scope is on most of the time, but there's plenty of room for one if required, as in the original design.

The new wiring used is rated at 6kV – 1m was plenty. The old potentiometer bushes through the front panel were used to support the spindle extensions – 7 × ¼in. steel rod with couplers.

The scope now works well.

K. D. Bunting,
Huntingdon, Cambs.

THE GREAT PLUGTOP MYSTERY

Since the advent of transistor power supplies this magazine has devoted much space to fuse blowing and the destruction of expensive output transistors, particularly the problem of the whole thing happening again shortly afterwards. The causes of these problems within particular chassis have been covered, for example the main reservoir electrolytic in the G11 and pitted on/off switches, and reference has been made to faulty house wiring. The predominant cause however is a loose connection in the 13A mains plug, and the blame largely rests with the setmakers themselves. Why? Well, they tin the ends of the wires, turning them into single conductors. Strip this tinning off, twist the bare copper strands well, reconnect and your troubles in the plug will be gone.

Many of you know this already, so what's the mystery? Simply this: why is the loose connection always the neutral one?

Harold Peters,
Lowestoft.

Problems with Older VCRs

Nick Lyons

The first domestic VCR to appear in the UK was the Philips N1500, back in 1974. This format was superseded by the N1700 in 1977, but it wasn't until VHS and Betamax machines started to appear in the UK in 1978 that the market began to take off. There are nevertheless quite a few N1500 and N1700 series machines around: they are useful for those who require only time shifting, and can often be picked up cheaply. Many Betamax and VHS machines have by now seen several years' service. There will obviously be run of the mill and various stock faults with equipment as complex as a VCR, but problems of a different nature begin to appear as machines age. It's this sort of problem we're going to consider here: a machine bought as a well-used second-hand unit may exhibit several of these problems.

Belt Arrangements

With faults that look like servo problems it's always advisable to change the belts. Early machines of all formats used belts extensively. They give good service, but not forever: never mind how long they are reputed to have been in the machine, change them. Whilst doing this, clean all the pulleys with a lint-free cloth moistened with alcohol. Dry them off before putting the belts on, or you may partially dissolve the new belts. If there's a piece of ingrained dirt that can't be removed with alcohol on one of the pulleys, forming a small pimple, use a very small amount of Brasso, again on a lint-free cloth. Polish the dirt off, then clean off the Brasso.

Drum and Capstan Drive

After restoring the belt arrangements to their former glory, try the machine again. Have you got capstan or drum hunting? Is it in fact hunting, or is the capstan or drum running at the wrong speed? Let's take incorrect speed first. Is it too fast or too slow? If you're not sure, apply slight pressure to the top rim of the head drum or to the capstan flywheel to slow it down. If this improves matters, the relevant item is running too fast and the chances are that you've got servo trouble. Before delving into the servo circuitry however check that the supply lines are correct. Exactly right, as there's little margin for error here, tens of millivolts only. Check at the servo board as well as at the power supply panel.

It's advisable to check the presence and amplitude of the off-tape control pulses as they progress through the relevant servo circuit, as without them the servo won't lock. We'll assume that they are o.k. for the moment.

On the older Philips machines motor control was achieved by the use of eddy current brakes. It's a very simple matter to disconnect one wire from the brake coil and note the effect. If the motor was running too slowly before the wire was disconnected and then speeds up, you've servo trouble. If the motor continues to run too slowly the chances are that the relevant motor (gramophone type shaded-pole unit) has bearing trouble. Often no amount of oil will improve matters. The bearing may not seem stiff to you, but it may to the motor. With the belt removed and the power off, spin the fan blade: if the motor stops after about two revolutions or less, it's too stiff. I can't understand why, but the motor shaft seems to swell with age! An otherwise useless motor can sometimes be revived by polishing the rotor shaft with Brasso. Remember to clean the shaft thoroughly and lightly oil it before reassembling into the bearing. If this fails to provide a cure, a rather expensive new motor will be required. If a motor consistently runs too fast, check that the brake coil is not open-circuit or has a loose wire. Then if necessary check for output stage failure.

Let's assume that the off-tape control signal is missing. The result more often than not is that the motor runs at almost the correct speed but the servo fails to lock, the tracking control having no effect. Loss of the off-tape control signal is a common problem with N1500 and N1700 machines, particularly with the N1500 series as the control track is narrower and is interleaved with the edge of the video tracks. The audio/control track head assembly on these machines swivels out on the capstan pinch roller assembly, and a frequent cause of the trouble is fractured connecting leads – there's usually enough spare to trim and remake the ends. The head seems to be a particularly soft type, and considering that with this format most of the tapes are of the chrome type maximum head wear is to be expected. Not only is there the half inch wide groove across the main head face, the actual head area is even softer, wearing to a hollow dimple. As a result, head-tape contact is lost and there's no signal. The only cure is to fit a new head.

These heads need replacement every eighteen months to two years if the machine is used a lot. Poor tape interchange or misalignment of the head will also cause loss of output, the track being very narrow considering the poor mechanical stability of this format. Listening to the off-tape audio signal may well provide a useful clue. There's plenty of head adjustment range, and a special signal is recorded on the alignment tape to ensure correct adjustment. Failing this you'll have to use a recording made on a reasonably well set up machine. Make the adjustment gradually – it's unlikely to be miles out.

Loss of the control track signal due to faulty electronics is very rare with these Philips machines, but the simple amplifier circuit makes signal tracing easy.

The head itself is less likely to be suspect with VHS and Betamax machines, though bad interchange, i.e. tape misalignment, may well be the cause of minimal output from the control head. Betamax machines seem to be more prone to this trouble than VHS ones, probably due to the longer tape path. With both formats gross audio/control head azimuth or position inaccuracy may be the cause. If this is the case, why is it so? Has the machine been dropped or tampered with by less than expert hands?

It's been my experience with VHS and Betamax machines that very little goes far out of adjustment on the mechanical side provided it's been left alone. As regards head adjustment, if you haven't got an alignment tape, record a test card and tone on a known good machine. Replay this on the faulty machine and adjust the head for best audio response. Also monitor the control signal output with a scope. Go for the maximum control signal output commensurate with good audio azimuth.

It's again quite simple to follow the control signal through the amplifier in early Japanese machines.

Servo problems can often be cured by careful setting up. Where the speed discrepancy is great, just examine the transistor(s) that drive the motor. Has it latched up or down to a supply rail?

Even the early "dead-finger" VHS machines (3320/3V00) used d.c. motors. These generally give very little trouble, but the manufacturers recommend replacement every 2,000 hours. This seems to be showing excessive caution as I see it, being virtually on a par with the head replacement recommendation, but obviously original motors in an old machine must be suspect where servo trouble is experienced.

Tape Speed Wobble

A very common fault on these dead-finger machines is a cyclic tape speed wobble, a slow wow really though not generally obvious on the sound, the main effect being cyclic displacement of the colour – it sways from side to side over the luminance. If rebelting and a complete servo set up hasn't cured the problem, the chances are that changing the capstan and its bearing will do so. Don't forget to oil the new assembly or it won't be long before the fault recurs.

If the fault is not too pronounced, you might get away with dismantling the capstan assembly. Withdraw the flywheel assembly, clean the shaft and look for any marks. If it's badly "ringed" it's a gonner. If it's just slightly shaded, use a little Brasso to take the worst off. Reclean and reassemble, using a good spindle or thick general purpose oil. Oil the capstan shaft all the way along, and twist it as you push it back into the bearing to avoid scratching – gently does it – while supporting the weight of the flywheel. Remember also to clean the surplus oil from the exposed part of the capstan, using a paper towel or something similar, before playing a tape or letting it come into contact with the pinch roller. On the subject of pinch rollers, a drop of oil down the centre will not go amiss. If the roller is at all mishapen or scarred, it must be replaced. On the Philips format machines, swollen (barrel shaped) pinch rollers are the cause of much tape misguiding and creasing.

Threading Problems

Sticking whilst threading and unthreading, or refusing to thread/unthread on starting or after a timer recording, can usually be solved by applying a good grease to the bits of sliding metalwork in the threading mechanism. This is located (3320 etc.) beneath the tin cover adjacent to the capstan flywheel. Grease is applied initially, but tends to dry up and is then more akin to candlewax. The problem is particularly bad with timer recordings as the machine is often at its coldest and the motors have to start under the best conditions for stalling, i.e. with a heavy load pre-engaged and the power rails still coming up.

Threading difficulties with early Philips machines (1500, 1501, 1520) can be something of a trial. During threading the whole drum assembly, complete with the lower drum and most of the guides, rotates. In the later 1502 and 1700 this rotation is done with a worm gear that engages in the lower drum assembly: this gives little trouble. With the early machines however threading is done with a "tuning cord" type of system: the cord wraps around the lower drum assembly, then over the pulley wheel of the threading motor's gear train. This gear train also carries the cams that operate limit switches to switch off the motor when threading or unthreading is completed. In operation, the cord is tensioned by what are basically two Biro refill springs. Surprisingly, the cord itself gives little trouble, the main problems being with the gears.

In this train there are gears consisting of toothed plastic mounted on splined metal shafts. These plastic gear wheels tend to split and consequently get out of mesh and synchronism with the rest of the train, putting the limit switches out of sync as well. This will result in the motor over winding, stretching the springs and in extreme cases snapping the cord. The worst offender is the threading motor's own gear. It's a sleeved extension to the motor's shaft, and can be replaced separately. Any other damaged gear wheels will necessitate replacement of the whole gear train assembly. It's a waste of time trying to repair this unit as it operates under far too much strain. The cord should also be replaced, mainly because the springs will have been stretched beyond their limit. Later versions of the cord have strings and eyes fitted as spring protectors.

The threading motors in these Philips machines can also be faulty, and great care is required when a new motor is to be fitted. This is because Philips decided to change the speed and direction of rotation of this motor during production. The speed change is not significant but the direction is. Check the machine and ascertain the required direction of rotation of the motor and which type you have: failure to do so is costly, because if the motor turns the wrong way or switches on, the cord springs will be damaged and the gear train may be chewed up. The modification required is simple – connect the wires the wrong way round so that the new motor goes backwards (two wrongs make a right, I suppose!). Philips did get around to putting a note in with most motors, telling us to swap over the wires, but the first few didn't and I can tell you I've looked more than bewildered more than once on this account. The first time I thought I'd a freak motor, wired wrongly internally, till it happened again. Remember that your machine might have the later motor fitted already – if the red wire doesn't go to the red dot terminal on the motor, the later motor has been fitted.

Failure to Latch

Back to VHS machines. The dead fingers themselves can be a cause of trouble. If one or more fingers won't stay down or keep on unlatching themselves, first check the stop solenoid. If the solenoid isn't operating spuriously, the problem lies elsewhere. In this case the chances are that the notch in the finger assembly (inside the machine, where it engages with the stop bar) is worn. With the flat edge of the notch worn away, the key will refuse to latch or be so poorly latched that the vibration and movement caused by threading may shake it free. It's quite easy to refile the notch: a look at the stop or pause keys will show you the pattern. In badly worn cases you can interchange the worn key with another in which the notch is not used or gets little use, i.e. the stop, pause or audio dub keys.

Mechanical Alignment

It's necessary to check the mechanical alignment of any VCR from time to time. This can be satisfactorily done only by using the proper alignment tape. Prerecorded tapes from libraries definitely won't do. Before disturbing any alignment adjustment, ensure that the tape path and the heads have been thoroughly cleaned and are free of debris. Similarly make sure that all the rollers are actually rolling. The older VHS machines have an additional roller before the sound head. The speed stability and alignment will suffer if the machine is trying to drag the tape over stuck rollers.

If the lower drum is particularly dirty, remove the upper drum. This will give much better access and enable you to clean the top rim of the lower drum assembly. It's quite remarkable how much debris can collect here.

When all this has been done, check the alignment again and if necessary adjust. I know that an alignment tape is expensive, but if you're a dealer you should have one. If you're not and you haven't, what then? The best thing I can suggest is to find a friend or a friendly TV shop that will record for you a tape of a test card on a new machine. This will not be perfect, but most new machines are now pretty close to specification.

Though capable of giving perfect results, many of the older machines were often not as well or consistently set up when new as the latest machines. This is particularly so with Betamax VCRs. I would not advise therefore that you record this makeshift alignment tape on an old machine, no matter how reliable or well cared for it's been, unless you know it's been properly aligned fairly recently.

Actual adjustments should be made in accordance with the service manual for the particular machine, using an oscilloscope to view the f.m. output from the tape. Be warned that any random tweaking of guides and the like will definitely end in tears. If you don't have a scope it's still possible, with care, to align the machine by watching the picture on a TV screen – by mistracking the VCR and adjusting for uniform noise over the whole field. A set with underscan is useful here, as the level of noise around the head switching point, i.e. near the field sync pulse area, must be as nearly uniform as possible with the rest of the field if field jitter is to be avoided. In any case, when you think the adjustment is complete, turn down the height on the TV set or mislock the field hold control and just check that all is well around the field sync pulse area.

Finally, stick to the manual and remember that with alignment discretion is the better part of valour: if it's near enough, leave it alone!

Service Briefs

The following notes are based on information given in recent issues of *Ferguson Feedback* and in the *ITT Service Bulletin* issue no. 14.

Thorn TX9 Chassis

In sets fitted with main panel PC1044 (chopper power supply) R92 in the brightness control network is 18kΩ. As a result, the background presets should be turned fully towards the rear when setting up the grey scale, not to mid-position as in previous versions of the chassis.

The values of R942 and R970 on infra-red preamplifier panel PC1527 have been modified on a couple of occasions for best sensitivity with immunity from external interference. The final values are R942 18kΩ, R970 82kΩ.

Thorn TX9/TX10 Chassis

The value of R32, connected to pin 8 of the SL1432 i.f. preamplifier i.c., has been changed to 10kΩ to avoid top pulling at certain signal levels.

Refusal to switch on from cold, going into the standby mode when the on/off switch is actuated, or failure to switch on from standby via remote control, has been traced during production to tolerances in the ceramic resonator circuit associated with the SAA5012 i.c. on panel PC1536. It has been overcome by reducing the value of R1131 to 56kΩ. This change might be worth trying where similar difficulties are encountered in the field.

Thorn TX10 Chassis

A new type of focus unit which differs from the original physically is now being supplied. Two hardware fitting kits with instructions for their use come with each unit.

C781 (100μF) in the 1500/1550 series can be responsible for field foldover though reading all right on test.

The position of the i.f. output coil in the tuner unit has been changed. In earlier tuners the coil was mounted vertically on the tuner's board, with access at the side of the tuner casing. In the later tuner the coil is mounted in parallel with the board, with access through the top of the casing. A shorting link replaces R504 with the later tuner. The tuners are interchangeable provided this modification is carried out.

No vision can be caused by failure of the biasing LED D657 on the c.r.t. base panel. After replacement, check that the current flowing through the LED is approximately 20mA. If excessive, check the transistors on the panel for shorts.

C656 on the c.r.t base panel is shown dotted as an optional item in the circuit given in the manual. The capacitor is fitted as standard in later production to avoid slight video instability in a minority of sets, its value being 220pF (250V disc). 0·01μF and 150pF capacitors have been fitted in earlier production.

C783 (240pF) was added, between pins 5 (output) and 4 (chassis) of the TDA3652 field output chip used on the later PC1560 main panel, to remove slight field instability that took the form of a band of interference across the middle of the scan. Two different types of mains filter choke have been used on mains input panel PC1565. The later, larger type can be fitted incorrectly: the correct position is with the winding closest to the mains fuse and filter capacitor. To prevent an unlocked picture at switch on from cold, C742 is now 100μF and C745 220μF. If this trouble is experienced, check the values of these capacitors before adjusting RV742 or RV741.

Thorn TX90 Chassis

In later production the h.t. rectifier diodes have been changed to type BY133GP in place of type BY127 or 1N4004GP.

A modified mains transformer is being fitted to improve the regulation performance under low mains voltage conditions. If vertical bending is experienced under high beam current conditions and the mains supply is known to be at the low end of the range, the new transformer (type 90D3-035-002) may help.

R213 in the trip circuit was changed from 47kΩ to 51kΩ to eliminate tripping under no signal/low brightness conditions.

RV174 (field hold control) is now 100kΩ.

R157 and R151 in the chroma feed to the decoder chip were changed to 1·5kΩ and 390Ω respectively to prevent colour breakthrough on monochrome due to the presence of a spurious residual burst component.

The mounting of R203 in the field output stage is being altered to prevent it shorting to the adjacent transistor clip. As an interim measure a piece of insulated sleeving was added to the clip.

Two different channel tuning/selector switch assemblies have been used. With the 001 version the value of R101 should be 22kΩ; with the later 002 version it should be 47kΩ. An incorrect combination can cause a.f.c. problems.

C12 (0·01μF, 50V ceramic disc) was added between the 18V line and chassis in battery converter TA127 to prevent random dot patterning or swirling lines of dots.

C131 has been changed to 0·22μF (polyester) to eliminate buzz on sound on ch. 8 with certain VCRs.

To avoid sound buzz when used with signals having an incorrect sound-vision ratio, e.g. from a TV games unit or microcomputer, C200 (68pF) is being fitted in place of R122.

To overcome difficulties experienced with the Sinclair Spectrum, R171 has been changed to 270kΩ and R167 to 22kΩ. This change alters the duration of the burst gating pulse.

Thorn 1790 Chassis

Line output transformers and deflection coil assemblies from two different sources are being used in this chassis. The original types have a white line output transformer moulding and rectangular yoke tag panel holder. The later line output transformer has a black moulding. The later yoke can be recognised by the absence of the metal clips that hold the two halves of the ferrite core of the original coils together. The units are interchangeable *in pairs* provided that LK17 is fitted and LK18 removed with the later units and vice versa.

ITT CVC1100 Series Chassis

With the introduction of c.r.t. base panel CMB1100, the focus control has been changed to part no. 3722.20.63 and R1004 (2·2MΩ) in series with the focus electrode has been deleted. The new focus control can be used with both panels – the old one must not be used with the new panel.

The over-voltage protection zener diode D658 should be replaced whenever it has operated, blowing the h.t. fuse Si651.

To operate the switch-mode power supply with no h.t. load, connect a 60W, 240V bulb across the 115V output.

ITT CVC1200 Series Chassis

If the switch-mode power supply fails to start, check for 13V across C703. If the voltage here is low or absent, check the start-up resistor R716 (150kΩ) for being open-circuit or high in value. If necessary check the voltage-limiting diode D702 by substitution (it may appear satisfactory when checked with a meter). The switch-mode power supply may try to start with an audible chirp when D702 is faulty. Also check that the h.f. unit is plugged in correctly as this forms part of the power supply isolated earth path via pins TZ13 and TZ32. These two pins are linked via the metal screening shroud on the h.f. unit. Dry-joints here can cause shut-down, possibly intermittent. The power supply shuts down when the h.f. unit is removed – this does not apply to the later CVC1212 and CVC1217.

If the picture is dark, check the c.r.t. first anode decoupling capacitor C1001 (0·01μF) for leakage.

CVC1210/CVC1215

Link 639 in the beam limiter circuit is fitted in 26in. sets and omitted in 22in. sets. If pulling on peak whites is experienced with a 22in. set, check that link 639 has been removed.

A fluttering picture, particularly noticeable at peak white, can occur with stereo Model ST3493 when there is no AV input. The cure is to add a 10kΩ resistor from the emitter of transistor T3702 to the 12·5V rail – this transistor will otherwise be in an indeterminate state of operation due to absence of a switching voltage. For an over bright display LED when using the video input socket, increase the value of R622 to 3·3kΩ or 3·9kΩ as necessary.

Sound drop out when playing a poor-quality tape can occur with Models 3432 and 3732 that have a discrete component interface board. This is due to the distorted sync pulses from the VCR not synchronising the line timebase correctly, as a result of which the coincidence circuit mutes the sound channel. To minimise this problem, reduce the value of C1061 on the interface board from 470pF to 220pF.

Brightness

The tubes used in some ITT sets produced during 1983 had a longer than normal settling down period. This may result in a rather bright picture. To compensate, reduce the setting of the first anode preset control by a small amount, then check the grey scale setting. If the viewer normally uses a remotely controlled set in near darkness, it may be advisable to alter the range of the preset brightness control for a darker picture. Change R1447 to 5·6kΩ and R1449 to 18kΩ. These two component value changes must be made at the same time.

VCR Model VR3905

Intermittent or complete loss of the clock/function displays can be caused by the material used to coat the clock display board – it appears to be hygroscopic. The remedy is to peel off the coating carefully, taking care not to damage the board. If the symptoms persist, clean the board with a solvent such as RS 555-207. The same plastic coating has been used on other panels, including the mechacon board, and is suspect for other fault symptoms.

ITT CVC25 Chassis

Failure of the EW correction transformer L22/L23 can be the result of C701 (100μF) which decouples the 12V supply on sync/line oscillator panel CMS30 going low in value. This usually results in the line oscillator squegging audibly at switch on. EW correction transformer part no. 06575 must be used in this chassis. If the width is unchanged when the driver transistor T13 is shorted across from emitter to chassis, suspect the EW modulator diodes D24/5: if these are o.k., the transformer is probably faulty.

ITT CVC30/32 Chassis

When servicing sets fitted with these chassis, check scan correction panel CMZ30 or CMZ31 in the vicinity of connection pin Y10 for signs of overheating. This pin carries the line scan current and a poor solder joint here will result in arcing and burning. Problems in this area usually result in power supply tripping and eventual failure of the BU208 line output transistor.

Control Panels

Operation of the on/off switch over a period of time in sets fitted with control panels CMC50/54/63/67, i.e. some versions of the CVC25/30/32 chassis, can result in stressed solder joints at the junction of the switch connections and the copper pads on the board. Sets where the switch is soldered directly to the panel without any other form of mechanical support should be carefully checked when serviced. If damage to the copper or base material has occurred, it's best to hard wire the four unused connections on top of the switch to the appropriate copper pad farthest from the switch on the underside of the board, using 16/0·2mm wire with insulation thickness of at least 0·5mm. Two brown and two blue insulated leads approximately 12cm long will be required. The problem does not arise with later sets that have additional mechanical support for the on/off switch.

What's Up Doc?

Les Lawry-Johns

We get so used to our own ways of going about things – diagnosing troubles in errant TV sets, putting things right after a preliminary examination or not putting them right after jumping to a wrong conclusion – that I thought my recent experiences of another sort might make an interesting comparison.

The Swelling

Over a year ago I noticed that the right side of my stomach was larger than the left. I didn't take much notice, and the months went by. Then niggardly pains started, and so did Honey Bunch.

"You've got to get something done about it."

"Yes dear."

The pains got worse so I eventually went to the doctor, who said I'd better see a consultant. This I did.

First a nurse weighed me and measured my height.

"Aren't you tall?" she smiled.

"And good looking with it" I smiled back.

"Now take your clothes off and lie down."

The things these girls say nowadays. But I did as I was told. Next the consultant's understudy came along to ask a few questions.

"Why did you leave it so long?"

"Because I thought it would go away."

"Where does it hurt? Put your finger on the place."

"Mainly about here."

So he pressed and probed and I jumped about a bit.

Then he explored my private parts, holding my testicles.

"How many have you got?"

"How many of what?"

"What I'm holding."

To say I was put out would be to put it mildly. I'd always assumed one had two, and here was a man asking whether I'd any more.

"Just two" I said in a small voice. "How many am I supposed to have?"

"Two of course. But sometimes one gets lost inside you see."

I couldn't, so I settled back so that my mind could assume its usual blankness.

"Turn on your side" I was told briskly. As I did so I snatched a glance at what was going on. The nurse had handed the doctor a long chrome stick with a bulb at the end of it, and he was coming towards me. "Hang on" I panicked. "What are you going to do with that?"

"Examine your rectum of course. Now keep quiet and relax. It won't hurt all that much."

But it did. I never knew what heaven was. It was when he'd finished.

"There" said the nurse. "That wasn't too bad was it? Mr. X will be in to see you in a second."

I heard the consultant consulting with his assistant who described something as a trifle strange.

Mr. X came across and prodded and probed but fortunately didn't go through the whole procedure again. "Hum" he said when he'd finished his examination. "You'll have a blood test and an X-ray, then we'll see you again."

So I visited various departments and eventually went home to await instructions. H.B. wanted every detail of what had transpired. I told her most, in hushed tones.

"You poor dear. It must have been terrible, being the first time."

I never really know whether such concern is genuine or not.

Back to Work

After a cup of coffee I started on the jobs that had come in during my absence. A Philips G8, a G11, a Bush T20 and a Pye 697. First the G8.

It was a late one with touch tuning, in a white cabinet. The 800mA h.t. fuse on the line output stage panel had failed, so we looked at the line output transformer with suspicion. It seemed to be fairly new, so we made some other checks. One of the BU105 line output transistors was short-circuit. We replaced this, connected the meter across the fuseholder, and switched on. Nothing, except a reading of a few milliamperes. So we could fit a new fuse and then proceed to find out why there was no line drive.

The driver and trigger amplifier stages were in order, so we turned the set up to find out what was happening under the line oscillator section. A nice board crack had stopped the start-up system working. After repairing this a raster appeared – a very bright one with no control. To cut a long story short, a wirewound resistor in the 12V supply was found to be dry-jointed. When this had been seen to a picture that only required converging appeared. We then had a very nice display.

A Headache

The T20 gave us a headache. It would go for a long time before it cut out. When it did everything reverted to normal. So no fault could be found because there wasn't one.

The next time it went off we hooked a 10kΩ resistor across 4C19 to keep the line oscillator working. When it went off again we found that the line driver transistor's collector voltage was very low. We accused it of shorting intermittently and fitted a replacement, which didn't help. We then checked the voltages in the stage more carefully and changed this, that and the other. Eventually we found a burn mark on plug 4Z2 which links the timebase and line output panels. Pin 2 (black, earth lead) wasn't making good contact and this was the cause of the trouble. It's been reported in these pages before, for example by Mike Dutton in the March issue, but is one to watch out for as the results are so confusing.

The G11

The complaint with the G11 was a horizontal white line. The field timebase supply fuse was intact and after fitting a new TDA2600 chip a full raster appeared. It collapsed to a white line when the heatsink was touched. So we fitted a new holder for the chip and all seemed to be well.

No Picture

The complaint with the 697 was no picture. Our first move with these sets is to switch on and see what works and what doesn't. If the valves warm up we take tube base voltage readings to see whether it's a simple case of a low-emission PL802 luminance output valve. If the cathode readings are over 200V, this could well be the case. The first anodes should be at around 400V if the line output stage is working, and there should be some 100V at the grids. If the grids are at a negative voltage we dive straight for the 200 + 300μF main smoothing block. In this case we chose to read the green gun voltages. The cathode was high with the others normal. So we changed the PL802 and got a small green screen. Measurements were then made on the red and blue guns. Each grid was heavily negative. The main smoother was at fault after all. It seems we have to change one of these daily of late.

Monochrome Portables

Another common fault seems to be putting in an appearance more frequently. Lots of imported monochrome portables come our way with the complaint no raster and no e.h.t. due to no line drive. In each case the small resistor feeding the collector of the line driver transistor via the transformer has been found to be open-circuit. This is a small-wattage (for safety) resistor of some 20-47Ω. It often stands clear of the panel and has sleeved legs, but not always.

ITT CVC30 Series

We've had a lot of CVC25/30/32s in recently. Although the faults have varied several have exhibited a common failing, field collapse. The easiest to cure cause of this is poor soldering to the metal frame earthing tags at the field output, top left centre, so this is what we look at first. If necessary we then let the main frame down and remove the small panel on top of the scan coils. Examination of this will nearly always show where overheating has taken place, and reversing the panel will show what has to be done by way of making good. One then has to decide whether to improve the plug-socket contact or wire the contacts directly.

TV Test Pattern Generator

Part 1 **Tony Jenkins, G8TBF**

Now that off-air BBC and IBA test pattern transmissions are so infrequent, service engineers are having to rely increasingly on test pattern generators. Several designs have already appeared in this and other journals. For this latest project we decided upon a generator that produces a single composite pattern similar to the broadcast ones. The main reason for this is that with the possible exception of full screen colour bars, which can be very useful for colour decoder setting up, a composite pattern is really all that's necessary in the workshop. Ideally, the pattern generator should be permanently wired up to a signal distribution system and left on all the time so that engineers have the pattern available constantly, needing only to plug in the TV set or VCR.

Use of EPROMs

Another consideration was that the unit should be simple to construct and set up, and be capable of being adapted to suit particular requirements if required. For this reason the pattern is coded and stored in a set of EPROMs (erasable, programmable read-only memories). This results in an extremely stable display, a comparatively simple circuit and the ability to alter the pattern simply by changing one or more of the EPROMs. In fact the main restriction on what can be put into the pattern is the imagination of the person devising the programme. A set of preprogrammed EPROMs will be made available to produce the pattern shown in Fig. 1 (though in colour of course). This differs quite markedly from the pattern shown on our front cover (that pattern was produced by the author's original programme), illustrating the sort of changes that can be made without any circuit modifications.

Arrangement of the Raster

The active area of the raster is divided into an array of character cells, 65 across by 35 down. Each of these has a corresponding location in the control EPROM (IC12, Fig. 2) where a code for the character to be displayed in that particular location is stored. Each character is made up of 64 pixels (picture elements) in an eight by eight matrix. By appropriate programming of the relevant locations in the three (one each for red, green and blue) character generator EPROMs (IC16/17/18), each pixel can be set to any one of eight colours. Any character cell in the display can be set to any of the 256 possible programmed characters. In addition, the background level of each cell can be set to either black or grey.

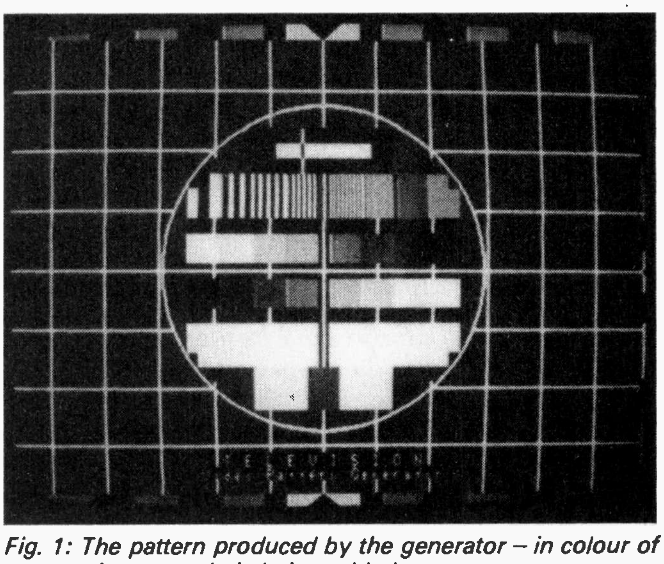


Fig. 1: The pattern produced by the generator – in colour of course. A grey scale is being added.

Timing and Sync Signals

All the timing signals used in the unit are derived from the output of a 20MHz crystal oscillator built around two sections of a 74LS04 hex inverter (IC1). This feeds two dividers, a 74LS92 (IC4) that produces outputs at 6·66MHz, 3·33MHz and 1·66MHz, and half a 74LS393 (IC3) that produces outputs at 10MHz, 5MHz, 2·5MHz and 1·25MHz. These frequencies are all used in the frequency gratings circuit: the 10MHz and 2·5MHz signals are also used as clock signals for the rest of the circuit.

The 2·5MHz output drives the clock input of a ZNA234E pattern generator i.c. (IC8) which is used in this circuit as a source of high-quality sync and blanking signals. A small amount of additional circuitry, using IC10 and IC11, provides field sync and an even/odd field signal.

Operation of the Control Circuitry

The 10MHz output is used as a "dot clock", each pulse advancing the dot and column counters and shifting data out of the three 74LS166 shift registers (IC19/20/21) used for parallel-to-serial conversion of the data from the character generators. After every eight pulses, corresponding to one character cell, the dot counter gives a carry pulse which simultaneously clocks data from the control EPROM into the 74LS374 latch (IC13), loads the information for the pixels in this line of the next character into the 74LS166s, clocks the function latch and increments the column counters.

This rather complex sequence is necessary because a new character is required every 800nsec (eight cycles at 10MHz) but the EPROMs used have an access time, giving a delay, of about 450nsec each. There's a total delay of about 900nsec before the information required is available. To get round this problem, information is taken from the control EPROM two character locations in advance. At the end of each character cell, this information is stored in the data latch. The character generators thus get the data they need one character in advance, while the last lot is still coming from the shift registers. This sequence of operation enables the circuit to work with EPROMs having an access time of up to 800nsec.

The dot and column counters are clocked continuously, not just during the displayed part of the line, and are preset by the line sync pulses from the ZNA234E to a number just under the maximum possible count. They then count during the back porch period, reaching char-

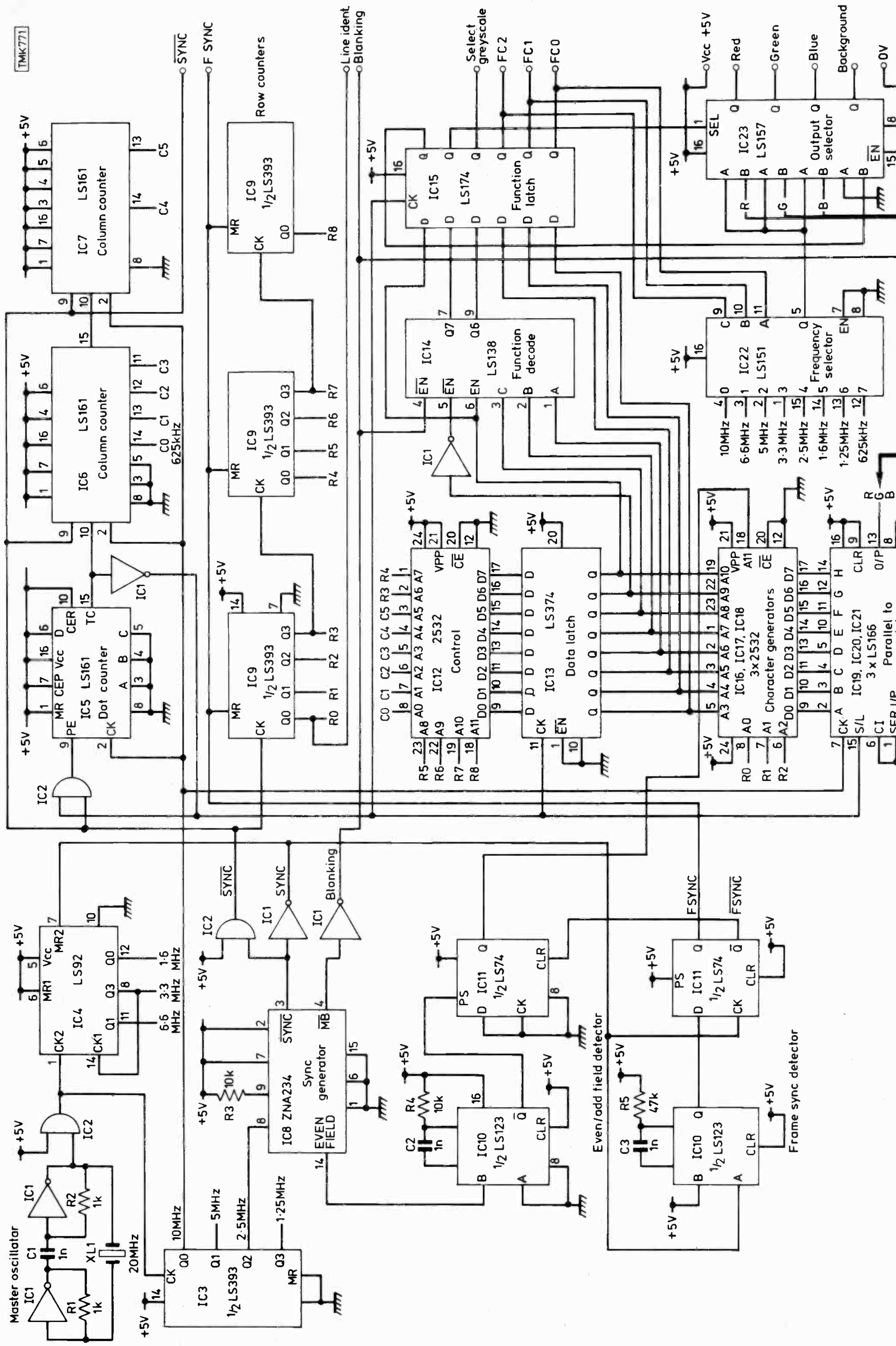


Fig. 2: Logic board circuitry.

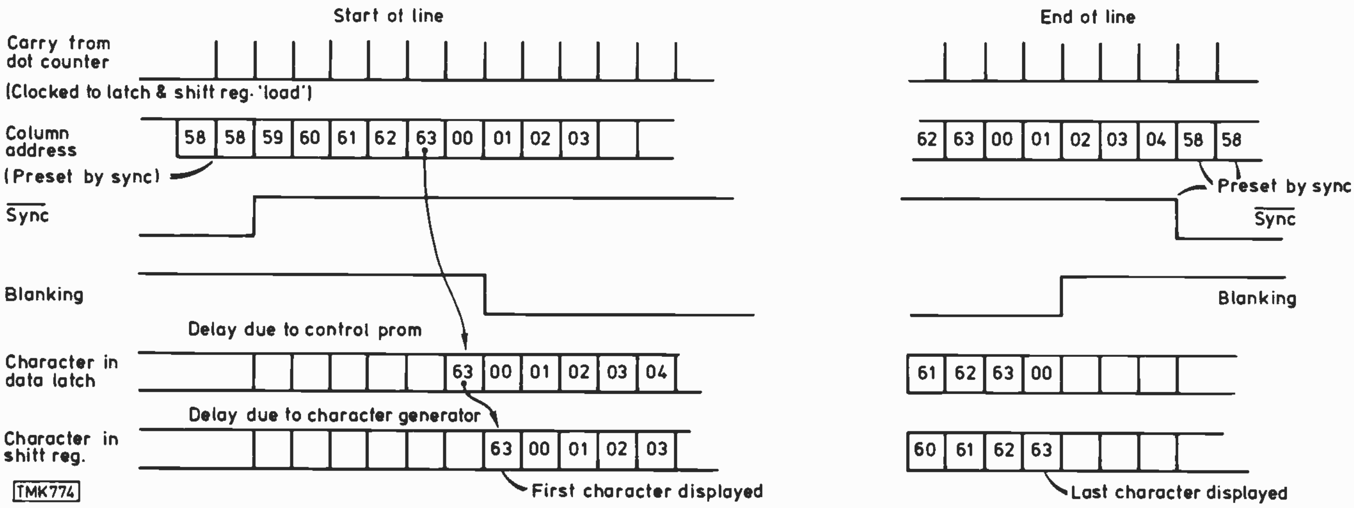


Fig. 3: Column counter and character timings – not to scale.

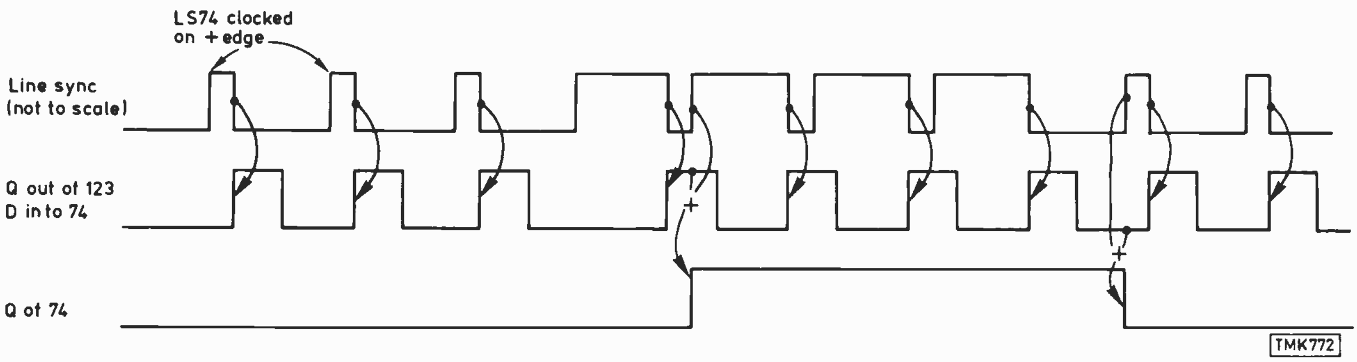


Fig. 4: Field sync pulse generator waveforms.

acter 63 coincidentally with the end of the blanking pulse. Note that character location 63 is used twice on each line – as the first character of the left-hand border and the last of the right-hand border.

The row counters are simpler in operation, being advanced one count by each line sync pulse and reset by the field sync pulse. The outputs R0, R1 and R2 from the row counter are fed to the character generators to control which of the eight lines of each character is to be displayed on the line being scanned. Outputs R3-R8 go to the control EPROM, giving the number of the character row being displayed.

To Follow

Next month we'll deal with the colour encoder and power supply sections of the unit.

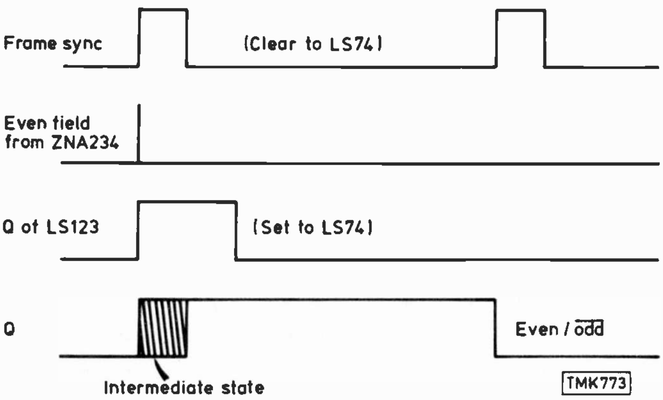


Fig. 5: Odd/even field detector operation.

Components list: logic board

Resistors:
R1 1k
R2 1k
R3 10k
R4 10k
R5 47k
All ¼W, 5% carbon film.

Capacitors:
C1 1n
C2 1n
C3 1n
All 10%, 63V polyester (Dubilier MMP1)

Several supply decoupling capacitors will also be required – details will be given later when construction of the board is dealt with.

Miscellaneous:
XL1 20MHz crystal in HC18/U case.
PCB

Semiconductors:
IC1 74LS04
IC2 74LS08
IC3 74LS393
IC4 74LS92
IC5 74LS161
IC6 74LS161
IC7 74LS161
IC8 ZNA234E
IC9 74LS393
IC10 74LS123
IC11 74LS74
*IC12 2532
IC13 74LS374
IC14 74LS138
IC15 74LS174
*IC16 2532
*IC17 2532
*IC18 2532
IC19 74LS166
IC20 74LS166
IC21 74LS166
IC22 74LS151
IC23 74LS157

* A set of preprogrammed EPROMs will be made available to readers.

The Saticon Camera Tube

David K. Matthewson, B.Sc., Ph.D.

The initial stimulus to the development of single-tube colour cameras was the need for compact, lightweight units for ENG use. Once tubes for this purpose had been successfully developed, it became possible to produce colour cameras at a price suited to the domestic market. Colour tubes used in domestic colour cameras include the tri-electrode vidicon, the Trinicon (Sony) and the colour Saticon.

The Tri-electrode Vidicon

The most widely used tube is the tri-electrode vidicon. As with other vidicons, this has an antimony trisulphide photoconductive layer. The difference with the tri-electrode type is that the incoming light passes through a red, green and blue striped filter which is bonded to the tube's faceplate. A tri-electrode mesh is mounted behind the photoconductive layer with the electrodes arranged to correspond with the filter stripes. In this way separate RGB outputs are provided. Fig. 1 shows a very simple block diagram of the electronics required with a tri-electrode tube.

Whilst vidicon tubes are inexpensive and robust, they suffer from various limitations. The dark current is high, the sensitivity low at low light levels, and there's a tendency to image lag – if a camera is left looking at a contrasty scene for a few minutes and then moved, the old image may briefly remain as a ghost image.

The Saticon

Like the vidicon, the Saticon, which was developed by Hitachi, is a photoconductive tube. The photoconductive layer consists of a selenium-arsenic-tellurium compound however. Advantages of this include very low lag, higher sensitivity and a spectral response that more closely approximates that of the human eye. The colour fidelity of a camera fitted with a Saticon tube is noticeably better than that achieved with a vidicon tube. There are one or two disadvantages, though these are not too important. The low lag can cause problems – fluorescent tube flicker that would be hidden by a vidicon's slow response can show up unless care is taken to avoid this. In addition the photoconductive target can be damaged by exposure to high temperatures – if you leave the camera in a car boot on a hot day for example. Exposure to 75°C for three hours will reduce the tube's sensitivity by 20 per cent.

Colour Version

The colour filter stripe system used with the Saticon tube is quite different from that used with the tri-electrode vidicon. It's based on the system originally developed by RCA for use with their Spectraplex tube. If the filter consists of clear sections (for the luminance signal) and two sets of colour stripes (to give two colour signals) and a single composite output signal is taken from the tube, this output will consist of three basic components (luminance plus two colour signals) that can be separated by filtering. The luminance signal is not much of a problem: it can be separated from the higher frequency colour signals by means of a low-pass filter. The problem is to distinguish between the two colour signals.

The original RCA system used a two-carrier approach. Yellow (−B) filter stripes were laid down on the tube face vertically while cyan (−R) filter stripes were laid down diagonally – see Fig. 2(a). Since different spacings were used for the yellow and cyan stripes, the output contained two carrier frequencies, modulated by B and R respectively, corresponding to the stripe frequencies. These signals could be separated by using bandpass filters (the carrier frequencies were 3·5MHz and 5MHz with the original 525-line Spectraplex tube).

The Saticon tube uses a single-carrier approach. As shown in Fig. 2(b), both sets of stripes, again yellow and cyan, are laid down diagonally. Several factors determine the actual carrier frequency with this technique, the main one being the pitch of the filter stripes. The exact formula is as follows:

$$f = [W/(P \times T)] \times 10^3$$

where f is the frequency carrier in MHz, P is the stripe pitch in μm, W the line scan width in mm and T the line scan time in μsec.

As with the Spectraplex tube, the luminance signal can be separated by means of a low-pass filter. The two colour signals can be separated electronically since there's a phase difference between them. Fig. 3 shows a simple block diagram of the electronics required.

Let's consider the effect of the cyan filter – see Fig. 4.

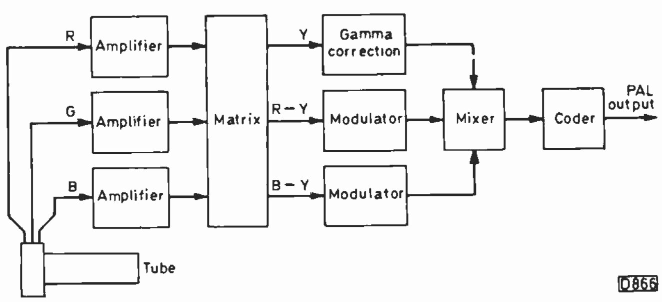


Fig. 1: Block diagram of the electronics required with a tri-electrode vidicon tube.

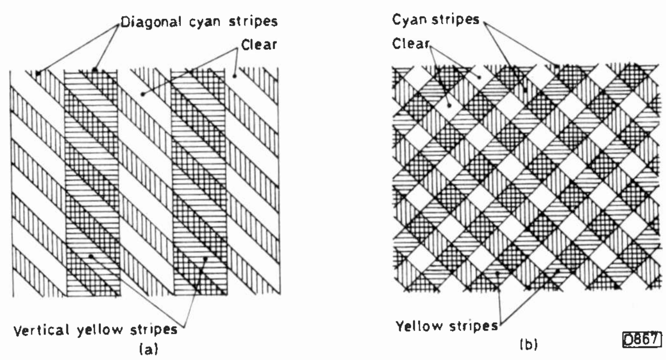


Fig. 2: Filter stripe arrangements used with electronic colour signal separation. (a) RCA Spectraplex tube. (b) Saticon colour tube. Arrangement (a) gives rise to two different colour carrier frequencies. Arrangement (b) introduces a 90° phase shift between the two colour signals.

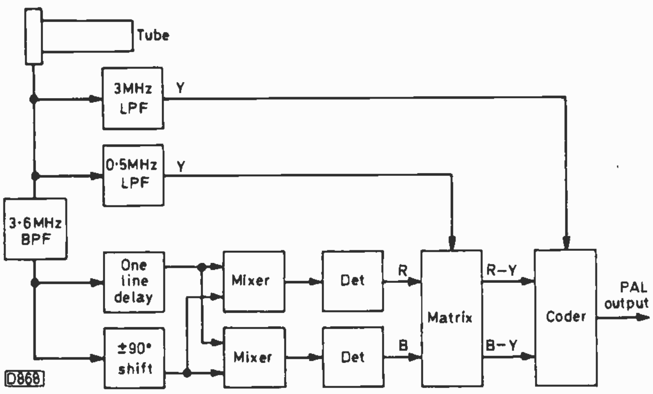


Fig. 3: Block diagram of the electronics required with a Saticon colour camera tube.

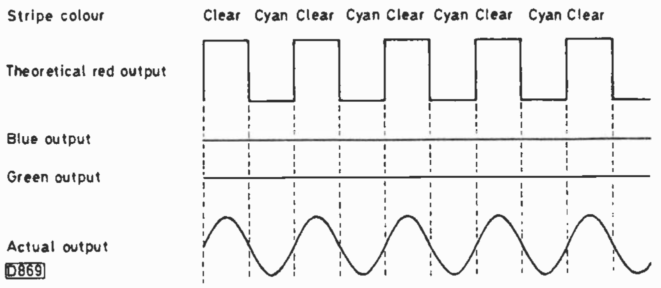


Fig. 4: Effect of the cyan filter in the Saticon tube.

Suppose the light source is white, which of course consists of red, blue and green light. The cyan sections of a line will block the red component of the light, passing the green and blue components. The clear sections will pass all the light. There will be no difference for blue and green therefore but there will for red. What we will get in theory is a squarewave corresponding to the red light present. The same applies to the yellow filter, only this time the output corresponds to blue. In practice the output will not be a squarewave. Due to the system limitations we end up with sinewaves corresponding to the red and blue light inputs. The carrier frequency is 3·6MHz.

Fig. 5 shows how these two signals are separated. If two

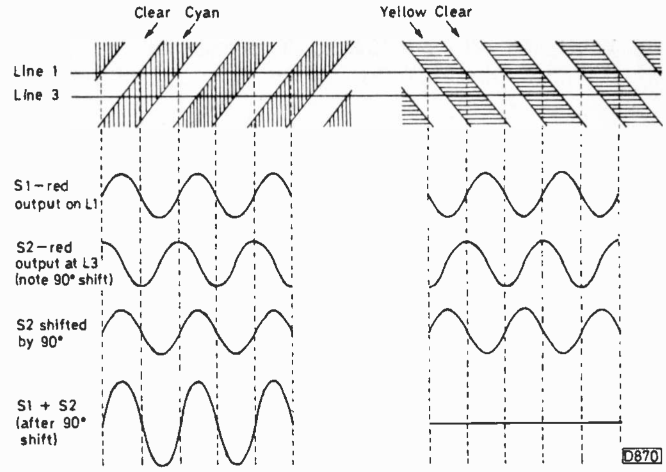


Fig. 5: Colour signal separation with the Saticon tube. The use of a 90° phase shift, a 64μsec delay line and addition gives signal reinforcement or cancellation.

adjacent lines of an odd field are called L1 and L3, then as shown the output from the cyan filter area will be two signals S1 and S2 with a phase difference of 90°. The yellow filter will produce similar outputs, but since the stripe angle is reversed the phase shift is in the opposite direction.

The colour component of the composite signal is filtered out by a 3·6MHz bandpass filter (see Fig. 4) with a bandwidth of 0·5MHz. This is followed by phase shift and delay circuits which enable the signals to be separated – the principle is similar to that used for PAL delay line signal separation.

The system works very well in practice, though problems can occur when shooting a finely patterned object where the pattern frequency approaches the filter pitch frequency. This can cause a beat signal that produces a false colour output – usually seen as a green fringe or patterning. To help overcome this problem, a crystal filter that reduces the system resolution can be incorporated in the faceplate. Even with this limitation, a respectable horizontal resolution of 260 lines is obtained.

TV Fault Finding

Reports from Malcolm Burrell, Mick Dutton, Tony Thompson, John Coombes and G. R. Wilding

Philips TX2 Chassis

This monochrome portable suffered from field cramp. The voltages around the field output stage were correct, but we noticed that the field hold control was set to one end of its travel. So we moved over to the field oscillator circuit. Once again the voltages were correct, and the two transistors measured o.k. when checked with the AVO meter. For want of anything else to do we decided to try transistor substitution. When TS401 (BC558) was replaced the fault had gone and the field hold control provided locking at the centre of its range. **M.D.**

Noisy Controls

There seems to be a common belief that the cause of a noisy control is always a faulty carbon track. This may of course be the case, but I tend to find that the usual cause of the trouble is that the slider has become oxidised and thus makes poor contact with its slip ring. Most controls are quite easy to dismantle, and it's well worth giving both the slider and slip ring a scrape then a smear of silicone grease before reassembly. Even though the carbon track still has score markes left by the slider, in most cases you'll find that the slider itself was the cause of all those crackles. And this method of cleaning, particularly when the correct replacement isn't to hand, is vastly preferable to the quick squirt of fluid that seems to go everywhere but inside the control. **M.B.**

ITT CVC25/30/32 Chassis

For excessive height with these sets, check D2002 (ITT921) by replacement. It's part of the discharge circuit on field timebase modules CMF25 and CMF30. **J.C.**

Fidelity FTV12

The customer who brought this set in didn't want to wait. Said it was dead, he was in a hurry, and would I phone when it was o.k.? After I'd removed the cabinet I could see why he didn't want to wait. The scan coil clamp was missing, also the tubular bit that extends from the coils for clamping purposes. Very odd, I thought. After removing the Jubilee clip someone had unsuccessfully tried to use to secure the coils, and wondering why they'd not shattered the tube neck in the process, I noticed that the fuses were missing.

The problem was simple enough to deal with once the fuse had been replaced. No output from the series regulator transistor due to someone having removed the 120Ω resistor in parallel with it. Without this there's no start-up feed. That left the scan coils, which I managed to repair using a plastic self-clamping buckle, part of some scrap coils and adhesive. You can imagine the direction the conversation took when the customer returned. But no he'd not touched it. **T.T.**

Philips G11 Chassis

The usual cause of field collapse in the G11 chassis is failure of the TDA2600 field timebase i.c. (IC2600), possibly in turn due to the h.t. reservoir capacitor C4029 (470μF) – there can be a poor internal earth connection, or possibly on the board. If still in trouble, check the voltage at pin 16 of the TDA2600. The reading should be about 19V. If low or intermittent, replace R2066 (1·5kΩ). **J.C.**

Rank T26A Chassis

Tripping or failure of the power supply fuse 7FS1 (1·6A H.R.C.), possibly intermittently, can be caused by the overvoltage crowbar thyristor 7THY2 (S2062D) or the diodes in its gate circuit going leaky – these are 7D12 (1N4148) and 7D13 (BZX79-C27). If still in trouble check 7C5 (47μF) by replacement – note correct polarity.

In the event of no sound or raster, check the EW modulator diodes D10/11 (type SKE2G2). They tend to go open-circuit. If replacement restores sound but there's still no raster, check whether D12 (BY228) is short-circuit. **J.C.**

Toshiba C1410B

For the dead set symptom (no sound or raster with the tube's heaters out) check the mains fuses F801/2 (1·6AT). If these are open-circuit, check the mains bridge rectifier diodes D801-4 (1S1887s) for shorts. If the fuses are all right, suspect the mains transformer T802. **J.C.**

Philips G11 Chassis

If the volume, brightness and colour controls don't operate either manually or remotely, check whether the 12V supply is reaching pin 13 of the SAA5010 chip (IC1) on the remote control receiver panel. If missing, R49 (10Ω) on this panel is probably open-circuit. **J.C.**

Thorn 1500 Chassis

This set worked normally for about a minute after switching on. There was then field collapse – the same symptom occurred after replacing the PCL805 field timebase valve. When the field collapse was present there was voltage at the triode anode and the anode and screen grid of the pentode section of the valve, but no voltage at the pentode cathode, indicating that this section of the valve was cut off. Placing the test probe on the pentode control grid restored the vertical scan, but it would rapidly fall to zero after removal of the test probe. The meter resistance was clearly providing a d.c. path to chassis, thus discharging the coupling capacitor network C73/C76. The normal chassis return path is via a series chain consisting of R99, R98, R100, R104 (top linearity control), R105 and R106 (main field linearity control). The cause of the fault was found to be a hairline crack in the track of R104. **G.R.W.**

Mitsubishi CT2004B

Intermittent height variation in this model can be caused by several things. Check as follows. First the height control VR401 (500Ω) by replacement, secondly the HA11414 timebase generator i.c. (IC401), again by substitution. If the fault persists, check the 20V rail at R416 (1kΩ). Voltage variations here can be caused by fuse F572 (400mA) developing a high resistance internally. **J.C.**

Saba H Chassis

There must be many of these solid-state sets around. They are unusual in employing a TBA500P luminance processing i.c. which can be responsible for spasmodic or drifting change of brightness level. Several component distributors can supply the TBA500, but only the TBA500P is suitable for use in this chassis. Saba themselves cannot supply it but have informed us that the i.c. is available from SEME Ltd., Units 2E and F, Saxby Road Industrial Estate, Melton Mowbray, Leicestershire at £1·60 plus VAT and postage. **G.R.W.**

GEC 20AX Chassis

There were severe, spasmodic brightness variations on this set, throwing suspicion initially on the TBA560C luminance/chrominance signal processing i.c. A check at the c.r.t. base connector however revealed that the brightness variations coincided with first anode voltage variations. R606 (150kΩ) in the feed to the first anode presets was seen to be badly burnt: there was no partial short, and it seemed that the resistor had simply succumbed to the effects of heat and power dissipation. To be on the safe side we fitted a higher wattage replacement. **G.R.W.**

Beovision Hybrid CTV Chassis

Although they use complex circuitry – there are two PL509s, a PY500 and a PY88 in the e.h.t. can – the Beovision hybrid colour chassis have proved to be reliable. A case of a very blurred picture was found to be due to zero voltage at the tube's focus pin, in turn due to zero voltage at the chassis mounted focus control. We then noticed that one of the high-value resistors in series with this control had unsoldered itself and was lying, badly discoloured, at the base of the cabinet. The other resistors in the chain were as new, so there was no apparent reason for just this single resistor burning up. A correctly focused picture was obtained after replacing the resistor, but within minutes there was defocusing as the replacement resistor cooked up. Although the material appeared to be all right, the only possible cause of the trouble was severe leakage across the greenish plastic plate on which the resistor chain and the associated reservoir capacitor are mounted. On cutting out the area adjacent to the burnt resistor – the first in the chain – and supporting a new replacement above it on stiff support wires, no further defocusing was experienced.

Some weeks later however the owner complained that there was no sound or raster. We found that one of the PL509s, the PY500 and the PY88 had grossly overrun heaters, while the heaters of the other valves had hardly visible glow. In addition the fusible resistor in the supply to the screen grids of the two PL509s was open-circuit. This was initially thought to be due to the overheated PL509 passing excessive screen grid current, the prime suspect being a heater-cathode short-circuit, but all the valves and the heater decoupling capacitor concerned were in order. We then thought that the heater circuit wiring insulation – bunched together with many other leads – might have deteriorated due to the heat from the valves. All leads proved to be perfect however when the insulation was tested.

The fusible resistor was next resoldered and the set switched on. Within a minute a strong and unusual burning smell arose from a small, round charred area between pins 5 (heater) and 6 (screen grid) of the underrun PL509's valveholder, on the green plastic board. By first forcing a small screwdriver blade, then a small file, through the charred spot all the carbonisation was removed. This restored normal operation.

Various types of plastic have been found to deteriorate progressively over the years when subject to high voltages and high temperatures, the insulation value falling. Discolouration usually shows this up, as on the board supporting the valveholders. The board that supported the focus components still appeared to be perfect however. **G.R.W.**

VCR Servicing

Part 28 ***Mike Phelan***

This month we'll take a look at the arrangements used to drive the reel motor in the 3V24 – see Fig. 126. The reel motor is in operation in all modes except "stop". It's driven by the now familiar bridge configuration, this one containing nine transistors.

In the 3V23 the reel motor torque is controlled by a power transistor that supplies the bridge. On functions such as record and playback the torque required is low and the transistor dissipates considerable heat. This presents no problems in the 3V23, but in a portable machine a different approach is required. The technique used is to drive the control transistor with a squarewave whose mark-space ratio can be varied in the different modes. Since the transistor will be either saturated or off, the heat dissipation will be minimised.

Control System

The mode is selected by a four-bit signal from the control microcomputer i.c.'s D port. This signal is decoded by IC7 on the servo board to provide ten output lines. Only eight of these are used, but as the microcomputer i.c.'s D0 output is high for all reverse modes and low for the forward ones, this output is taken directly to the reel motor drive bridge.

Outputs Q8 and Q9 from IC7 go to the head servo for speed correction on fast forward and rewind search. Output Q0 (stop) goes to the drive bridge for braking purposes. Q1 and Q2 (fast forward and rewind) are linked. This and the other three outputs are used to operate transistor switches that select reference voltages to control the chopper. In this way the chopper mark-space ratio and the motor torque are varied.

The three reel drive modes are play, (including audio dub, slow and record), unload (taking up slack tape when going from a laced-up mode to stop) and idler (the initial turning of the reel motor to move the reel idler across). It should be mentioned that when play is selected the idler mode is first entered: the reel motor stops, acting as a brake on the take-up reel – as the brake solenoid has been released, the reel is braked. The drum, capstan and loading motors then start, in that order. To avoid overloading the supply, they come in at 100msec intervals. When the after load switch closes, the reel motor restarts in its play mode, acting in place of a take-up clutch.

In the fast forward and rewind search (SFF and SREW) modes, the reel servo i.c. (IC5) acts as a frequency-to-voltage converter and X17 is switched on. Output Q8 or Q9 from IC7 goes high to apply speed correction to the head servo to compensate for the incorrect line frequency (plus 4·3 per cent in fast forward search, minus 5·3 per cent in rewind search).

Circuit Operation

Now to circuit details, see Fig. 127. The chopper transistor is X49, the variable mark-space ratio drive to the base coming from IC10. The two inputs to this i.c. consist of a d.c. control voltage, from IC8, and a 22kHz sawtooth from IC9. The chopper transistor's on time is thus proportional to the d.c. voltage applied to pin 1 of IC10 – this varies with the mode selected.

In the search modes the d.c. control voltage is produced by the reel servo chip IC5. We've met this type of circuit several times before – it's simply a frequency-to-voltage converter that's in this case disabled in modes other than playback by removing the supply to the emitter of transis-

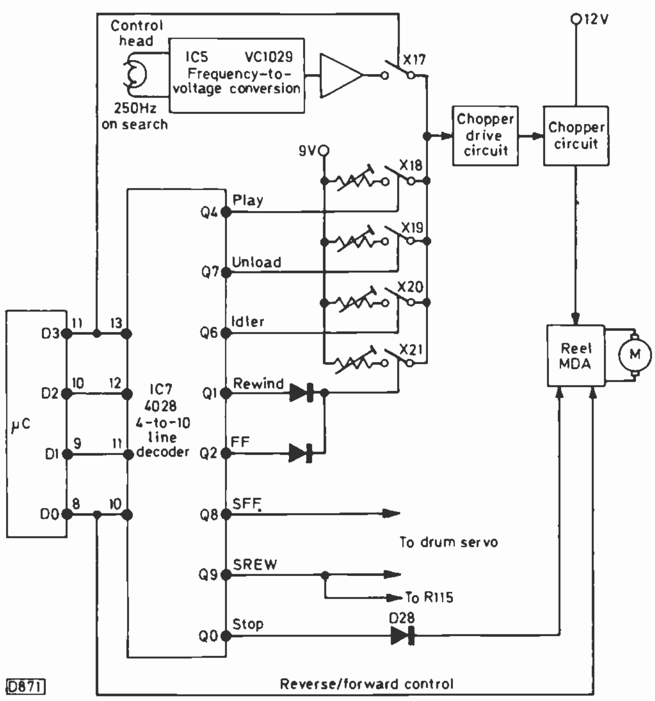


Fig. 126: Reel motor control system used in the 3V24.

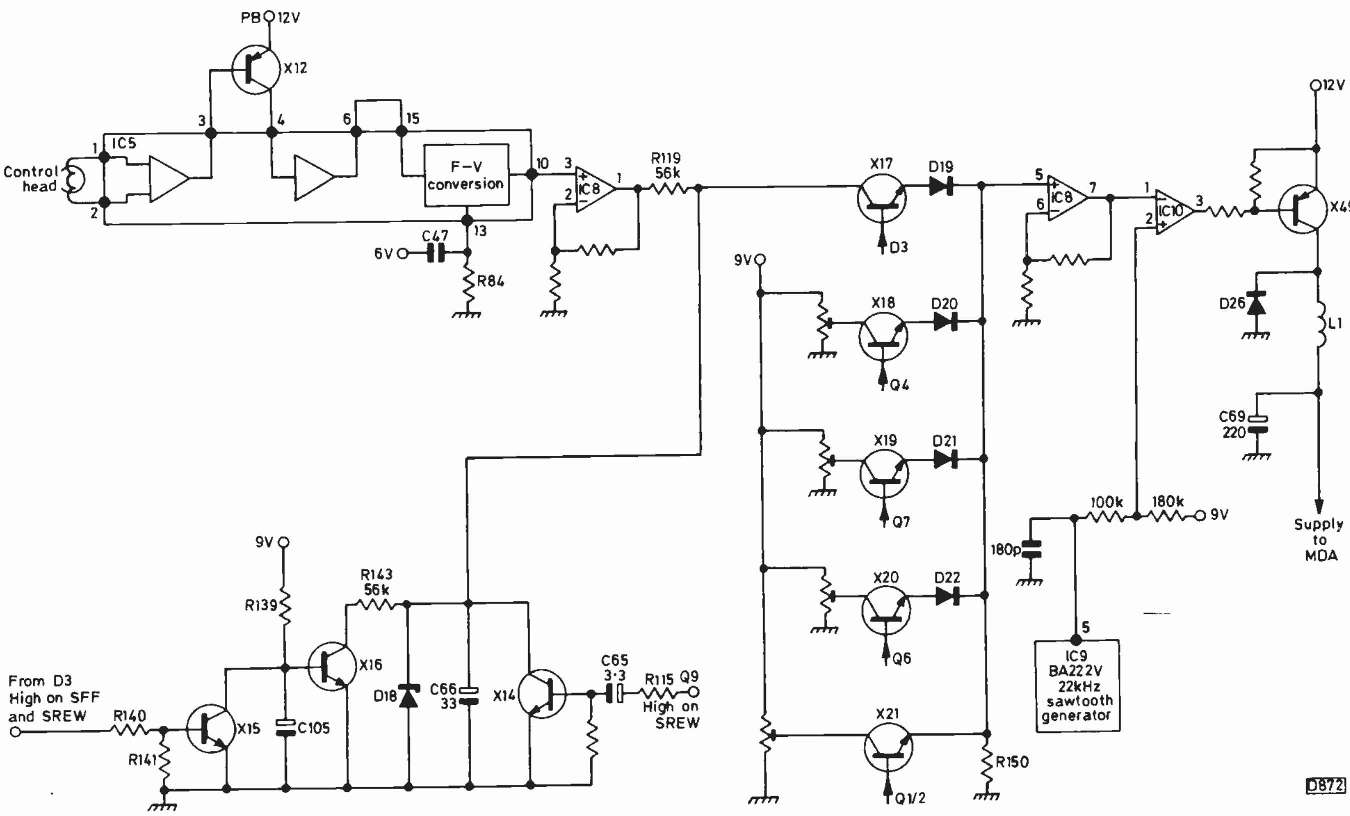


Fig. 127: Circuit details of the reel motor control system.

tor X12. The input consists of pulses from the control track. X17 is used to bring the reel servo into operation. In the other modes, one of the transistors X18/19/20/21 supplies a reference voltage set by a preset control to pin 5 of IC8 and therefore pin 1 of IC10.

Since the motor-drive amplifier requires a d.c. supply, L1 and C69 are used to integrate X49's on/off current. The associated diode bypasses the flyback spike.

By now, someone must be wondering about the other bits and pieces connected to the collector of X17. Imagine what would happen if a few control track pulses went missing during fast search. The reel motor would instantly speed up and the reel servo would take a considerable time to relock. To prevent this, filtering is incorporated. In the play mode, X16 is switched on, the filter time-constant being R143/C66. When fast forward search is selected, the D3 output from the microcomputer i.c. goes high and X15 turns on: X16 then switches off, taking R143 out of circuit to lengthen the time-constant. When the search fast forward button is released, C105 charges via R139 so that the time-constant gradually falls to the playback value. In rewind search the same thing happens but we need to remove the time-constant momentarily while the reel motor's direction of rotation is reversed. To this end the Q9 output from decoder IC7 goes high to turn X14 on briefly: C66 is thus discharged until reversal of the motor's direction of rotation has taken place. C65 then discharges and X14 turns off.

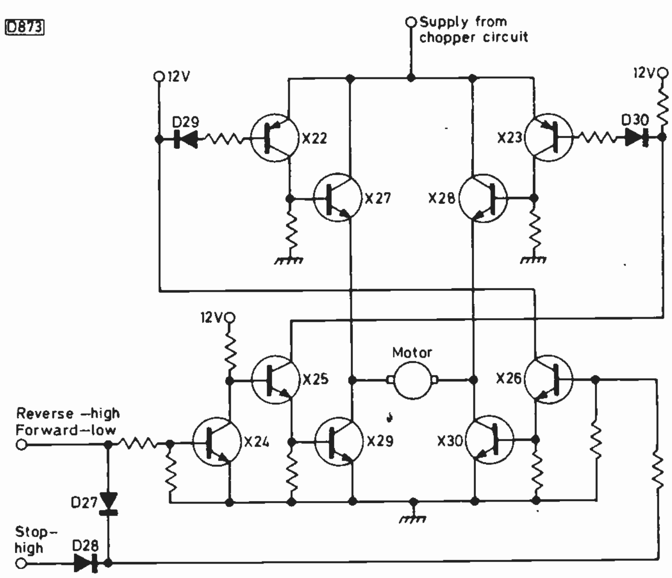


Fig. 128: Reel motor drive amplifier circuit.

Motor Drive Amplifier

Finally the reel motor drive bridge, see Fig. 128. The direction of rotation is set by switching X24 on or off. When it's on, X28 and X29 are off and X27/X30 are on. The opposite situation arises when X24 is off. Motor rotation reversal is thus achieved.

In the brake mode, i.e. during loading and when mode changing, forward rotation is selected (X24 off) and in addition D28 is forward biased. As a result the whole bridge turns on, placing a direct short-circuit across the motor. Won't the chopper transistor disappear in a puff of smoke? The microcomputer i.c. takes care of this by removing the chopper's supply while the short-circuit is present.

What Next?

The 3V24's signals circuitry doesn't deserve any special mention as it's a simplified version of that used in the 3V23 – this has already been covered. Next month we'll look at some common faults on the 3V24 and outline what to look for when buying a second-hand machine.

Vintage TV: The Mysterious Mullard

Chas E. Miller

For a short period after the war, the Philips organisation sold TV receivers under the Mullard brand name. An early example was the MTS389, a 9in. table model for use in the London area. It employed 21 valves plus the c.r.t. – later versions used an extra valve for line sync pulse processing, "to improve performance in areas of weak signal strength". It was an a.c. only design, with mains isolating transformers, suitable for supplies of between 100V and 200V. Well, that's what the book says – perhaps someone can confirm whether this was a misprint or 200V was indeed the highest voltage in London at the time?

Unlike most of the sets of the day, the MTS389 was a superhet, with fairly high i.f.s – 13·2MHz vision and 9·7MHz sound. Seven of the valves were the dreaded EF50s, while a goodly proportion of the rest were types more commonly found in radio sets than TV receivers. Complication starts virtually at the aerial socket, which was for use with balanced-twin 75Ω screened feeder. This was followed by an EF50 r.f. amplifier, no doubt included to induce a false sense of familiarity. There were then two ECH35 frequency changers, one for the sound and one for the vision signal. The triode sections shared a common tuned circuit and were operated in push-pull, the oscillator frequency being 31·8MHz.

The vision i.f. strip used three EF50s and a prodigious number of small components. It was terminated by one of the few genuine TV valves used in the set, an EB91 double diode. The video amplifier reached fresh heights of incongruity: of all the types of valve that could have been used, including the EF50, the designer chose an EBL31. This was a large, octal based double-diode pentode, commonly used in radio sets but even then verging on obsolescence. One of the diodes served as an interference limiter while the other one was used as a low-power rectifier in conjunction with a special winding on the mains transformer to produce a negative supply for the contrast control. The latter provided bias for the first two i.f. amplifier valves.

The pentode section of the EBL33 was operated as a class A amplifier of course, with its cathode earthed and negative bias applied to its control grid. The positive-going video output was a.c. coupled to the tube's grid, with d.c. restoration by means of the other section of the EB91.

An EF50 was used as the sync separator. The problem here was the same as that mentioned recently with the Ferguson 841T – it had to operate with negative-going sync pulses at its control grid. This time the d.c. restorer acted for both feeds, a whopping 220kΩ resistor being used in the feed to the sync separator to prevent it loading the video drive to the tube. The sync separator valve was used as a "grid current and anode saturation limiter", i.e. it was held hard on during the vision signal and was cut off by the sync pulses. This was achieved by cathode bias in conjunction with operating the anode at a much lower voltage than the screen grid (anode voltage 15V, screen grid voltage 145V, cathode voltage 1·7V).

In the original version, the EF50 was followed by a pair of diodes (another EB91) that fed the two timebases. In later versions the EB91 was replaced by a tiny EA50 diode in the field sync feed, an EF91 being used in the line sync pulse feed. This was a strange change. Perhaps when the first service engineer saw an MTS389 he called out "give me strength!" and the request was misunderstood. The EF91 was possibly used more to clean up the signal than to provide amplification: its anode and screen grid were operated from a 10V supply obtained from the cathode of the line ouput valve, with a 270kΩ load resistor.

Maybe Mullard had a glut of ECH35s when this set was built. Two more were used as the timebase oscillators. These were straightforwardly connected as cross-coupled multivibrators, driving pentode output stages. The EL33 field output pentode was choke-capacitance coupled to the scan coils, the trick here being to connect the capacitor at the earthy end of the circuit to ensure that the coils themselves would have h.t. on them to trap the unwary engineer.

The EL38 line output valve was transformer coupled to the scan coils, using a simple two-winding transformer. But what's this? Flyback e.h.t.! The EL38's anode also drove a voltage-doubling rectifier circuit that produced some 7kV for the tube's final anode. Don't go away with the idea that the high-voltage rectifiers used were TV types such as the EY51, with their heaters supplied by windings on the line output transformer. No, a couple of HVR2s were used, large, old-fashioned valves with British four-pin bases and 4V 0·65A heaters. To accommodate their heater requirements, a special highly-insulated transformer was used, with separate windings for each valve. The 6·3V primary winding of this transformer was driven by a separate mains transformer that also supplied the tube's heater.

Focusing was done with an electromagnet, with current by courtesy of the h.t. smoothing network. The tube being a tetrode type (MW22-7 or MW22-14C), a supply of some 335V was required for the first anode. It was taken from the unsmoothed side of the h.t. smoothing network. The h.t. supply used another hangover from the thirties, an FW4-500 directly-heated double diode with a 4V, 3A filament and an envelope rivalling a 500W floodlight. The circuit is shown in Fig. 1. Our kindly designer obviously felt that this powerful valve might find it too much if the

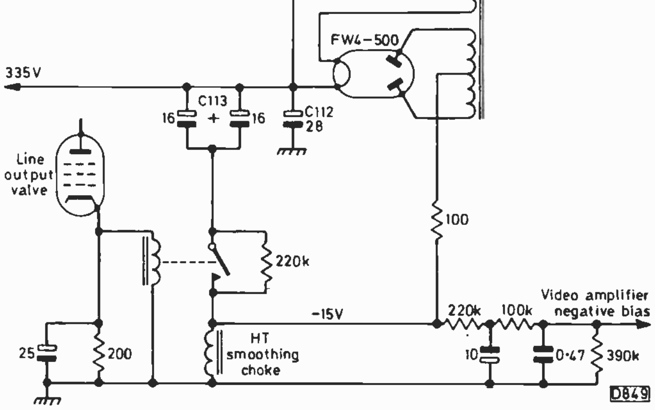


Fig. 1: The full-wave h.t. rectifier circuit used in the Mullard Model MTS389.

full reservoir capacitance was in operation before the set had fully warmed up. So he included a relay in series with part of the h.t. reservoir capacitance (C113) to switch it out of circuit until this stage had been reached. The relay's operating coil was shunted across the line output valve's cathode bias resistor: to keep the capacitor polarised whilst the relay contacts were open, they were shunted by a 220kΩ resistor.

The sound channel was straightforward, with two EF50 i.f. amplifiers, an EB91 detector/interference limiter and an EL33 output valve. A tone control in a complex negative-feedback circuit was provided.

Comparing the circuit with that of some of its contemporaries brings home the fact that for many designers cost was not a primary concern in those days – the Mullard set had over twice the number of small components as some rivals. The old saying "you pays your money and you has your choice" certainly had truth in it then.

Service brain teaser for the MTS389. According to the components list, the screen grid feed resistor (R118) for the ECH35 frequency changer valves consisted of no fewer than twelve 27kΩ resistors in parallel! Assuming that this was not a misprint, what value single resistor would you use to replace them? Answers please to the writer, on the back of a ten pound note. The first correct entrant will receive a mint copy of *Health and Efficiency* for December 1948.

N1500 Clock Repair

John de Rivaz, B.Sc. (Eng.)

In *1984* George Orwell refers to clocks striking 13. Barely had the new year arrived when the clock on one of my faithful N1500s – the subject of speed-reduction articles in this magazine some years back – stopped. A check with the AVO revealed that the clock's motor coil was open-circuit.

Nothing would be lost by attempting to repair it – a new one would probably be totally uneconomic to purchase. Being fastened by two screws, the motor was easily removed from the clock. It's held together through its fixing holes by two hollow rivets which were soon removed with an electric drill. The coil slots in, and was thus easily removed. It also came apart with no problems: there was no glue or mess, the whole assembly being made of plastic, with some yellow tape to secure the turns. As I was unable to find the break I took the existing coil off. There must have been thousands of turns of very fine wire.

Stamped on the motor was the information that it was a 220V, 50Hz type and required a 12kΩ resistor in series. In the VCR however it's driven at 80V, with no series resistor. I get the impression that Philips simply wound on as many turns of that fine wire as they could, said a rude word when they found that 220V was too much, then specified the 12kΩ resistor. The important thing about a coil is the number of ampere-turns, not the voltage across the coil. This fact enables some interesting calculations to be made. The current consumed by the motor is that which drops 140V across 12kΩ, i.e. about 12mA. Its power consumption, assuming a unity power factor, would be 12mA × 80V = 960mW, say 1W.

The motor's power consists of flux reversals in the coil, and it's irrelevant whether these are produced by milliamperes flowing through thousands of turns or amperes flowing through a few turns. It would normally be inconvenient to power a clock by means of an ampere flowing through a few turns, as one would need a transformer to provide that ampere at a suitable voltage. In this case however a transformer is already used (T2). It's also of the type on which it's easy to wind a few turns to get a low voltage. If this clock was purpose-made for the VCR, it seems irrational that Philips didn't use say a 12V winding on this transformer. It would have been cheaper and more reliable.

Having available a length of 0·5mm diameter enamelled-copper wire, I rewound the clock coil using twenty turns of this, the number of turns being the most I could get on. A test with a low-voltage supply and a low-value variable resistor revealed that the clock ran when an ampere was flowing through the coil. The voltage across the clock read 0·1V on the AVO, and this seemed to agree with the earlier calculations.

Ten turns on the transformer produced the desired current in the motor, which ran without any noticeable overheating. It's probable that there's quite a lot of series inductance in the circuit, due to the method of winding, but the required result of an ampere flowing through the clock was achieved. There was some slight noise from the clock however, probably due to slight misalignment of the motor during the violent surgery. This was not objectionable, and could be heard only when I put my ear to the clock. The thickness of the wire used means that the possibility of a further failure of the coil is about as near to zero as one can get!

Anyone wishing to carry out a similar repair should note the following points:

(1) Wind the ten-turn coil on top of the transformer. Take care to avoid any other wires going to the transformer, and don't scratch off the enamel when pushing the wires through the gap. It's not necessary to remove the transformer from the VCR to wind the coil. Push the wire through and catch the end with pliers: feed the wire through with the pliers used to take up the slack. Don't use the pliers to pull the wire through.

(2) Use a meter or other tester to make sure you've located the wires at the transformer coming from the clock. If you don't get the right wires and leave the 0·1V clock coil connected to the 80V winding on the transformer, you could burn the transformer out.

Physical details of the transformer and its position in the VCR are shown in Fig. 1.

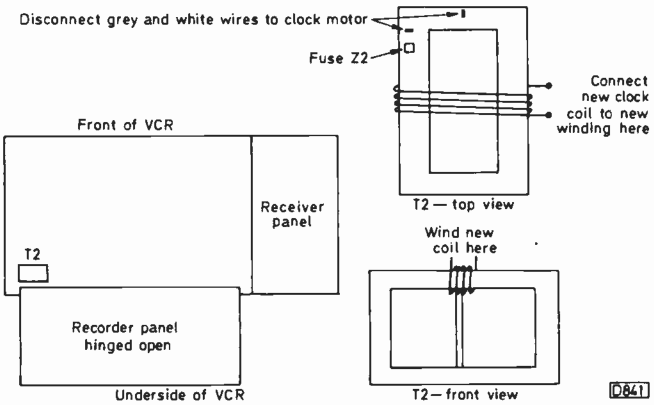


Fig. 1: Transformer details.

The Rediffusion Mk. 5 Chassis

H. K. Hills and A. Mole

The Mk. 5 chassis is used in Rediffusion's 14in. colour portable TV sets – also in models bearing the Doric brand name. It's been in production since 1981 and is based on a Sharp design – in fact similar circuitry is to be found in various Sharp sets sold in the UK. Most of the circuitry is on a single main panel. The class A RGB output stages are on the tube base panel, and in addition there are tuning and selector boards.

The main panel is held in position by mouldings in the cabinet and back cover. Once the latter is removed, the chassis can be withdrawn for servicing by sliding it backwards as far as the leads to the control panel will permit, after which it will stand upright on the three control knobs that normally appear just under the bottom of the tube.

Much of the circuitry is contained in five i.c.s. The design is mostly conventional, with a transistor line output stage and a series chopper circuit which provides a stabilised 115V rail. The way in which the chopper transistor is controlled is rather unusual however, as we shall see.

Signal Processing

A Mullard U322 tuner unit is used. The output from this is coupled to a bandpass shaping SAWF via a single transistor preamplifier stage. There follows a single chip i.f. amplifier which also provides tuner a.g.c. and a.f.c. outputs. The chip complement is as follows:

I201 IX0064 I.F. strip
I301 IX0096CE Intercarrier sound channel plus audio amplifier and output
I401 IX0118CE Luminance signal processing
I501 IX0065CE Sync circuitry plus line and field generators
I801 IX0129CE Colour decoder.

The decoder i.c. provides R – Y, B – Y and G – Y colour-difference outputs which are mixed with the luminance signal in the RGB output stages – luminance goes to the emitters and the colour-difference signals to the bases of the 2SC2229 RGB output transistors.

The Switch-mode Power Supply

The heart of the set is the switch-mode power supply: a simplified circuit is shown in Fig. 1. It's not easy to puzzle out how the circuit works without some clues, as there are two chopper drive arrangements, one for start-up purposes and the other that comes into operation once the set is running normally.

The mains input is fed to a bridge rectifier circuit (so the chassis is at "half mains" potential) which produces some 310V across the reservoir capacitor C706 (150μF). This is applied to the collector of the chopper transistor Q701. At switch on, the potential divider network R716/7/8 provides Q701 with a base bias voltage, via R715. As a result, Q701 starts to conduct, charging C711 and drawing current through the chopper transformer/energy storage inductance T701. By transformer action, a positive-going ramp is produced across pins 5 and 7 of T701, providing positive feedback to the base of Q701 via R712/D710/C712. D710 is included to prevent the bias voltage provided by R716 being shorted out. Q701 is thus driven into the fully on condition. Once this happens T701 no longer provides a base drive waveform. So Q701 switches off. The voltages then developed by T701 reverse: Q701's base is driven negatively and diode D706 conducts, providing the efficiency diode action and clamping Q701's emitter to chassis. When the energy in T701 has been transferred to C711, Q701's base is no longer held off and the circuit can start up again. In this initial mode of operation the circuit is self-oscillating.

Once the h.t. voltage has been built up, the line timebase comes into operation and Q701 is driven by a secondary winding on the line output transformer, via D705/R702/C707 – D705 is included for the same reason as D710. In fact in this mode Q701 is triggered instead of being wholly self-oscillating. By this time C717 will have charged via R719/R720, turning Q704 on. R716 is thus shorted out, removing the initial chopper transistor base bias voltage. The trigger pulse from the line output transformer does not provide full drive: it initiates conduction of Q701 and holds it conductive for long enough for the positive feedback action via T701 to come into effect. It's necessary for the circuit to rely on this feedback so that regulation can be provided.

Q702 and Q703 are used for this purpose. The base of Q703 is fed with a sample voltage corresponding to the h.t. voltage. It drives Q702 which acts as a variable resistor across Q701's base-emitter junction. Q702 thus acts on the drive supplied to Q701, controlling its conduction time in accordance with any h.t. voltage variations.

All in all a neat and rather unusual arrangement. The 160V zener diode ZD702 provides over-voltage protection, conducting and thus blowing the mains fuse in the event of the h.t. rising to 160V.

Shut-down Circuit

Further protection is provided by a circuit (see Fig. 2) that comes into operation under either of three fault conditions: (1) excessive beam current; (2) field output stage failure; (3) excessive line flyback pulse amplitude. In any of these circumstances the voltage across R615, and thus at pin 9 of IC501, rises. IC501 contains the line generator circuit, whose output is inhibited when pin 9 goes high. The line timebase thus closes down, leaving the set in a safe condition. What happens when pin 9 goes low again? The effect of pin 9 going high is to switch the state of a bistable within IC501: so the line timebase inhibition continues when pin 9 goes low. The set has to be switched off for approximately one minute to restore line drive.

The beam current returns to chassis via R624 and R625. Excessive beam current will increase the negative voltage developed at the junction of these two resistors, with the result that zener diode ZD602 will conduct. Q603 in turn switches on to produce a positive voltage across R615.

Conditions in the field output stage are checked by monitoring the voltage at the collector of the "upper"

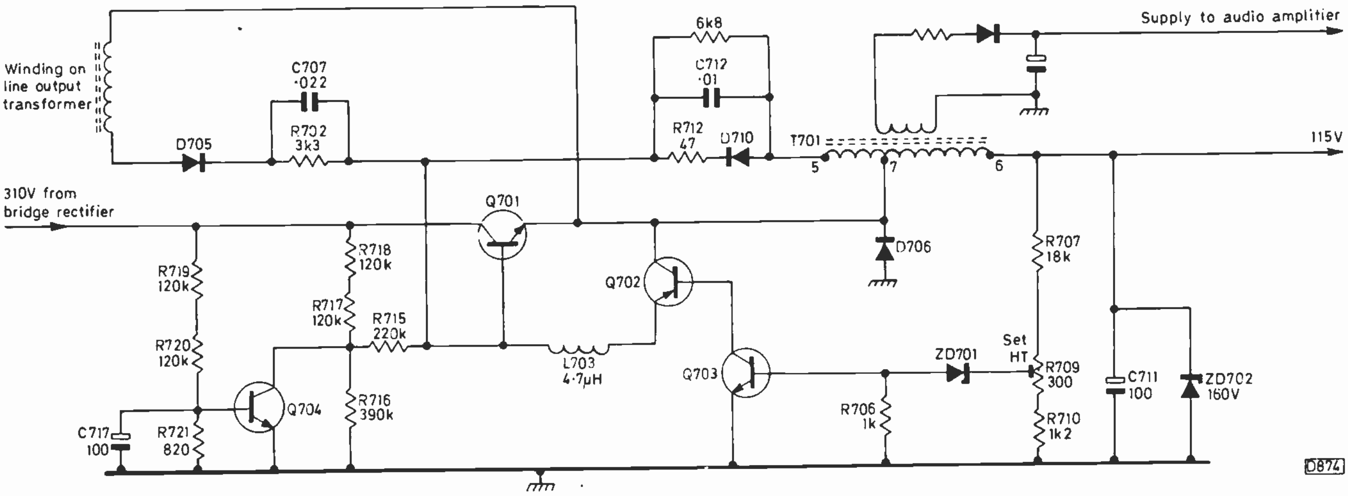


Fig. 1: The switch-mode power supply – simplified circuit.

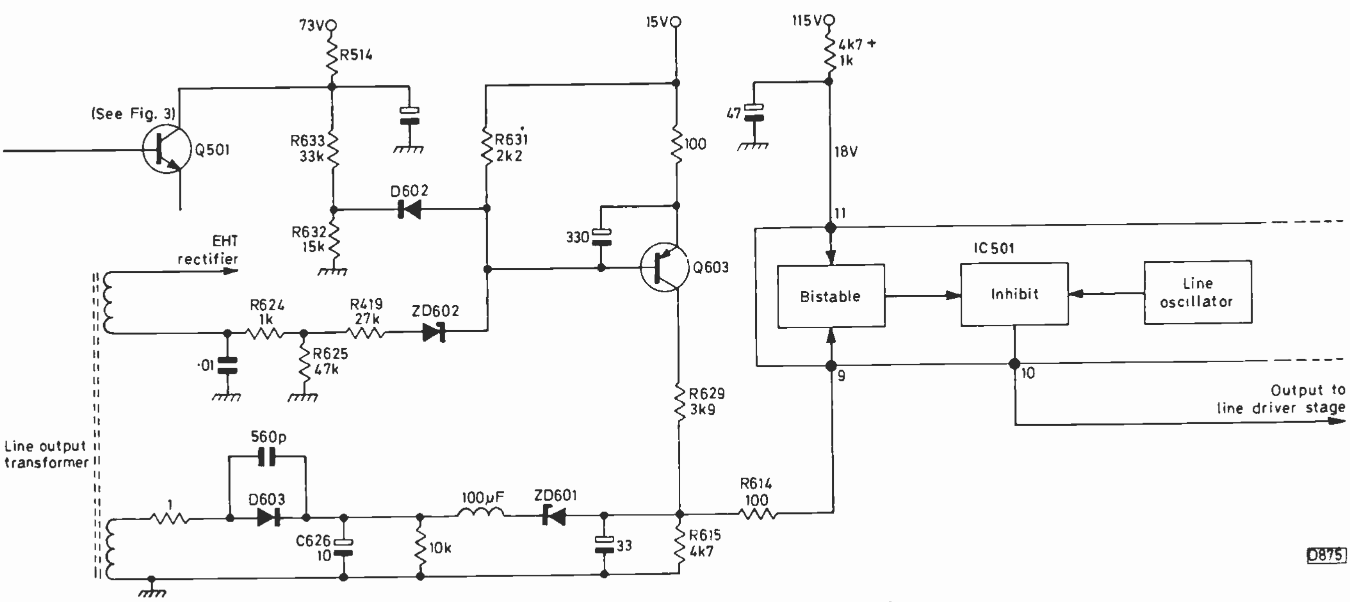


Fig. 2: The shut-down protection circuit.

transistor Q501. In the event of excessive current flowing via R514, D602's cathode voltage will fall below its anode voltage. D602 and Q603 both conduct therefore. This means that a field timebase fault will give the no sound or raster symptom. Fig. 3 shows the field output circuit.

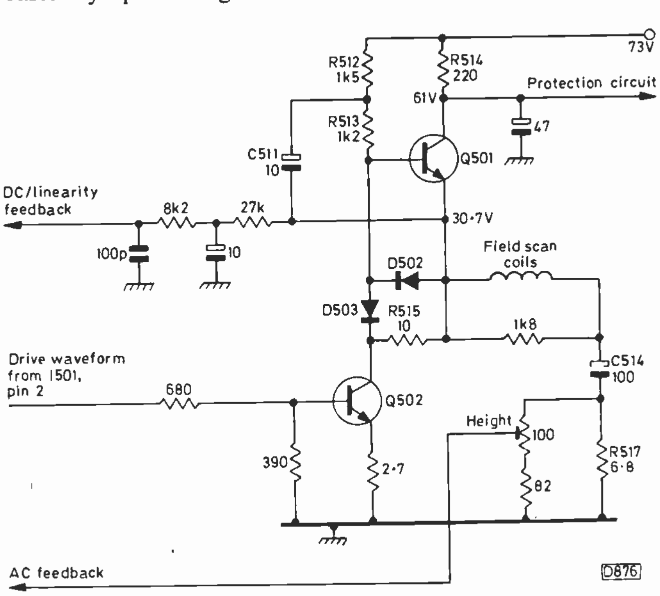


Fig. 3: The field output circuit.

The rectifier circuit D603/C626 produces a voltage proportional to the line flyback pulse voltage. In the event of excessive voltage zener diode ZD601 conducts and a positive voltage is produced across R615.

Timebases

The line driver and output stages are conventional, though it's worth noting that the efficiency diode and line output transistor share a common encapsulation (type 2SD868). The tube does not need EW correction and neither width nor linearity controls are required.

The field output stage looks like a class AB amplifier, but the operation is rather different. During the first part of the scan, i.e. from the top of the picture to the centre, the drive waveform from IC501 holds the lower transistor Q502 lightly conductive. The upper transistor Q501 is forward biased by R512/3, so that current flows through the scan coils, charging the coupling capacitor C514. During the second part of the scan, from the centre of the screen to the bottom, we want the current through the coils to reverse. The drive to Q502 is thus increased, the current through Q502 discharging C514. During this process the voltage across R515 increases: when Q501's base is negative with respect to its emitter it switches off. At the end of the scan, Q502 is saturated and Q501 is cut off. To initiate the flyback, the drive waveform switches

Q502 off. The energy in the coils then produces a half cycle of oscillation. As the voltage swings positive, D502 and the base-collector junction of Q501 conduct, clipping the flyback pulse at about 60V. The beam has then returned to the top of the screen and the circuit action is repeated as the drive waveform switches Q502 on again.

C511 decouples the junction of R512/3 to the emitter of Q501 so that ripple on the supply doesn't affect the conduction of Q501. The 73V line is derived from the line output transformer.

The Mk. 5 chassis is a neat design and consumes 60W. There is also a version with infra-red remote control.

Test Report: Altai DM6013 Capacitance Meter

Eugene Trundle

We already have a capacitance checker in the workshop: it's of honourable and ancient (especially the latter) origin – a Hunt's Model CRB no less. Over the years it's been used to prove the virtues and vices of many hundreds of Hunt's and other makes of capacitors. It has a neon whose one flash per second will indicate 100MΩ of leakage, and a rather nostalgic green magic-eye indicator to wink amiably at you when you've got the bridge balanced. In its old age it's developed a mains leak to the metal case, and our dealings with it now can be alarming – dangerous even, on a damp morning. It's a brave and determined man who will prove his diagnosis on our bridge!

In contrast to this, the Altai digital capacitance meter is a small, hand-held instrument measuring about 18 × 8 × 4cm and working from an internal PP3 battery. It will check capacitors from about 2pF to 2,000μF in eight switched ranges, with an accuracy of 0·5 per cent (± one digit) on the 2,000μF range. The readout is presented on a 13mm 3½ digit LCD display. There's out of range indication and fuse protection against charged capacitors. Battery life is 100-200 hours. The meter comes with two test-clip leads, a spare fuse and an instruction book.

Trial

Unlike many of the instruments we review, this one would see little action if it was installed on the bench to live with us for a few weeks and be used as and when required. So for the purposes of our trial we armed ourselves with a large box of assorted capacitors, including some known bad ones, and put it through its paces.

This produced one or two surprises – relating to the capacitors, not the tester – and taught us something about the very wide tolerances of electrolytics. The closest tolerance capacitors we could find were some 1 per cent silver mica ones. These read within 1 per cent of their stated values, so no quibbles as to accuracy. We found that the 0·1pF resolution on the lowest range enabled us to check very small capacitances such as those present in wiring and between valveholder pins: the capacitance of the test leads could be offset with the set-zero control, which has a range of about ±20pF.

For checking electrolytic capacitors a polarising voltage is present, though no test voltage exceeds 3V peak, an important point when checking certain disc ceramic types. Oscilloscope checks on the waveform across the capacitor under test did not reveal the method of measurement used – various waveforms varying from 8Hz to 800Hz were seen, in the form of quasi-squarewaves and steps. One point that was appreciated was the fast sampling time: the reading stabilised within half a second of finding the right range, though on some ranges it took us several seconds more to work out the *absolute* value in terms of pFs, nFs or μFs (an LED indication of this would have been a help).

We next tried loading the test capacitor with parallel resistance to simulate leakage. On a typical check with an 0·01μF capacitor, leakage above about 1MΩ made no perceptible difference to the reading – lower parallel resistance would reduce the indicated capacitance range and produce different readings as different scales were selected. We had to get below a few tens of ohms to get the over-range symbol (1), and decided that the instrument is not a good tool for detecting leakage. In all fairness, it doesn't pretend to be. Many of the capacitor faults we get are due to leakage rather than changed capacitance value however, so the need for an ohmmeter remains and in most cases this is the instrument we'd turn to first.

The readout is clear and legible, and the built-in prop convenient. The short test leads provided are easy to connect and are all that are needed in most cases – in situ testing is not really relevant with this instrument. The plastic case looks tough enough, and to check the meter's electrical robustness we connected it to a 220μF capacitor charged to 100V; this blew the protection fuse, and no damage was apparent after the fuse had been replaced.

Replacing the fuse gave us an opportunity to inspect the innards. We found nine assorted chips, including a 40-pin LSI decoder/display driver, and twelve transistors. A busy little ensemble! The operating instructions give no clue as to the circuitry, but are otherwise helpful and comprehensive.

Verdict

Capacitors frequently fail, but it's probably true to say that most of these failures will be found more quickly using a multi-range ohmmeter than a special capacitance checker. Certainly the manual bridge type of capacitor tester gave one the "feel" of a capacitor, and an indication of its Q by the sharpness of the balance null: many, including my oldie, could check leakage and power factor.

In view of this, the number of times per year when a tester such as this one will justify its presence in the workshop are likely to be rather few. For laboratory and design use however, and when confronted with boxes of unmarked capacitors, the DM6013 would be of greater use. It would really come into its own for factory quality control or in a goods acceptance department.

As a service practitioner however I have to conclude that the £49 plus VAT of my test gear budget this tester represents would be better spent on a more revenue earning instrument farther up the wanted list, good though the performance and accuracy of this tester are.

The Altai DM6013 digital capacitance meter is available from BK electronics, Unit 5, Comet Way, Southend on Sea, Essex SS2 6TR (telephone 0702 527572). The price includes post and packing.

Classification of Sinewave Oscillators

S.W. Amos, C. Eng., B.Sc., M.I.E.E.

The oscillator, i.e. sinewave generator, is one of the most familiar of electronic circuits. There's a very large number of different types, ranging from the long-established Hartley to the newer tunnel diode oscillator. Despite this diversity, oscillators fall into a very small number of basic categories. In this article the principles of a wide variety of circuits are examined in order to develop a system of classification.

As Fig. 1 shows, all oscillators consist essentially of two sections, one that determines the frequency of oscillation and the other (the maintaining system) that supplies the power required to keep the first section going. The maintaining section requires a d.c. supply of course. With some types of oscillator the output is taken from the frequency-determining section while with others it must be taken from the maintaining section. The need for this distinction will be explained later.

LC OSCILLATORS

A low-frequency oscillator may employ a circuit consisting of a separate inductor and capacitor as the frequency-determining section. At higher frequencies the inductance may consist of a length of transmission line, while at still higher frequencies the frequency-determining section may be a cavity resonator. All these are examples of lumped or distributed inductance and capacitance, and can therefore be grouped together for purposes of classification. A feature they all share is that any signal induced in them causes oscillation at the resonant frequency, i.e. they all ring when struck. Without the energy supplied by the maintaining section, the oscillation would then die away exponentially as a result of dissipation in the inevitable resistance present in any oscillatory circuit.

In many oscillator circuits the maintaining section consists of a single active device acting as an amplifier. This is designed to feed regular pulses of energy to the frequency-determining section of the circuit to ensure a constant amplitude oscillation. The way in which this is done can be seen from the skeleton circuit shown in Fig. 2, which shows an *LC* circuit connected to a bipolar transistor. If we take point *e* as the reference point, when the tuned circuit oscillates the signal at *c* will be inverted with respect to that at *b*. If *b* is connected to the base of a common-emitter amplifier transistor, a magnified and inverted version of this input will appear at *c*, thus maintaining the oscillatory action. In practical versions of the circuit the transistor is often biased off for a large fraction of each cycle of oscillation, conducting for only a brief period on the peaks of the signal. Thus a once per cycle pulse is developed at *c*, in the right phase to maintain oscillation.

To the *LC* circuit, the transistor acts as a source of energy to make up that lost in the circuit resistance. To the amplifier, the *LC* circuit appears as a network that accepts the collector output, inverts it and returns it to the base as an input of sufficient amplitude to maintain the output. As the transistor inverts the signal, this is an example of positive feedback that enables the amplifier to supply its own input. This positive feedback is the distinguishing characteristic of our first main category of oscillators. The *LC* circuit performs the dual function of defining the frequency of oscillation and providing the positive feedback on which the oscillatory action depends. To accept the amplifier's output, the *LC* circuit must have two terminals. Another two terminals are required to deliver the input to the amplifier. One of the terminals can be common to both sections of the circuit however, so that a minimum of three connections is required between the frequency-determining and the maintaining sections of the oscillator. This is true of all oscillator circuits that use an inverting amplifier as the maintaining section. The number of interconnections can be reduced to two if the amplifier section does not provide signal inversion: an example will be given later.

Many of the well-known oscillator circuits differ from each other only in the way in which the connection to the emitter (assuming the use of a transistor) is made. In the Hartley circuit (Fig. 2) the emitter connection is made to a tap on the tuning inductance: in the Colpitts circuit (Fig. 3) the tap is made on the capacitive side of the tuned circuit, using two capacitors connected in series.

In some oscillator circuits the amplifier section is connected to the resonant circuit via one or more inductively coupled coils. Fig. 4 shows three examples. There may appear to be four interconnections here between the oscillator's frequency-determining and maintaining sections, but as two of these are taken to supply lines and are thus at zero signal-frequency potential there are basically only three interconnections.

At v.h.f., u.h.f. and beyond, the internal base-emitter and collector-emitter capacitances of a transistor can provide the required tapping point for a Colpitts oscillator,

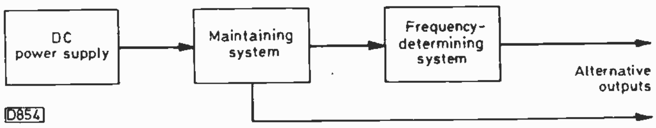


Fig. 1: Basic features of an oscillator circuit.

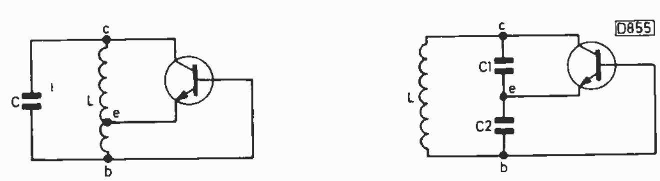


Fig. 2 (left): Basic form of Hartley oscillator.
Fig. 3 (right): Basic form of Colpitts oscillator.

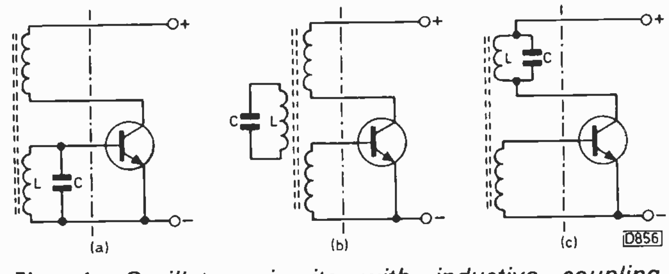
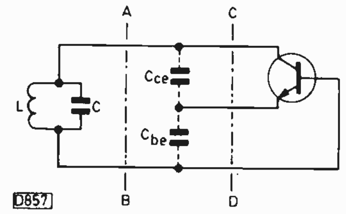


Fig. 4: Oscillator circuits with inductive coupling. (a) Reinartz; (b) Meissner; (c) tuned collector.



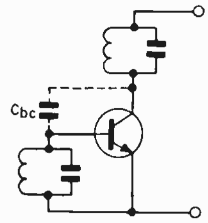
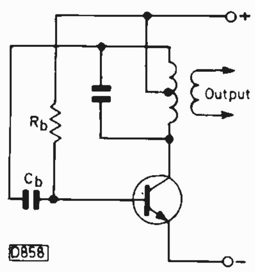


Fig. 5 (left): Colpitts oscillator using a transistor's internal capacitances to provide positive feedback at v.h.f. or u.h.f.
Fig. 6 (right): Tuned-collector, tuned-base oscillator with positive feedback via the transistor's internal collector-base capacitance.



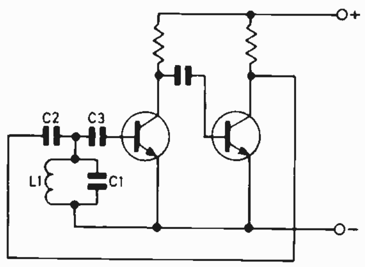


Fig. 7 (left): Hartley oscillator circuit with automatic bias provided by Cb and Rb.
Fig. 8 (right): Basic Franklin oscillator circuit.

as shown in Fig. 5. Line AB suggests that only two interconnections between the two sections of the circuit are required. An ideal transistor has no internal capacitances however, and to use such a transistor in a Colpitts oscillator circuit it would be necessary to add external capacitors to provide the required positive feedback. Thus three interconnections as shown by line CD are involved, the internal capacitances here being shown as external.

Fig. 6 shows the tuned-collector, tuned-base oscillator. If both tuned circuits are resonant at the same frequency, the circuit will oscillate even though there is no inductive coupling between the two inductors. The coupling is again provided by internal capacitance, this time the transistor's collector-base capacitance (shown with broken lines) which links the output of the amplifier to its input to give positive feedback. This circuit is mentioned because it forms a useful analogy with the two-cavity klystron described later.

So far most of the circuits have been shown in basic form, sometimes without d.c. feeds, in order to concentrate on the essential oscillator connections. A practical circuit requires a d.c. supply for the active device and a bias supply for its control electrode. Often the oscillator's output is used to provide the bias. Such an automatic bias system has the advantage of stabilising the oscillator's output against changes in (a) the supply voltage, (b) external loading of the tuned circuit and (c) amplifier gain. The oscillator can function satisfactorily despite wide variations in the gain of the amplifier section, a factor which distinguishes this type of oscillator from the *RC* type.

An example of automatic biasing is shown in Fig. 7. When the base of the transistor is driven positively by the oscillatory waveform, capacitor *Cb* will be charged by the transistor's base current. The resulting voltage across *Cb* will then bias the base negatively – it's quite normal for this bias voltage to be sufficient to cut the transistor off during much of each cycle of oscillation. In the intervals between charges, *Cb* discharges via *Rb*, but provided the time-constant *RbCb* is long compared with the cycle of oscillation little of the charge across *Cb* is lost. Thus *Cb* provides a nearly constant base bias voltage which is dependent on the amplitude of the oscillatory waveform. The transistor operates in class C, taking a burst of base and collector current once per cycle. The tuned circuit is kept in oscillation by the succession of collector current pulses.

If the amplitude of the oscillations tends to fall, due for example to an increase in external loading, the bias voltage falls and the transistor's period of conduction increases. Thus more power is supplied to the tuned circuit, meeting the increased demand and minimising the fall in output amplitude. The bias can fall low enough for the transistor to conduct throughout the whole of each cycle, i.e. it operates in class A. Class C operation is more usual however, the amplifier current being in pulse form. If a sinusoidal output is required from the oscillator, it must be taken from the tuned circuit, for example via a coupling coil as shown in Fig. 7.

In the oscillators described so far, an *LC* circuit (or equivalent) provides positive feedback in addition to defining the frequency of oscillation. (In some examples internal capacitances in the maintaining amplifier also play a part in providing the feedback but, as mentioned earlier, such capacitances can be regarded as external to the amplifier and part of the frequency-determining network.) It's possible to separate the two functions of the *LC* circuit however, for example by transferring the positive feedback to the maintaining section. A resistive network could be used in the amplifier to give positive feedback: this, in the absence of a frequency-determining section, would result in relaxation oscillation. By including the tuned circuit in the feedback loop to eliminate feedback at any except its resonant frequency, the circuit is made to oscillate at this frequency.

In this type of oscillator (see Fig. 8) there's no need for the tuned circuit to provide signal inversion and only two connections are required to it. In Fig. 8 the parallel *LC* tuned circuit is connected in shunt with the positive feedback path so that it short-circuits the feedback loop except at its resonant frequency. The amplifier is a two-stage, common-emitter type with the feedback applied via capacitors C2 and C3. This circuit, devised by Franklin, was used many years ago with triode valves as a highly stable oscillator. The values of C2 and C3 were made as small as possible, consistent with the maintenance of oscillation, to minimise the effects of the maintaining amplifier on the tuned circuit.

In most of the oscillator circuits so far described a tuned circuit is stimulated into oscillation by the output current of an active device which usually operates in class C and delivers a pulse once per cycle. Such pulses could be obtained from a number of different sources, e.g. a multivibrator. At microwave frequencies the pulses can be produced by velocity modulation and a number of microwave oscillators use principles similar to those already descibed except for the method of pulse generation.

Klystron Oscillator

If an electron beam passes through two grids (grids 1 and 2 in Fig. 9) between which an r.f. signal is applied, the velocity of the electrons is modulated at the signal frequency. Beyond the grids the faster electrons overtake slower ones that passed through the grids earlier, and by suitable design it can be arranged that at a particular point the beam arrives in the form of well-defined bunches. If

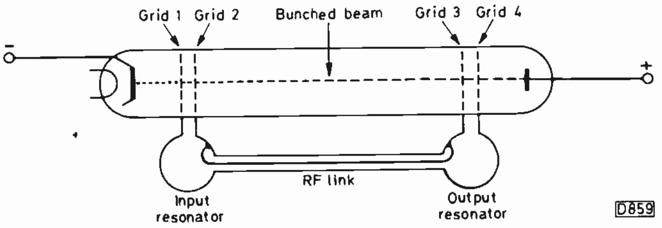


Fig. 9: Two-cavity klystron used as an oscillator.

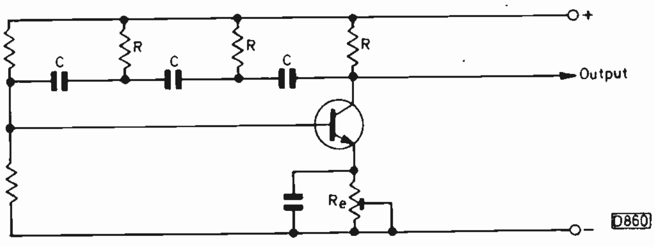


Fig. 10: Simple RC phase-shift oscillator circuit.

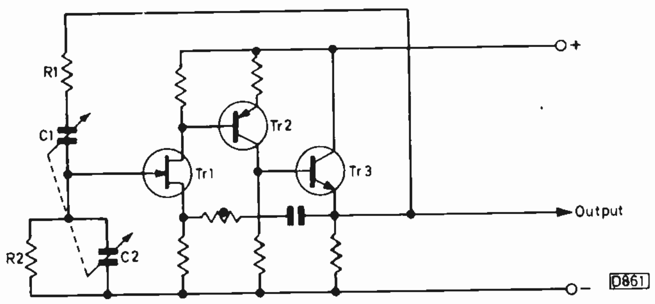


Fig. 11: Wien-bridge oscillator circuit, basic form.

two further grids (3 and 4) are included at this point and are connected to a second resonator tuned to the same frequency as the first, this second resonator can be kept in oscillation by the regular pulses of energy received from the beam. The signal in the second resonator can be many times that in the first, so that the device is an effective microwave amplifier – known as a two-cavity klystron. An r.f. feed from the output resonator to the input resonator can provide the positive feedback required to sustain oscillation. The principle of this type of r.f. oscillator resembles that of the tuned-collector, tuned-base oscillator described earlier: both have an electron beam linking synchronous tuned circuits, and both have an r.f. path between the tuned circuits to provide positive feedback.

In the reflex klystron oscillator a single resonator is used in place of the two coupled synchronous resonators, the electron beam passing through it twice. After its first passage the beam is reflected back along its incident path by a negatively-charged electrode, the design being such that bunching occurs before the beam arrives at the resonator for the second time.

RC OSCILLATORS

In a second group of oscillator circuits the frequency-determining section consists of a network of reactance and resistance, usually *C* and *R*. Such a network doesn't have a resonant frequency and doesn't ring when struck. Oscillators using such networks thus operate in a manner quite different from that of an *LC* or equivalent oscillator.

One type of *RC* oscillator relies for its operation on the fact that a sinusoidal signal subjected to a 180° phase shift is identical in shape to the initial waveform but is inverted. If therefore a 180° phase-shift network is fed from the output of an inverting amplifier and the network's output is the amplifier's input, the amplifier sees this as positive feedback. The result is oscillation, provided the amplifier's gain is sufficient to offset the attenuation in the network at the frequency of oscillation.

A network consisting of a single resistor and capacitor can at most introduce a 90° phase shift between input and output signals, and at the frequency at which this phase shift occurs the attenuation is infinite. It's usual therefore to use three sections, each giving a 60° phase shift at the operating frequency. The current attenuation at this frequency for the network shown in Fig. 10 is 29, which can be made good by a single transistor amplifier, resulting in the simple oscillator circuit shown.

One of the disadvantages of this circuit is that to obtain a sinusoidal waveform the transistor's gain must be just sufficient to make up for the loss in the network. This can be achieved by critical adjustment of *Re*. If the gain exceeds the critical value, the oscillatory output increases to a point at which the transistor will cut off/saturate for an appreciable fraction of each oscillatory cycle. Ideally some means of amplitude limitation is needed to maintain the gain of the amplifier at the critical value. The need for such precise control over the maintaining amplifier's gain distinguishes this form of oscillator from the *LC* types previously described. Another difference is that the output should be taken from the amplifier section, as shown in Fig. 10. A disadvantage is that any significant load applied to the *RC* network affects the phase shift and thus prevents normal operation of the oscillator.

Wien-bridge Oscillator

Another disadvantage of this circuit is that it's difficult to vary the frequency of oscillation to any extent. This problem can be overcome by using a Wien-bridge network in place of the ladder network. Fig. 11 shows a Wien-bridge oscillator. If R = R1 = R2 and C = C1 = C2, the Wien network gives zero phase shift and has a voltage attenuation of $\frac{1}{3}$ at the frequency $f = \frac{1}{2}\pi RC$. It's easy to alter the frequency by using a two-gang variable capacitor for C1 and C2, while different frequency ranges can be selected by switching in different values of R1 and R2.

To obtain positive feedback, the maintaining amplifier needs to be non-inverting with a voltage gain of three – not a difficult requirement, but the amplifier must in addition have a very high input resistance to minimise shunting R2, which is commonly several megohms to give oscillation at the lowest audio frequencies. In the circuit shown in Fig. 11 the f.e.t. provides the required high input resistance while the emitter-follower Tr3 provides a low output resistance.

For a sinusoidal output the amplifier's overall gain must be kept down to three, otherwise the oscillatory amplitude will grow until limited by cut-off and/or saturation in the transistors. Gain limitation is generally achieved by including a negative feedback loop between the emitter of Tr3 (effecively Tr2's collector as Tr3 is an emitter-follower) and Tr1's source. A linear resistive feedback potential divider would not be successful because it would be impossible to find feedback resistance values that would give exactly correct gain at all settings of the frequency controls. Gain control is therefore made automatic by making the ratio of the feedback potential divider dependent on the amplitude of the output signal. This can be done by using a resistor with a positive resistance/temperature coefficient for the lower section of the Wien

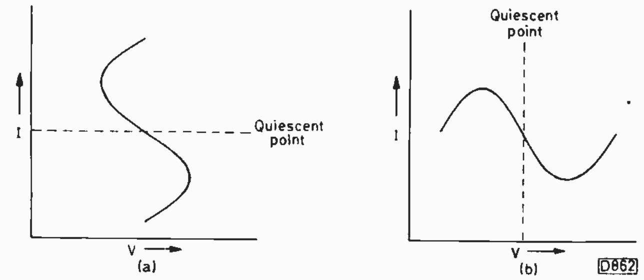
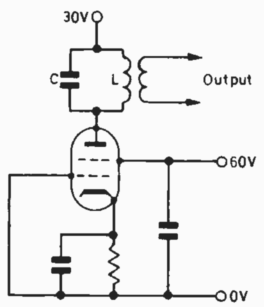


Fig. 12: Examples of current-voltage characteristics with a negative-resistance region. (a) Current controlled, (b) voltage controlled.



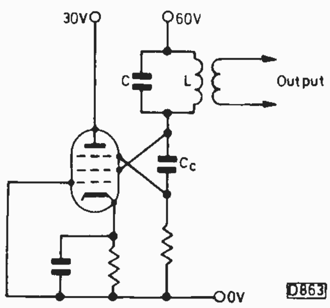


Fig. 13 (left): Dynatron oscillator circuit, basic form.
Fig. 14 (right): Transitron oscillator circuit, basic form.

network or a resistor with a negative resistance/temperature coefficient in the negative feedback loop. The second alternative is shown in Fig. 11.

A significant feature is that the thermistor is fed from the oscillator's output via a capacitor. Immediately after switch on, in the absence of an output, the thermistor's resistance is at maximum and the amplifier's gain is therefore very high. Oscillation thus starts immediately. The output reduces the thermistor's resistance, increasing the feedback and decreasing the gain – which falls until the critical figure of three is reached. It must not fall below this value, or oscillation would cease. So the gain is automatically maintained at a value that's just sufficient to sustain oscillation – the condition required for a pure output waveform.

NEGATIVE-RESISTANCE OSCILLATORS

Oscillations induced in a resonant circuit die away as a result of dissipation in the circuit resistance. As we've seen, the inclusion of a maintaining amplifier will make good this loss. An alternative approach is to connect the resonant circuit to a source of negative resistance. It's sometimes said that positive-feedback oscillators are negative-resistance types, the argument being that positive feedback gives the maintaining amplifier an effective negative input or output resistance. But in such oscillators the *LC* circuit is the means whereby the positive feedback is applied. Without the *LC* circuit the amplifier has a normal positive resistance. A true negative-resistance oscillator is one in which the negative resistance is an inherent feature of the maintaining system, and is present whether the *LC* circuit is connected or not.

Two types of negative-resistance characteristic are shown in Fig. 12. In both, the negative-resistance region is confined to a limited range of voltage and current. With characteristic (a), a particular applied voltage could produce two or even three current values whilst a particular value of applied current can produce only one voltage value. Characteristic (a) is thus known as current-controlled. Characteristic (b), which is by far the more familiar shape, is a voltage-controlled type. In both, the negative resistance is a differential, incremental or a.c. quantity. In other words, the characteristic that's negative is the ratio of a small change in voltage to the corresponding change in current.

To use this characteristic in an oscillator circuit, the negative resistance must clearly be sufficient to offset the positive resistance of the tuned circuit connected to it. Thus with characteristic (a), which would be used with a series tuned circuit, the negative resistance must be numerically greater than the tuned circuit's series resistance. And with characteristic (b), which is normally used with parallel tuned circuits, the negative resistance must be numerically less than the parallel (i.e. dynamic) resistance of the tuned circuit. If the negative resistance is much less than the dynamic resistance, the oscillation amplitude grows until it occupies a voltage range greater than the extent of the negative-resistance region. In fact, at the peaks of the oscillation the operating point enters the regions of positive resistance at each end of the negative-resistance region. These apply damping to the tuned circuit, taking power from it and limiting the amplitude of the oscillation. The oscillation amplitude grows until the average slope of that part of the characteristic over which the operating point moves during each cycle of operation is equal to the dynamic resistance of the tuned circuit. As a result, the amplitude of the ouput that can be obtained from such an oscillator is limited, and to obtain the maximum output the quiescent point must be accurately placed at the centre of the negative-resistance region.

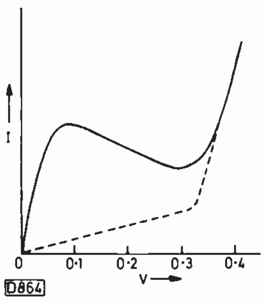
There are many ways in which a negative-resistance characteristic can be obtained. We'll look at the most commonly used circuits.

In the dynatron oscillator (see Fig. 13) the negative resistance arises due to secondary emission from the anode of a tetrode valve. As a result, there's a region of negative resistance in the anode current/voltage characteristic over a limited anode voltage range below the screen grid voltage. A tuned circuit connected to the anode will therefore oscillate, provided its dynamic resistance is greater than the negative resistance. The secondary emission properties of a surface vary depending on its nature, geometry and the angle and speed of the primary electrons that strike it. It's thus likely that certain specimens of a particular type of tetrode will be better than others for use as a dynatron oscillator.

A pentode valve can also provide a negative resistance characteristic when its suppressor and screen grids are coupled – the transitron oscillator, see Fig. 14. The coupling capacitor *Cc* must have a small reactance at the tuned circuit's frequency of oscillation. This circuit is more reliable than the dynatron since it's not dependent on the vagaries of secondary emission.

If the two regions of a pn junction are heavily doped, the device's forward characteristic has a shape (see Fig. 15) quite different from that of a normal junction diode. The depletion layer at the junction in such a device is so thin that electrons with very low velocities can cross it, the so-called tunnelling effect. Thus forward current in a tunnel diode starts at a very low forward voltage, after which there's a region of negative resistance for voltages between 0·1V and 0·3V. This negative resistance kink can be used in the design of an oscillator capable of working at up to 100GHz. The amplitude of oscillation is very limited of course.

A negative-resistance characteristic can also be obtained



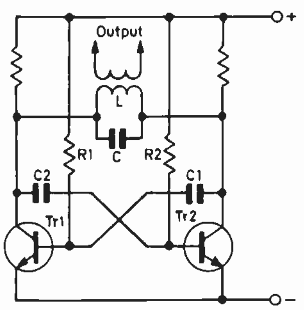


Fig. 15 (left): Forward voltage-current characteristic of a tunnel diode (shown in solid line) and a normal pn junction diode (shown in broken line).
Fig. 16 (right): Negative-resistance or push-pull oscillator using two transistors.

from a circuit using two active devices. An example is shown in Fig. 16. The circuit is basically that of an astable multivibrator which, in the absence of the *LC* combination, would produce squarewave outputs at both collectors, the transistors switching between cut-off and saturation alternately. The presence of the tuned circuit modifies the action because the inductor provides a short-circuit between the two collectors at low freqencies while the capacitor does the same at high frequencies. Operation is thus confined to the tuned circuit's resonant frequency. At this frequency, the effective resistance between the two collectors is approximately $-2/gmß$, where gm is the mutual conductance of the transistors and ß the voltage attenuation of the inter-transistor coupling circuits. One such coupling circuit is R1, C1 – note that R1 is shunted by the internal base-emitter capacitance of Tr1, and this affects the attenuation. For oscillation, the dynamic resistance of the tuned circuit must be greater than this. The circuit is sometimes described as a push-pull oscillator.

SELECTIVE NOISE AMPLIFIER

A third major category of oscillators consists essentially of a tuned amplifier. The gain of the amplifier is made so high that the inevitable noise signal at the input produces a significant output with a wide and continuous frequency spectrum: selectivity is employed to confine this to a single frequency. The selectivity required can be obtained from an *LC* combination included in the amplifier circuit or alternatively by use of frequency-discriminating negative feedback.

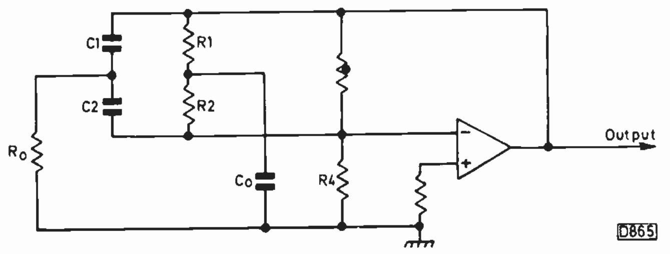


Fig. 17: Oscillator using selective amplification of noise, with the selectivity provided by a parallel-T RC network in a negative feedback path.

Fig. 17 shows a circuit based on the second approach. This employs an operational amplifier with a parallel-T network in the negative feedback loop. This network has a null in its transfer characteristic at the frequency $f = 1/2\pi RoCo$, where R1 = R2 = $2Ro$ and C1 = C2 = $Co/2$. At this frequency there is thus no negative feedback and the amplifier operates at full gain. At all other frequencies the gain is reduced by feedback. The amplifier thus has a sharply peaked response curve similar to that of a tuned amplifier using a conventional *LC* circuit, the peak frequency being determined by the feedback network component values. The peak frequency can be varied by adjusting the resistance and/or capacitance in the parallel-T network. It's necessary to stabilise the output amplitude to avoid the transistors in the operational amplifier circuit being driven into saturation or cut off. An additional negative feedback loop can be used for this purpose, with one amplitude sensitive arm as discussed for *RC* oscillators – in Fig. 17 a thermistor with a negative resistance/temperature coefficient is used for this purpose.

The same principle is used in the backward-wave oscillator, a microwave tube in which amplification is achieved by interaction between an electron beam and a slow-wave structure (commonly a helix). If the tube's gain is increased, by increasing the beam current, the output from the amplified noise in the beam becomes narrower in frequency spectrum until it ultimately becomes a coherent oscillation at the frequency of maximum gain.

CLASSIFICATION TABLE

In conclusion, Table 1 summarises the oscillator classification presented in this article, and also lists the principal features of each category.

Table 1: Classification of sinewave oscillators.

Type of circuit	*Principal features*
(1) Positive feedback.	
(a) Using an *LC* circuit or equivalent.	
(i) *LC* circuit giving feedback, e.g. Hartley, Colpitts.	Three connections to *LC* circuit. Output from *LC* circuit. Amplifier gain not critical.
(ii) Separate feedback loop, e.g. Franklin.	Two connections to *LC* circuit.
(iii) Velocity-modulated oscillators, e.g. reflex klystron.	
(b) Using an *RC* circuit, e.g. phase-shift or Wien-bridge oscillator.	Output from amplifier. Amplifier gain critical.
(2) Negative resistance. Dynatron, transitron, tunnel diode.	Two connections to *LC* circuit. Amplitude limited by characteristic. Dynamic resistance critical.
(3) Selective amplification of noise.	
(a) With resonant circuit selectivity, e.g. backward-wave oscillator.	
(b) With negative feedback providing selectivity, e.g. parallel-T oscillator.	

Long-distance Television

Roger Bunney

February was a depressing month for DX-TV reception in the UK. Meteor scatter propagation produced short duration Band I signals on most days, but tropospheric propagation was sadly lacking except for the period 12-14th when a prevailing high-pressure system produced a small lift, sufficient for West German u.h.f. and Danish Band III signals to reach the south and south east. Our colleagues in the Benelux countries fared a lot better, with v.h.f. and u.h.f. signals from Scandinavia and E. Europe. The ionospheric log content is similarly poor, though one hopes that with the new season approaching by the time these words are read things will once again be humming!

4/2/84 Miscellaneous auroral induced SpE over most Band I channels.
5/2/84 ARD (W. Germany) ch. E2.
6/2/84 NRK (Norway) E2; TSS (USSR) R1, 2.
7/2/84 TSS R1, 2.
8/2/84 MTV (Hungary) R1.
13/2/84 SRG (Switzerland) E2; afternoon auroral activity.
15/2/84 ARD E2; ORF (Austria) E2a.
16/2/84 NRK E2.
4/3/84 DFF (E. Germany) E4.

Satellite Reception at 11·5GHz

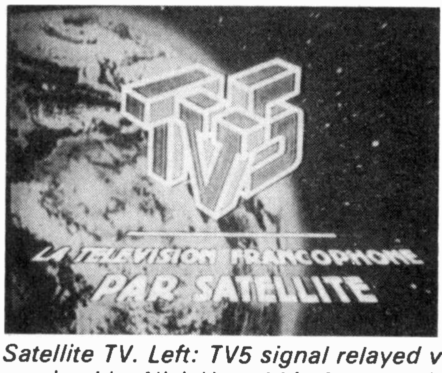
There's been rather more encouraging news on the satellite front. Both Nick Harrold (Essex) and Hugh Cocks (E. Sussex) have succeeded in resolving signals from the ECS-1 satellite at 13°E, with Sky Channel (11·66GHz), TV-5 (11·49GHz) and W. German (11·575GHz) downlinks. The Sky Channel signals are of good quality via both Nick's 8ft petal and Hugh's 10ft spun dishes, though the programme content is scrambled – test transmission colour bars during the day are not scrambled. The French TV-5 service is also well received, though scrambling starts at 2100 (news time). The W. German channel is more interesting. It carries colour bars with a caption indicating that there are audio carriers at 5·5 and 5·75MHz, and has been seen carrying a service for "Allemagne Kable Kommunication" with a digital inlay identification "PK5" (PKS?). A PM5534 (PM5544 with digital clock) test pattern has also been seen with the identification "AKK PK5". Perhaps most significant is that both Nick's and Hugh's receiving systems were independently devised and neither includes an LNA, the signals being fed directly to the mixer via a waveguide. Positioning with both dishes proved to be very critical. Our congratulations are due on these achievements – I'm sure we'll be hearing of further progress soon!

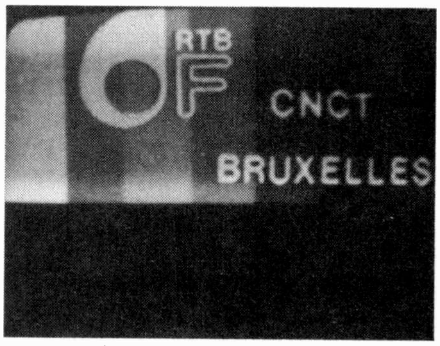
G8ZMM on Air

I'm now transmitting pictures at 437MHz, using my call sign G8ZMM. Signal sources consist of an ex-surveillance Ikegami camera and a modified Technalogics pattern generator, also test cards C and F. The transmitter is a 20W Fortop TVT435 with bandpass filter and an in-line demodulator (to extract video at the output for monitoring with a scope etc.). This feeds a Jaybeam 8 over 8 array at 56ft via UR67 feeder. Noise-free reception at 15 miles has been reported, over an obstructed path under flat propagation conditions. Unfortunately there's been interference to neighbouring TV installations, mainly those using head amplifiers. Transmissions have had to cease until these installations can be dealt with by filtering. This is a group A area, with rather low-level signals from Rowridge.

News Items

Belgium: The Wavre u.h.f. mast collapsed last October. In early February vertical stripe test patterns were noted on ch. E25 and now Wavre BRT-2 ch. E25 is back on air – no sign of ch. E28 at present. Mystery RTBF-2 transmissions on ch. E49 appear to originate from Riviere at 200kW e.r.p. The EBU now lists Brussels RTBF-2 ch. E45 at 1kW e.r.p. horizontal.
Norway: NRK hopes to run the second service at present being discussed. The EBU lists a further three u.h.f. relay stations, all under 100W, using chs. E34, E35 and E52.
Holland: AFN Shape ch. E34 (NTSC system M) now calls itself "AFN-TV Europe", taking programme material from AFN-Germany with live Intelsat feeds of the ABC World News at 2200-2230. Cyril Willis logged either the Alkmaar or Hoorn pirate TV station (ch. E34) during a recent tropospheric opening.
Poland: New TVP-2 transmitters: Olstyn ch. R26; Poznan R27; Krakow R33 (all 1,000kW e.r.p.); Jelenia R30 300kW e.r.p.
Tunisia: It's not often nowadays that there are prospects of a new Band I TV transmitter. RTT (Tunisia) has applied to the IFRB for the use of a ch. E4 transmitter at





Satellite TV. Left: TV5 signal relayed via satellite and received on a Belgian cable network. Centre: The same signal as received by Nick Harrold in Essex, using an 8ft petal dish. Right: A TV5 test pattern as transmitted from Brussels on ch. E56 – the pattern varies slightly from time to time.

Remada, with 40kW e.r.p. via omnidirectional, horizontally polarised aerials.

In brief: Laos has commenced colour tests, using system PAL-M at v.h.f. . . . TSS (USSR) is currently experiementing with various forms of digital encoding with a view to eventual digital transmission to provide better quality signals with freedom from co-channel interference . . . The RTE (Eire) Donnybrook (Dublin) ch. C transmitter closed on April 4th . . . There are rumours that RTL (Luxembourg) is to increase the ch. E7 transmitter power to extend its international coverage.

Interference at Milton Keynes

The cable system at Milton Keynes uses a centre control frequency at 143-144MHz. Distribution is via underground trunking but emerges at various points where poorly screened units are used for links to houses. Interference levels of typically 14dBm have been measured at 100m. If anyone is experiencing interference the DTI/Post Office should be contacted. The source of the problem was discovered after the RSGB became involved.

From our Correspondents . . .

Mike Gaskin is now established at Caterham, some 575ft a.s.l. on a flat plateau with no obstructions. His aerial system consists of a Triax grid for u.h.f., a Premier log-periodic for Band II (f.m.) and a Band I dipole. He reports that under normal flat conditions Goes (Holland) is always present on 87·85MHz, at some 10-30μV, though with aircraft scatter at times. The aerial feeders are short, but in view of the grid aerial's wide beamwidth and the close proximity of local u.h.f. transmissions a low-noise, low-gain preamplifier is being considered.

Gosta van der Linden reports that the following pirate TV stations are in operation in Holland:

Ch. E23: Coenstad TV, Hoorn.
Ch. E30: H.O.S., Heerhugowaard.
Ch. E33: Paranoia, Hoorn.
Ch. E34: Noorderkoggen, Medemblink.
Ch. E35: Orion, Alkmaar.
Ch. E50: Nova-1, Alkmaar.
Ch. E55: A.O.S. Alkmaar.
Ch. E63: Ciba, Heerhugowaard.
Ch. E64: W.F.T., Midwoud.
Ch. E65: Atlantic, Alkmaar.

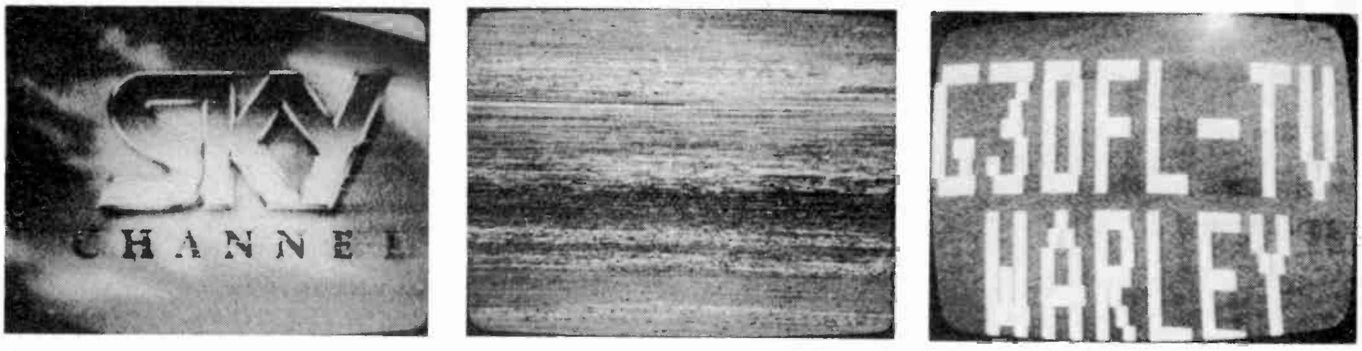
The situation varies, with channel changes etc. depending on the activities of the Dutch PTT.

Wenlock Burton (Victoria, Australia) reports that the SpE season there is now fading away, with fewer and less intensive openings. There's a local ATV repeater (VK3RTV) and since the ATV band in Australia is at the centre of the broadcast u.h.f. band any viewer with a standard TV set can receive it. The sound-vision spacing is 5·5MHz.

Satellite News

A contract for the Scandinavian Tele-X satellite has been signed. It's due for launch by Ariane in 1986. The Japanese BS2a satellite has been successfully launched: a non-commercial NHK service is to start this month. New Zealand is considering a third service via an Intelsat craft, covering NZ and its Pacific Islands dependencies.

As mentioned last month, the FCC has agreed to the use of 2° orbital spacing for 4GHz US satellites. Following



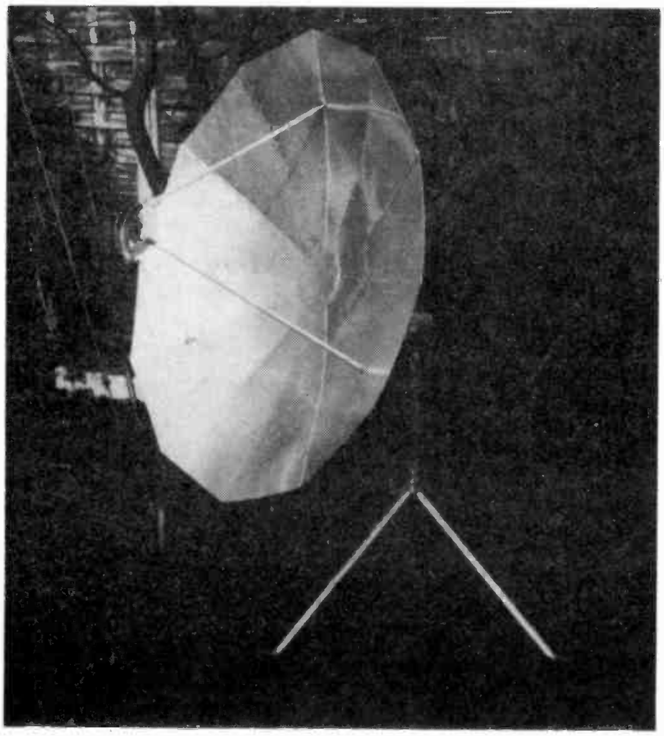
More satellite TV. Left: Sky Channel signal received by Nick Harrold via the ECS-1 satellite. Centre: An example of scrambling – TV5 at 2100 with the news. Right: Amateur TV reception by Robin Crossley at Dunstable – G3DFL Warley on the 435MHz Band.

a flood of applications to operate 12GHz satellites, a 1° spacing is expected in this band. Special consideration will need to be given to hybrid satellites that use both bands. Ford Aerospace is planning a large satellite with 54 36MHz wide channels in both the 4 and 12GHz bands.

With the large number of US viewers that pirate services using illegal descramblers, the BBC/IBA have been giving thought to improved scambling methods, such as chopping each line into three parts with one section digitally scrambled and the other two sections compressed and otherwise distorted. Electronics companies in the USA openly offer descrambling kits, but these BBC/IBA proposals suggest that any such UK kits would be decidedly up-market!

Sporadic E Signals

We are approaching the annual SpE season in the UK. This mode of signal propagation, i.e. via reflection from ionised regions in the E layer of the ionosphere, can provide spectacular reception over long distances using minimal receiving equipment, at least as far as aerials are concerned. In the UK, the season usually starts in mid-May and lasts until mid/late August, sometimes a little beyond at reduced intensity.



The Premier Pattern Company's four foot diameter petal dish with stand.

The E layer ionisation that reflects v.h.f. signals tends to be "patchy", the patches moving in both direction and angle. During a typical opening signals from as low as the 27MHz CB band to some 70MHz will be reflected. During a really good opening the MUF (maximum usable frequency) can rise to Band II and very occasionally Band III – during an extremely intense opening some years ago the MUF reached the high end of Band III, giving reception from the USSR on all Band III channels.

As the reflective patches move, so reception at a given site varies, bringing in new transmitters as others are lost. A wide patch can reflect signals from many transmitters on each channel at high strengths, typically 3mV from a dipole. A single-hop reflection may produce signals from a transmitter some 1,200 miles away while a double reflection can give reception in excess of 2,000 miles. There's a minimum skip distance of normally 450 miles or so.

The signal path may introduce very little attenuation, and at a particular site the signals can arrive from more than one reflective area, resulting in time delay effects that produce ghosting. The fluctuating nature of the reflection in turn produces unstable signal conditions, though at high strength. Really distant signals may have characteristics more akin to tropospheric ones, i.e. slow-fading and relatively stable. Signal stability also tends to increase at higher frequencies. Where the sound signal is the higher one it may be poorly propagated though the vision signal is well received.

SpE Reception

Aerials can be simple – just a wideband dipole often suffices. For more distant signals a rotatable two- or three-element array will increase the gain and provide directional discrimination against co-channel signals. Mast-head preamplifiers are generally avoided due to problems with local transmissions – it's better to use an indoor amplifier so that appropriate filtering can be inserted easily. With the increasing use of Band I for various types of transmissions, it seems that careful filtering will more and more be necessary.

In recent years SpE signals from Jordan, Syria, central USSR, Nigeria, the Canary Islands, Canada and Puerto Rico have been seen in the UK via multiple-hop reflection. Single-hop propagation gives signals from most of Europe. Remember that if the going is good and Band II is active it's worth taking a look on the lower Band III channels. Those who would like further advice on SpE reception should write in to me care of the magazine.

VCR Clinic

Reports from Steve Beeching, T. Eng. (C.E.I.), Mike Phelan, Derek Snelling, Mike Sarre, Ian Hutton, Philip Blundell, Tech. (C.E.I.) and Les Harris

Sharp VC381

The complaint was that the recorder would not stay in record. A check revealed that the take up reel didn't rotate in record, which explained the symptom. I expected to find the same symptom on playback, but not so: the mechanism control operated correctly and the machine stayed in play with the spool happily rotating.

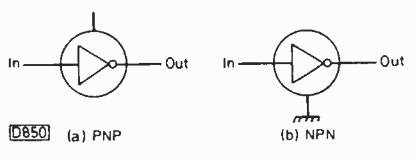
The playback picture was a disaster: very wobbly, with rippling verticals and intermittent jumping. It was extremely unstable. A look at the video output showed that synthesized field sync pulses were present on the signal during playback. This meant that some of the electronics thought visual search or still picture was operative during playback, an odd state of affairs. There's no circuit description in the manual, making it difficult initially to determine the meaning of some of the nomenclature used. I note from the March issue that D.S. had similar problems with a Mitsubishi manual. A certain signal line labelled VS-H seemed to mean that this point should be high in visual search however, and we found that it was also high in playback. A clue!

Neither the capstan nor the drum servo was locked. The capstan servo didn't produce a variable output from its sample and hold section. The drum servo produced an output but the motor didn't seem to take any notice of it. On the whole the servo panel seemed to be in a bit of a mess. The rogue high on the VS-H line was the likely culprit as it switches some of the servo functions.

Pin 59 of the mechanism control i.c. (IC801) feeds the VS-H line via a wire link. When this was lifted, pin 59 went low while the VS-H line remained high. I'll leave out a description of the time spent laboriously lifting and checking every component connected to the line to trace the source of the rogue voltage. It was finally traced to pin 1 of IC7754. When this was isolated, the VS-H line went low while pin 1 of the i.c. remained high. The i.c. consists of inverting gates, and the corresponding output at pin 16 was low. This shut off the tracking control voltage to pin 14 of IC703 in the capstan servo. The rogue 12V also switched off the drum servo action, connecting a fixed voltage instead. So there was no feedback to the drum servo which was free-running, explaining the wobbly playback picture. With pin 1 of IC7754 isolated the VS-H line went low and the drum servo locked. It took just over a week to get a new chip, set up the servo and visual search presets and restore the VC381 to full working order.

During our fault finding efforts on this machine we came across a new circuit symbol – at least it was new to us, see Fig. 1. We phoned Sharp and a nice man told us it was a digital transistor. Well, I wasn't going to leave it at that. I found it in a chart in a JVC service manual (you know, the ones that tell you things). Fig. 2 shows what's inside and Table 1 lists types.

Finally, Andy's piece. Did you hear about our so-called genius who spent fifteen minutes trying to find out why some new video heads produced no output? He was replaying a blank tape. **S.B.**



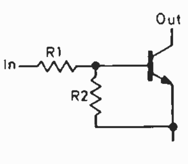


Fig. 1 (left): Integrated transistor symbols used by Sharp.
Fig. 2 (right): Integrated transistor circuit.

Table 1: Integrated transistor types.

PNP	R1	R2	NPN	R1	R2
DTA114	10k	10k	DTC114	10k	10k
DTA124	22k	22k	DTC124	22k	22k
DTA144	47k	47k	DTC144	47k	47k
DTA144WF	47k	22k	DTC144WT	47k	22k
DTA114Y	10k	47k	DTC114Y	10k	47k
DTA114T	10k	open	DTC143T	4·7k	open

Ferguson 3V29

There have been items before in this column on trouble with the sound mute circuit used in these machines. The symptom this time was odd – no sound on BBC-1, other stations o.k. As there was no output from the intercarrier sound chip in the fault condition we checked the voltage at the interstation mute pin 6. It was high, which meant that the mute action was in operation. The circuit works by amplifying and rectifying the line sync pulses, using an *LC* tuned circuit in the amplifier stage. In this case the coil (T4) was open-circuit, though the circuit just managed to work on all but the weakest channel. **M.P.**

Philips N1501

If looked after, the Philips N1500 and N1501 machines can still give superb performance with excellent reliability. The other day our training officer came in with one under his arm. "There's no head servo Mike, and I've no ancient manuscripts, i.e. data." The servo in the N1501 is beautifully simple, with no i.c.s to confuse matters. A trapezium waveform and a sample pulse should be present at test point MP220. The ramp was there all right, with some sort of disturbance running up it, but there was no sample pulse. This is applied to the circuit via the switching transistor TS203 which turned out to be open-circuit. **M.P.**

Sanyo VTC9300

A problem with the Sanyo VTC9300 has reappeared here recently as ex-rental machines are sold off. This model does not have an aerial amplifier, the signal from the aerial being attenuated by some 3dB before it reaches the TV set. Because of this these machines are not suitable for use in fringe areas, where a barely tolerable picture can become very poor. This is something that should be borne in mind by sales staff.

We've also had a couple of unusual problems recently on this model. One machine was at a video tape hire shop, the complaint being a black and white picture. Sure enough the playback was in black and white, with diagonal interference lines. Now the set-up was a bit unusual. The outputs from the Sanyo machine's video and audio output sockets were fed to the input sockets of a Ferguson VCR whose u.h.f. output was fed to the TV set some 15ft away on the other side of the shop. After sorting this lot out I decided to connect the Sanyo machine's u.h.f. output direct to the TV set. The black and white test signal appeared on the screen. That's handy I thought, the Sanyo and Ferguson VCRs are tuned to the same channel. Switch off the test signal, play back the tape, perfect. Reconnect everything as before, still perfect. Oh dear! Flicking switches here and there suddenly reproduced the fault. The switch concerned was the test signal switch. I then remembered that it was already on when I tried out the Sanyo machine direct. Now the test signal appears at u.h.f. only, not at video, and the Sanyo's u.h.f. output wasn't connected. The two VCRs were tuned to the same channel however, so the Ferguson machine was picking up the Sanyo machine's test signal output somewhere with the result that the picture was in black and white.

The fault with the other Sanyo machine was that it was dead except for the clock. Aha! I thought, the notorious 12V regulator transistor. Whilst the symptoms were similar however the wait light didn't come on as it normally does when the machine was put in the timer mode. A quick check showed that one of the 2A fuses had blown. A replacement didn't blow, but didn't improve matters either. I then noticed that R701 (100Ω) had burnt up. This resistor feeds the 17V rail via the timer switch to Q704/5, the purpose of these transistors being to switch on the 12V regulator for a timed recording. Replacing these transistors, the resistor and the 12V regulator transistor Q702 restored normal operation. It transpired that the timer had been faulty for some time: we were called in only when the 12V regulator transistor failed. **D.S.**

Mitsubishi HS304

The complaint with an HS304 was patterning on channel 4, though the picture was fine on the TV receiver. At first I thought it was co-channel or some similar type of interference – we've been getting a lot of it lately – but even a 30dB attenuator didn't remove the effect (reception was good, as the picture wasn't affected either). I then tried tuning the VCR's output to all channels between 32 and 42, again to no avail. Still convinced that the machine was o.k., I took another one out to prove that it was the same. It wasn't. So the machine was taken back to the workshop where, I thought, the signal from our aerials would give correct operation. It didn't and, forced to admit defeat, a new tuner was fitted. This cleared the fault of course. Now I'm sure that even a novice would have diagnosed a faulty tuner from the outset. My excuse is that the more you write for *Television* the more like Les you get. Perhaps the editor should arrange a special group rate for us all at a rest home . . . **D.S.**

Panasonic NV7000

The trouble we had with this machine was tuning drift. The relevant circuitry is shown (simplified) in Fig. 3. The voltages around the 33V stabiliser transistor Q7007 and the tuning voltage control i.c. IC7001 were checked and seemed to be o.k., but the tuning voltage stabiliser D7013 was hot enough to fry an egg on. The obvious thing to do was to change D7013, even though the voltage across it was correct. The result was the same. A more careful check then showed that the voltage at the collector of Q7007 was 1V high. So I changed the associated 5·1V

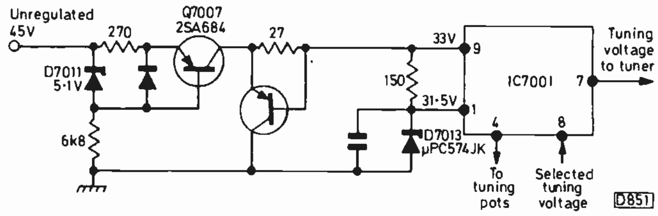


Fig. 3: Tuning voltage circuit, Panasonic Model NV7000.

zener diode D7011. The voltages around Q7007 were now even farther out, but D7013 was running cool, the voltage across it was correct – and the machine worked correctly. Panasonic said the new voltage readings were o.k., so I can only assume that those given in the manual are not very accurate. **M.S.**

Panasonic Preamplifier Fault

This Panasonic NV2000 had a common fault, failure of the aerial terminal board, but the symptoms were unusual. Failure of this item usually results in low gain in the E-to-E mode or low gain in the TV set. On this occasion however the fault was VCR operation normal with the TV set overloading. If the high/low gain switch was switched to the low position, the overloading was replaced by low gain. Similarly if a 6dB attenuator was tried. Replacing the aerial amplifier cleared the problem. **D.S.**

Sony C6

The capstan on this machine had stopped. As a first step the capstan motor voltage was checked. This comes from the emitter of the Darlington driver transistor Q022 which turned out to be off due to absence of drive at its base. The trail took me back to the CX143A capstan servo i.c. on the system control panel. The drive comes from pin 1 and there was no voltage here either. There's an operational amplifier behind this pin, the two inputs being at pins 2 and 3. The voltages at these pins were both incorrect. Now pin 2 is fed from a potential divider across the supply line, and further checks revealed that the supply to the board was at 15V instead of 12V. This comes from a regulator circuit which is entirely within IC001 (STK5314) on panel TP16. Replacing this i.c. got the machine working again. **I.H.**

Hitachi VT14

When the machine was switched to make a timed recording it would go straight into the record mode whatever the record time set. The control arrangement is shown in Fig. 4. As a first step, the voltages around IC904 on the system control board were checked. Pin 15 was high, though it

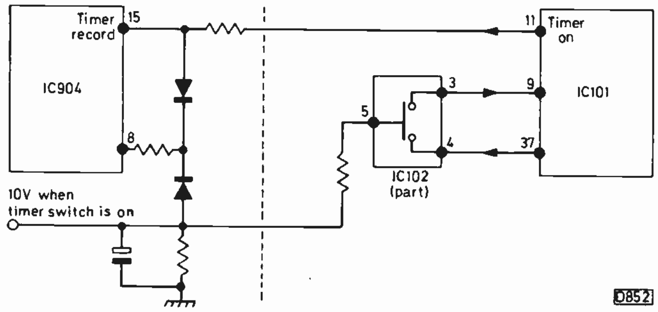


Fig. 4: Arrangement used to control the start of a timer recording, Hitachi Model VT14.

should have been low until the start of the recording time was reached. Pin 15 receives its input from pin 11 of IC101 on the timer board, so this i.c. then received attention. As expected pin 11 was high when it should have been low.

The next thing to check was the conditions at pins 3, 4 and 5 of IC102. This i.c. acts as an electronic switch, linking the pulses from pin 37 to pin 9 of IC101. These pulses make IC101 go into the record stand-by mode and compare the present time with the programmed time. Everything here was in order, but pin 11 was still high. Clearly either IC101 on the timer board or IC904 on the system control board was faulty. To isolate the two, pin 15 of IC904 was open-circuited. The pin was still high, a new HD38702A25 i.c. curing the fault. **I.H.**

GEC V4100/Hitachi VT11

A brand new V4100 (basically the Hitachi VT11E) was brought in for attention. On plugging in and pressing the operate button the operate LED failed to light. This switch connects an always 10V line to pin 7 of IC904 on the system control panel. The data outputs from this i.c. were correct – they go to pins 40 and 41 of IC902. Checks around this i.c. showed that pins 23, 24 and 25 were all in the high state. But pin 23 should have been low, as it's earthed by the mecha state switch when the machine is in the stop mode. The switch proved to be faulty, replacement restoring normal operation. **L.H.**

Sharp VC9700

The article on the Sanyo machine that lost servo lock when there was an explosion in the programme material being recorded (February issue) reminded me of a similar fault I had with a Sharp VC9700. In this case the field sync would be interrupted in record, the cause being the value of C542 on the YC board. The machine was fitted with an 0·33μF capacitor but the circuit specified 0·1μF. Fitting the latter value produced correct operation.

If you come across a VC9700 that won't play – it almost laces up, then goes into the stop mode – look to see whether the drum motor is rotating. It should speed up as lacing starts. You could well find that the AT 13V supply is missing due to L701 being open-circuit. **P.B.**

Toshiba V8600B – Corrosion Problem

The complaint was no colour. A test tape was played and the chroma signal was traced as far as the CX136A chroma processor chip IC203. Voltage checks here showed that pin 19 was very low at 0·7V instead of 5·3V. With a view to changing IC203, the bottom PCB was released. The cause of the trouble was then apparent – water had entered the machine (here we go again!). The TA7637P luminance record processing chip IC201 and the burst transformer T251 had to be replaced – the i.c. had rotted pins and the secondary of T251 was short-circuit to the screening can, hence the low voltage at pin 19 of IC203.

Whilst this VCR was in the workshop I met a computer technician (computers suffer from careless humans as well) who said that washing up liquid in a little water was good for cleaning PCBs. So I tried this on the Toshiba machine, using an old toothbrush and removing some of the i.c.s to clean between the pins. The result was a nice clean video board. **L.H.**

Sanyo VTC5300

The complaint was white spots on the picture during playback. I tried several possible methods of dealing with this, including Steve Beeching's suggestion of earthing the head amplifier screening to the metal chassis supporting the PCBs, all to no avail. I then found that earthing the head cylinder assembly screening can to the r.f. modulator greatly reduced the spotting. This earthing modification has since been tried on a second machine with good results. **L.H.**

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PYE 725 CHASSIS

We've the same trouble with a couple of sets fitted with this chassis. When the brightness or contrast controls are turned up, the picture goes "over the top" and the colour smears, making it look as though the tube is faulty or low emission. A new tube was tried in one of the sets without any improvement. A replacement decoder panel has also been tried.

All the chassis in this series are liable to this limiting, which is due to inadequate drive. You can improve matters a little by supplying the RGB output stages from a higher h.t. than the 185V used, though the smoothing will be less. Move along the resistors below the tube, in the "bus shelter".

HITACHI CNP190

The problem is no colour. The voltage at the collector of the colour-killer transistor TR28 is only 1V instead of 4V. Overriding the colour-killer produces incorrect colours.

We suggest you check C514 (0·047μF) which decouples the emitter of the burst amplifier transistor and C533 (0·001μF) which couples the burst to the ident amplifier circuit. Then adjust the burst transformer T503 and the ident coils L508 and T503 as set out in the manual. The gain of the ident amplifier transistors TR26 and TR27 can be increased by reducing the values of R491 (43Ω) and R495 (30Ω) in their emitter circuits. It's possible that the burst detector diodes CR8 and CR9 are out of balance: check them by substitution if necessary.

SANYO 14-T402

The problem I have is in getting a replacement line scan coupling capacitor for use in this monochrome portable. It's listed as a 6·8μF 50V lacquer type. Any suggestions?

A pair of 10μF, 63V electrolytics connected in series (negative to negative) should do the trick, using the positive connections to wire into the circuit.

TELPRO C561

There's a bright vertical line down the centre of the screen, fluctuating between about an inch and two inches wide. The picture seems to be split into two and not holding. The PL509 line output valve then glows red and the raster disappears. Switch off and on and the PL509 cools down and the set seems to work all right. The line timebase valves have been replaced.

This set uses a version of the Decca Bradford chassis. The trouble is almost certainly in the line oscillator circuit, and could well be due to the coupling capacitor C427 (470pF). It would be advisable to replace this along with the two 5μF electrolytics C419/425 and the oscillator feed resistor R441 (220Ω).

GRUNDIG 6632

Resistor R607 on the power supply panel has overheated and gone open-circuit. The circuit is a bit unusual – any ideas?

R607 is designed to fail if the start-up conditions are maintained for too long. Any fault in the line output stage will cause this. Check for dry-joints on the large wound components, then check whether R506 (associated with the commutator transformer) is open-circuit, followed by the tripler (disconnect to check), Di511 (commutator circuit) which may be open- or short-circuit, the efficiency diode Di508 and other items in the line output stage as necessary.

THORN 3500 CHASSIS

When the set has been on for about four hours the colours in the top third/half of the screen become incorrect. The fault may disappear for a few seconds then reappear.

This problem is fairly common with the 3000/3500 series. The cause is incorrect burst gating due to line drift – confirm this by adjusting the line hold control when the fault is present. The cure is to replace the items that can cause line drift – C506, C508, C511, W501/2 and VT501 – then set up the line hold.

GRUNDIG 5010

The colour is at times predominantly green while at other times there's a blue haze. This seems to make the picture dark.

This sort of effect is often caused by poor contact between the c.r.t. pins and the base holder sockets. Clean or replace the c.r.t. base socket, then if necessary check for dry-joints around the colour-difference output transistors. It's also worth checking for worn or noisy controls – the gain controls on the CDA panel and the low-light potentiometers on the main panel.

THORN 8500 CHASSIS

The set would trip after it had been on for a while. This got worse until the e.h.t. went altogether, leaving sound but no raster. Voltage checks on the timebase panel show that there's a small positive instead of negative voltage at the base of the line driver transistor while its collector is at the full h.t. voltage.

The incorrect voltages in the line driver stage point to a stalled oscillator. Check that the 18V supply is present at TP31, then check the line oscillator transistor VT403, its emitter decoupling capacitor C414 (10μF), the reactance transistor VT404, the flywheel sync filter capacitor C423 (10μF) and the discriminator diodes W405/6, preferably by substitution.

PHILIPS G11 CHASSIS

The h.t. fuse keeps blowing, with the line output transistor dying at the same time. This has happened seven times in twelve months. The h.t. voltage is correct, the h.t. reservoir capacitor has been replaced, and the line output and power supply panels have been thoroughly checked for dry-joints.

The usual cause of unexplained fuse blowing in these sets is a coarse mains input. Check that the on/off switch contacts are not unduly pitted (look for flashes with the enclosed type when switching on), and fit resistors as follows to cushion the effect. First remove mains fuse FS1302 and solder in its place a 10W, 1·5Ω wirewound resistor, making sure that it doesn't heat up adjacent parts. Secondly fit a 5W, 1Ω resistor in series with each of the two thyristor mains rectifiers, on the input side. This can be done on filter choke L4009, where two blank tags can take the transferred joints.

THORN 1600 CHASSIS

There's a strange effect on the left-hand side of the raster. The width is correct at the top, but is insufficient over most of the screen. The e.h.t. is a bit low at approximately 16kV, and the width core has no effect on the distortion.

First make sure that the effect is not due to an overload effect upsetting the line sync – clean, rectangular sync pulses should be present at the collector of the sync separator transistor VT9. Next check C113 (100μF) which decouples the supply to the line oscillator. If necessary make sure that the h.t. at the junction of C105 and R120 is 185V. If it's low, check the e.h.t. rectifier stick W35 by substitution. Finally, suspect the scan coupling capacitor C136 (0·13μF).

PHILIPS G11 CHASSIS

There's slight bowing of the verticals on the left- and right-hand sides of the screen, and poor corner convergence. Have there been any official modifications?

Some of these sets have poor corner convergence due to tube tolerances. The bowed verticals suggest trouble in the EW correction circuit. Check the output transistor Tr2150 (BD238) and the injection choke L3134 (on the line output panel). If the choke has started to get warm and bend it's worth replacing D3132 (BYX55-600) in the diode modulator circuit and resoldering the loading transformer L3137.

FERGUSON 3V22

The picture is perfect apart from a band of clutter that oscillates across the screen during replay.

First check that the stationary lower drum is clean where the tape travels. If the noise bar is stationary, check that the back tension brake band on the left-hand reel disc has not broken, also that both tape loading arms are going fully home. If not, the screw under one of them is probably loose (below the deck, accessible when the drum flywheel is removed). If the noise bar moves up or down the screen continuously, the capstan servo is at fault. The most likely cause is that the pick-up head above the capstan flywheel is open-circuit. It should measure 500-700Ω.

GRUNDIG 5010

The problem is colour dropout. This intermittent condition does not appear to be temperature dependent. The picture is sometimes in colour all evening, on other occasions it remains in monochrome. There are times when the colour flicks in and out a few minutes after switching on.

First ensure that the fault is not due to tuning drift, which is common with these sets. Then link MP13 and MP15 on the colour module when the fault is present. If there's still no colour, suspect the TBA510 and TAA630 i.c.s – voltage measurements at the pins should lead you to the cause. If bands of unlocked colour appear, check the burst amplifier transistor Tr845 and make sure that gated burst is present at pin 12 of the TBA510 i.c.

THORN 3000 CHASSIS

There are two problems with this set. First the convergence, which I cannot get right on the left-hand side. The lines, especially the blue ones, bow upwards. Secondly if you switch off and then on again the sound is low and distorted. The longer the set is left switched off, the better the sound on switching on again.

Assuming that the convergence controls have some effect, we suggest you increase the values of C703 and C704 in the blue line convergence circuit from 10μF to 22μF. This modification works very well. The sound fault is generally due to transistor trouble. Try replacing the audio output transistors VT403/4 along with C401 (5μF) and C402 (1μF).

ITT CVC30 CHASSIS

The trouble is intermittent loss of picture. It goes after a quarter to half an hour, leaving the sound. Switching off and on restores the picture for a couple of hours.

The continuation of the sound indicates that the line output stage remains operative. First check for first anode voltage when the fault is present. If o.k., check the cathode voltages, which should be around 160V. If correct, suspect the tripler. If high (200V or more), check that the 12V supply is present at pin 9 of the TCA800 i.c. in the decoder. If this is in order, look for 2V at pin 1 (luminance input). If o.k., suspect the TCA800. If not, suspect the TBA560C i.c., R518 (brightness preset) and check for stray flux on the decoder module pins.

TRANSISTOR SUBSTITUTES

We wish to replace the line output and series regulator transistors in a Teleton TW12EU monochrome portable. These are types 2SC508 and 2SA473 respectively, but don't seem to be readily available. Any ideas for substitutes?

The following can be used to replace the 2SC508: BD193, BDX22, BUY63, 2N4240 and 2N6233. The 2SA743 can be replaced with a BD242, BD576 or BD586.

THORN 1690 CHASSIS

The line output and series regulator transistors had to be replaced (they'd gone short-circuit). After doing this the l.t. voltage was set up. As the voltage was increased, a vertical black line appeared in the top left section of the display, varying slightly as the voltage was adjusted. At the correct voltage the line had gone, but it now appears until the set has warmed up.

This mysterious effect is usually due to spurious components at line and field rate modulating the l.t. line and thus getting into the video stages. It happens when the l.t.

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line's impedance is high. A cure might be to fit a 12Ω resistor in series with the supply to the line driver transformer T3, as in later production sets (R90). If necessary check the condition of C69 ($220\mu F$) in the regulator circuit, the boost reservoir capacitor C88 ($220\mu F$) and the line output stage supply decoupling capacitor C87 ($330\mu F$).

TEST CASE

257

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.

We don't see many Thorn 3000/3500 series chassis nowadays. They are getting rather long in the tooth, and the cost of maintaining them is increasing rapidly as they reach the right-hand section of their "bath-tub" reliability curve. One that had been spared the ignominity of the scrap heap came our way recently however. It belonged to a local hospital, and bore a plaque commemorating its presentation to Rosemary Ward by a local charity during the early seventies. It seemed to us a shame to have to scrap such a symbol of generosity, so we promised to do our best with it.

The symptoms were ominous. The red cutout button had popped out, and promptly did the same again when we reset it and switched on. Investigation with an ohmmeter revealed that the R2010B chopper transistor (VT604) was short-circuit and that the h.t. fuse F603 was open-circuit. Another R2010B was fitted and, after checking the two diodes in series with it and the "efficiency diode" W616, we tried again. Bang went F603. A further check showed that there was a short across the h.t. line: this was quickly traced to the line output transistor VT504, which was solidly shorted between all three leadouts. We found W507 in its collector supply circuit shorted as well, and added this to the growing pile of dead semiconductors. These items were replaced, also R907 on the beam limiter panel as it looked very tired – it's in series with the line output stage.

Having satisfied ourselves that no other obvious component failures were present, we connected the set to our bench (isolated) mains supply and switched on. The resulting fusillade frightened us no end, as it must have done the inmates of Rosemary Ward when it first happened! Tremendous fizzing and sparking occurred in the area of the e.h.t. transformer, and there were violent flashovers within the tube, lighting up the base-mounted spark gaps like a Brock's Benefit! Within a second a sickening buzz and a click from the cutout button terminated the performance as we crept out from under the bench.

As we totted up the casualties (the same sorry list as before, plus R609 which is in series with the chopper transistor and the excess voltage sensing zener diode W617), we became increasingly worried that the batch of expensive new parts being fitted might go the same way at the next switch on. So we decided to disconnect the supply to the line output stage (at W507) and wire in a big 100Ω resistor as a dummy load while we checked to see whether the h.t. voltage was excessive. It wasn't – the correct 60V was coming from the power supply module.

The next step was to disconnect the e.h.t. tripler, also W615 in the power supply module. The effect of the latter measure was to reduce the h.t. line to about 42V. With these precautions taken, we restored the supply to the line output stage and gingerly switched on. No fireworks this time (and no picture of course), but the line output stage was very lively. We measured over 1kV at the cathode of the tube's first anode supply rectifier W505, and could promote a healthy corona discharge at the tripler drive nipple on the e.h.t. transformer with an isolated screwdriver. It was plain that something was amiss in the line output stage.

The oscilloscope was then brought into action, and by merely waving its probe in the region of the line output transformer we had the trace that revealed all. Interpretation of this led to a diagnosis that turned out to be correct. What was wrong, and what did the trace tell us? See next month.

ANSWER TO TEST CASE 256

– page 328 last month –

The Sony SLC6UB we were working on last month suffered from poor field sync on replay. Examination of the f.m. playback envelope showed the reason why: there was a severe reduction in the amplitude of the waveform at the beginning of each head's sweep across the tape.

After unsuccessful attempts at tape guide adjustment, our trainee re-established the original settings and began to have doubts about the tape penetration by the heads, i.e. head wear, reasoning that if the head tip penetration was insufficient the signal pickup would be most impaired at the point where the tape begins its wrap around the head drum. This can sometimes be true, but on this occasion the cause was less dramatic and was easily eradicated. The senior technician merely pushed the tape tension regulator pole a little away from the cassette: the picture rolling then stopped and the f.m. envelope filled out.

Poor head-tape contact was causing insufficient head penetration during the first part of the head wrap. Adjustment of the back-tension brake band position provided the cure, and a final test with the alignment tape showed that all was well with the tape path. Our learner now knows more about tape path and tension settings than he would ever have done by simply reading about it!

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BC149	.10
BC157	.10
BC158	.10
BC159	.10
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BC187	.20
BC212	.10
BC237	.10
BC238	.10
BC303	.30
BC327	.16
BC337	.10
BC338	.10
BC477	.25
BC479	.30
BD124	.60
BD131	.32
BD132	.32
BD139	.30
BD140	.30
BD144	1.40
BD160	1.45
BD201	.85
BD202	.60
BD235	.42
BD243	.70
BD244	.70
BD379	.60
BD380	.60
BD441	.60
BD442	.60
BD535	.50
BD536	.50
BD537	.50
BD538	.50
BDX32	1.60
BDY20	.80
BF178	.32
BF179	.32
BF196	.11
BF197	.12
BF198	.17
BF199	.15
BF258	.28
BF259	.28
BF337	.32
BF338	.32
BF458	.32
BF459	.36
BFY50	.27
BU108	1.78
BU126	1.75
BU204	1.55
BU204	1.55
BU205	1.40
BU206	1.65
BU208A	1.80
(Pack of 10)	12.00
BU326A	1.40
BU407D	2.49
BU806D	2.00
BU807	2.00
MJE340	.50
R2008B	1.80
R2010B	1.80
R2540	2.40
TIP29C	.46
TIP30C	.45
TIP31C	.50
TIP32C	.50
TIP41C	.50
TIP42C	.50

INTEGRATED CIRCUITS

ETT6016	1.80
ETTR6016	1.80
HA1156W	1.25
HA1166	3.50
HA1366W	1.70
LM1303P	4.95
MC1327P	1.20
MC1330P	1.00
MC1351P	1.35
MC1358P	1.35
NE545B	2.90
NE555	.45
SAA5000	3.50
SAA5010	4.80
SAS560S	1.96
SAS570S	1.96
SL901B	6.20
SL917/918B	4.95
SN76023D	1.99
SN76033N	2.45
SN76110N	.95
SN76131N	1.40
SN76226N	1.65
SN76227N	1.10
SN76510N	.90
SN76533N	1.80
SN76660N	.60
SN76666N	.75
TA7176P	1.00
TA7205P	1.30
TA7217AP	1.80
TA7611AP	3.45
TAA350A	1.90
TAA550	.25
TAA621AX1	3.50
TBA120A	.95
TBA120AS	.75
TBA120S	.75
TBA120T	1.10
TBA120U	1.10
TBA395	1.75
TBA396	1.00
TBA480	.95
TBA510	3.20
TBA520	1.30
TBA530	1.45
TBA540	1.35
TBA550	1.50
TBA560	1.50
TBA570	1.40
TBA720A	2.60
TBA750	1.50
TBA800	1.05
TBA810AS	1.35
TBA810S	1.35
TBA820	1.20
TBA820M	1.95
TBA920	1.70
TBA950	1.80
TBA990	1.60
TCA270Q	1.50
TCA270SQ	1.30
TCA800	2.10
TCA940	1.80
TDA1002	1.15
TDA1003A	1.50
TDA1004A	2.50
TDA1035T	3.50
TDA1170S	2.70
TDA1412	.80
TDA2020	2.55
TDA2030H	2.95
TDA2190	3.50
TDA2522	2.00
TDA2523	4.30
TDA2530	2.20
TDA2532	2.50
TDA2540	.95
TDA2541	2.50
TDA2560	2.00
TDA2571A	3.50
TDA2581	1.50
TDA2590/91	2.50
TDA2593	2.50
TDA2600	6.00

LINE OUTPUT TRANSFORMERS

Autovox 90°	11.70
Autovox 110°	14.48
Baird 26" 90°	13.13
Baird 26" 110°	13.13
B&O 3100, 3300, 3400 EHT	22.88
B&O 3100, 3300, 3400	13.60
B&O 3000, 3200 EHT	22.50
B&O 3500, 3600, 4000, 5000, 6000	13.95
Decca 30, 2230	10.05
Decca 80	10.05
Decca 100	9.38
Decca 1730, 1830	12.30
Decca 1700	10.80
Dynatron 731, 735, 737, 741	10.50
Dynatron TV 202/3	10.25
Ekco CT 262, 862, 226, 827	10.50
GEC Solid State	9.00
Grundig 5010/UE, 6010 UE, 2222	17.63
Grundig 5010	12.63
Grundig 1500	16.20
Grundig 5010 EHT	22.88
Indesit 24" Mono	12.75
ITT CVC5	12.23
ITT CVC25, 30, 32	8.90
ITT CVC20	9.75
ITT CVC45	9.00
Korting 90°	13.13
Korting 110°	13.13
Luxor 2221	14.00
Luxor 26" 90°	13.13
Nordmende	13.95
Philips G8	9.68
Philips K70	29.10
Philips G9	11.03
Philips Mono	11.55
Philips 570	9.38
Philips K9	16.28
Pye 691, 697	15.68
Pye 731	12.23
Pye 713, 715, 717	10.50
Pye 725	11.78
Pye 169, 569, 769	11.95
Rank A823	13.58
Rank A640, 793	13.05
Rank A774	12.55
Rank 14" Port	9.50
Rank T20A	12.55
Rank Z718 18"	27.00
Rank Z718 22"	27.00
Saba T3715G	16.58
Salora 90°	13.08
Skantic 2621	14.00
Tandberg 90°	15.00
Tandberg 110°	13.95
TFK 711 & 711A	13.50
Thorn 1615	9.75
Thorn 1690	9.75
Thorn 1590/91	10.90
Zanussi 26"	13.08

PRESS BUTTONS

Pye 715, 207 Chelsea	13.05
Pye 713, 715	8.78
Pye 691, 697 repair kit	6.53
Philips G8 550 sloping	14.75
Philips G8 520 square	15.50
Telpro 4 way	9.50
GEC 2110 BBC/ITA	10.28
GEC 2112	14.33
GEC 2136/7	8.70
Hitachi 190 Nat. Pan. 4 way	8.50
ITT CVC8/9	13.95
ITT CVC5	11.93
ITT CVC20, 30, 32	9.08
Rank T20A	10.73
Rank A823 4 way	9.38
Rank A823 6 way	12.75
Rank Z718	12.75
Decca 1730, 30, 80, 100, 6 way	9.08
Decca 1730, 20, Mono 4 way	7.43
Salora 5 way	8.78
Salora 7 way	12.75
Luxor 6 way	13.95
Skantic 6 way	13.95
Thorn 9000 6 way	16.73

TUNERS

AEG 05 (1043/05)	9.95
AEG 06 (1043/06)	9.95
AEG 202 (U321)	8.00
AEG 204 (U322)	9.00
Mitsumi Rotary (Portables)	8.00

VALVES

PCF80	1.05
PCF82	1.65
PCL82	1.10
PCL84	1.10
PCL85	1.15
PCL86	1.05
PFL200	1.65
PL504	1.55
PL508	2.80
PL509	6.40
PL802T	3.45
PY500A	1.80

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20mm ANTI-SURGE

80mA, 100mA, 160mA, 250mA. 315mA, 400mA, 500mA, 630mA. 600mA, 1A, 1.25A, 1.6A, 2A, 2.5A, 3.15A, 4A, 5A ... 1.40

20mm QUICK-BLOW

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Type	Price
Rank 823 600/300v	2.05
Rank 823 2500+2500/30v	1.30
Rank 823 300+300/300v	2.20
Rank T20 220/400v	1.50
PHG8/GEC 600/250v	1.80
PHG8/GEC 600/300v	2.20
PHG9 2200/63v	1.25
PHG11 470/250v	1.60
Pye 691 200+300/350v	2.40
Pye 691 1000+1000/40v	.80
Pye 731 800/250v	2.10
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GEC 2010 1000+2000/35v	.95
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To fit most sets including: Decca, GEC, ITT, Pye, Philips, Rank, Telpro, Saba, Autovox, Bang & Olufsen, Grundig, Doric, Skantic etc.

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AT
Your Own Premises
with our DIY Polishing Kit

The Kit includes:
Everything you need to polish approx. 25* tubes to a high standard. Detailed instructions on how to do the polishing. All you require is an Electric Drill.

Practical instructions available to buyers of kit, please enquire for details.

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Available from Luton only.

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TV TUBES TUBE POLISHING

FREE DELIVERY*

Quality, High Temperature Reprocessing

Colour Tubes Delta	One year guarantee (optional extension up to three years)	Two year guarantee (optional extension up to four years)
90° up to 20"	£26	£29
90° up to 22"	£30	£33
90° up to 26"	£32	£35
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In Line & PIL		
Up to 20"	£36	£42
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Up to 26"	£40	£46

Please add £12 plus VAT for optional guarantee on any type of colour tube.

MONO TUBES (One Year Guaranteed)
A50-120W/R **£12**, A61-120W/R **£13**, Mono Portables **£16**
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Your good, working tubes with scratches or small chips, can be **POLISHED** with our purpose built polishing equipment. **Only £7 per tube.**

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AA117	0.090
AA119	0.090
AAY32	0.090
AC107	0.280
AC126	0.170
AC127	0.150
AC128	0.150
AC128K	0.230
AC141K	0.230
AC142K	0.220
AC153K	0.230
AC176	0.180
AC176K	0.200
AC187	0.150
AC187K	0.200
AC188	0.170
AC188K	0.230
ACY18	0.480
ACY19	0.480
AD142	0.600
AD149	0.450
AD161	0.220
AD162	0.220
AF124	0.250
AF125	0.250
AF126	0.250
AF127	0.250
AF139	0.220
AF239	0.220
AL112	0.700
AL113	0.800
ASZ15	1.000
ASZ17	1.000
AU106	1.000
AU110	1.100
AY102	1.800
AY106	1.800
BA145	0.100
BA148	0.100
BA154	0.060
BA157	0.120
BB101	0.130
BB103	0.160
BB105B	0.180
BB205B	0.240
BC107	0.070
BC108	0.070
BC109	0.070
BC115	0.100
BC118	0.110
BC140	0.190
BC141	0.190
BC142	0.190
BC143	0.190
BC147	0.055
BC148	0.055
BC149	0.055

BC157	0.055
BC159	0.055
BC182	0.060
BC182L	0.060
BC183	0.060
BC183L	0.060
BC184	0.060
BC184L	0.060
BC212	0.060
BC212L	0.060
BC213	0.060
BC213L	0.060
BC214	0.060
BC214L	0.060
BC237	0.070
BC238	0.070
BC300	0.160
BC301	0.180
BC302	0.180
BC303	0.180
BC327	0.060
BC382	0.060
BC337	0.060
BC328	0.060
BC557	0.060
BCY32	1.500
BCY33	1.500
BCY34	1.500
BCY42	0.200
BCY56	0.160
BCY70	0.160
BCY71	0.160
BCY72	0.160
BD115	0.260
BD124P	0.500
BD124	1.100
BD128	0.350
BD131	0.250
BD132	0.250
BD135	0.200
BD136	0.200
BD137	0.200
BD138	0.200
BD139	0.200
BD140	0.200
BD144	0.900
BD150	0.300
BD157	0.380
BD158	0.380
BD166	0.300
BD175	0.300
BD177	0.300
BD179	0.320
BD181	0.450
BD201	0.330
BD202	0.380
BD203	0.420
BD204	0.420

BD222	0.310
BD225	0.310
BD232	0.310
BD237	0.210
BD238	0.240
BD433	0.280
BD437	0.280
BD535	0.380
BD536	0.380
BD537	0.400
BD538	0.400
BDX32	1.000
BDX65	0.800
BF180	0.160
BF181	0.180
BF183	0.200
BF184	0.200
BF185	0.200
BF194	0.050
BF195	0.050
BF196	0.060
BF199	0.060
BF200	0.160
BF257	0.180
BF258	0.180
BF259	0.180
BF336	0.200
BF337	0.200
BF338	0.200
BF362	0.300
BF422	0.210
BF458	0.190
BF459	0.190
BFX29	0.200
BFX84	0.200
BFX85	0.200
BFX87	0.150
BFX88	0.150
BFY50	0.140
BFY51	0.140
BFY52	0.140
BFY56	0.250
BYF57	0.250
BFY64	0.250
BR100	0.140
BSX19	0.150
BSX20	0.150
BSX21	0.160
BSX26	0.160
BSX29	0.190
BZX76	0.180
BT106	0.900
BT109	0.900
BT116	0.800
BT119	1.000
BT120	1.000
BU104	1.000
BU105	0.800

BU108	1.000
BU110	1.100
BU111	1.400
BU126	0.700
BU204	0.750
BU205	0.700
BU208	0.750
BU208A	0.800
BU208D	1.200
BU326	0.850
BU406	0.850
BU407	0.750
BU408	1.000
BU500	1.100
BU526	0.800
BY126	0.060
BY127	0.080
BY133	0.080
BY164	0.220
BY176	0.850
BY179	0.350
BY182	0.320
BY184	0.320
BY187	0.320
BY196	0.200
BY206	0.110
BY207	0.110
BY223	0.720
BYX10	0.150
CA270	0.400
CA3086	0.250
CA3089	1.500
CA3240	0.900
C106D	0.230
MC1327	0.700
MJ2500	1.000
MJ2501	1.100
MJ2955	0.550
MJ3000	1.150
MJ3001	1.150
MJE29A	0.300
MJE30A	0.300
MJE340	0.250
MJE350	0.800
MJE520	0.300
MJE2955K	0.900
OA47	0.060
DA90	0.040
A091	0.040
OA200	0.070
OA202	0.070
OC28	1.000
OC29	0.800
OC35	1.000
OC45	0.500
OC71	0.300

OC72	0.500
OC200	1.800
OCP71	1.000
ORP12	1.000
DRP60	1.000
ORP61	1.000
R2008B	0.800
R2010B	0.800
SAS560	1.100
SAS570	1.100
SN76003N	1.400
SN76013N	1.400
SN76023N	1.400
SN76033N	1.500
SN76110N	0.700
SN76115	0.700
SN76226	0.900
SN76227	0.800
T2800D	0.520
TAG06-60	0.420
TAG521-200	0.720
TAG4443	0.760
TAG4444	0.760
TAA550	0.160
TBA120S	0.450
TBA395	0.600
TBA396	0.600
TBA520	0.750
TBA530	0.750
TBA540	0.750
TBA560	0.700
TBA800	0.350
TBA810S	0.600
TBA820	0.750
TBA920	0.800
TBA950	0.800
TBA990	0.800
TCA800	0.800
TCA940	0.850
TDA1170	0.900
TDA1412	0.600
TDA2002	0.800
TDA2003	1.500
TDA2020	1.400
TDA2030	1.400
TDA2522	0.800
TDA2530	0.800
TDA2532	0.750
TDA2540	0.700
TDA2560	0.700
TDA2593	0.800
TDA2640	0.800
TDA2690	0.700
TIP29	0.150
TIP29A	0.220

TIP29C	0.250
TIP30	0.160
TIP31A	0.240
TIP32	0.240
TIP32A	0.240
TIP33	0.500
TIP34	0.500
TIP41A	0.220
TIP41C	0.250
TIP42A	0.220
TIP42C	0.250
TIP47	0.400
TIP48	0.400
TIP49	0.400
TIP110	0.470
TIP112	0.540
TIP115	0.450
TIP117	0.560
TIP120	0.430
TIP121	0.460
TIP122	0.470
TIP125	0.470
TIP126	0.560
TIP127	0.560
TIP2955	0.340
TIP3054	0.380
TIP3055	0.340
TIS61	0.150
TIS90	0.150
TIS91	0.180
2N.2904	0.200
2N.2905	0.200
2N.2906	0.180
2N.2907	0.180
2N.2926	0.080
2N.3019	0.280
2N.3053	0.180
2N.3054	0.350
2N.3055	0.320
2N.3055H	0.380
2N3440	0.580
2N.3442	0.850
2N.3771	0.850
2N.3772	0.900
2N.3773	1.000
2N.4031	0.250
2N.4036	0.250
2N.4037	0.250
2N.4443	0.760
2N.4444	0.760
2N.5061	0.200
2N.5294	0.300
2N.5296	0.300
2N.6106	0.400
2N.6107	0.400
2N.6109	0.400

3N.128	0.550
3N.143	0.650
IN.914	0.020
IN.4001	0.040
IN.4002	0.040
IN.4003	0.040
IN.4004	0.040
IN.4005	0.040
IN.4006	0.040
IN.4007	0.050
IN.4148	0.020
IN.5400	0.090
IN.5401	0.100
IN.5402	0.100
IN.5403	0.110
IN.5404	0.110
IN.5405	0.120
IN.5406	0.130
IN.5407	0.130
IN.5408	0.130
VOLTAGE REGULATORS	
7805	0.350
7812	0.350
7815	0.350
7818	0.350
7824	0.350
7905	0.350
7912	0.400
7915	0.400
7918	0.400
7924	0.400
78L05	0.280
78L12	0.280
78L15	0.280
74L18	0.280
74L24	0.280
LM309K	1.000
LM317K	2.200
LM317T	1.800
LM323K	4.200
LM723	0.320
78HGKC	5.700
78HD5KC	5.200
78GU1C	1.900
79GU1C	2.150
79HGKC	6.700
JAPANESE TRANSISTORS	
2SA73	0.300
2SA104	0.320
2SA198	0.220
2SA203	0.300

2SA473	0.370
2SB54	0.250
2SB77	0.320
2SB337	1.200
2SB405	0.220
2SC460	0.210
2SC495	0.600
2SC733	0.400
2SC1161	1.100
2SC1172Y	1.500
2SC1279	0.240
2SC1306	1.000
2SC1307	1.000
2SC1520	0.250
2SC1969	1.300
2SC2029	1.200
2SC2078	1.200
2SC2122A	2.000
2SC2952	0.270
2SD234	0.370
2SK135	4.000
MB3712	1.500
TA7205	1.500
UPC575	1.000
ICS SOCKETS	
8 pin	0.060
14 pin	0.080
16 pin	0.090
18 pin	0.120
20 pin	0.140
22 pin	0.160
24 pin	0.180

28 pin	0.200
40 pin	0.250
VALVES	
DY87	0.530
DY802	0.450
ECC82	0.400
ECC83	0.430
ECC84	0.400
ECC85	0.400
ECH81	0.490
ECH84	0.520
ECL80	0.570
ECL82	0.590
ECL84	0.570
ECL85	0.570
ECL86	0.490
EF80	0.310
EF85	0.340
EF89	0.430
EF183	0.450
EF184	0.530
EL34	1.900
EY86	0.310
EY87	0.310
PC97	1.000
PCC85	0.420
PCF80	0.580
PCF200	1.350
PCF801	1.100
PCF802	0.570
PCF806	1.150
PCH200	1.000
PCL81	0.540

PCL82	0.630
PCL84	0.500
PCL85	0.550
PCL86	0.550
PCL805	0.550
PFL200	0.850
PL36	0.800
PL504	0.950
PL508	1.900
PY81	0.700
PY88	0.480
PY500A	1.600
ZENERS	
400MV BZY88 Range 2V7 to 39V	0.060
1.3W Zeners BZX61 Range 2V7 to 39V	0.120
MEMORIES	
2114	0.750
2716	2.200
2532	2.900
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6116	3.000
LM324	0.300
LM380	0.600
LM381	1.000
LM709 Dil	0.300

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LM741 Dil	0.150
LM741 Met	0.450
LM3900	0.250
NE555	0.150
NE556	0.400
BYX55/350	0.300
BYX55/600	0.300
BYX55/600	0.300
BYX55/800	0.320
BYX70/500	0.290
BYX70/500	0.310
BYX70/800	0.360
BYX71/600	0.800
LED	
LED 3mm RED	0.050
LED 3mm YELLOW	0.100
LED 3mm GREEN	0.100
LED 5mm RED	0.050

LED 5mm YELLOW	0.100
LED 5mm GREEN	0.100
BRIDGE RECTIFIERS	
1A/50V	0.160
1A/100V	0.180
1A/200V	0.190
1A/400V	0.210
1A/600V	0.230
1A/800V	0.280
2A/100V	0.350
2A/200V	0.360
2A/400V	0.420
2A/600V	0.540
2A/800V	0.580
3A/200V	0.660
3A/400V	0.680
3A/600V	0.780
6A/200V	1.000
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4700UF-16V CAN	0.200
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LP1195 (4000Ser)	2.250

Please add 40p. P&P and VAT at 15%. Govt. Colleges, etc. orders accepted.
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Please allow 7 days for delivery.
All brand-new Components. All valves are new and boxed.

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No. 1 distributor in U.K.

Special sale for this month only

G8 520 26″ **£6**. 520 22″ **£9**. G8 550 26″ **£10**. 550 22″ **£20**. G9 **£18**. Thorn 26″ **£5**. Thorn 22″ **£12**. Thorn 8500 **£20**. GEC Hybrid **£4**. GEC Solid State **£20**. Pye Hybrid **£4**. Pye Solid State **£20**. Chelsea **£20**. ITT Hybrid **£15**. Decca Hybrid **£15**. Also latest stock G11, ITT, Decca 80 and 100 series.

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MONOCHROME VALVES ALL 35p EACH.
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TELEVISION

No other consumer magazine in the country can reach so effectively those readers who are wholly engaged in the television and affiliated electronic industries. They have a need to know of your products and services.
The prepaid rate for semi display setting £6.00 per single column centimetre (minimum 2.5 cms). Classified advertisements 35p per word

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DELTA TUBE TYPE FROM **£27.50** to **£31.50**
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ALL PRICES EXCLUSIVE OF VAT.

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100's Colour TV's in stock in excellent condition–working sets for the trade.
Fresh stocks weekly
Untested – complete
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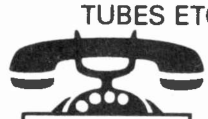

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(minimum 12 words), box number 70p extra. All cheques, postal orders etc., to be made payable to Television, and crossed "Lloyds Bank Ltd". Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Dept., Television Room 2612, IPC Magazines Limited, Kings Reach Tower, Stamford Street, London SE1 9LS. (Telephone 01-261 5846).

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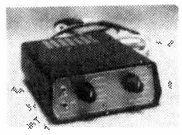

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Genuine RBM Units.

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Phillips G8 from £10
Bush Twin Chip from £8
Pye Chelsea from £15

Avo repairs prompt service scopes etc.
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Ring us for spares and type availability anytime.
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Guaranteed workers from £38.

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(C) That your name and address is written in block capitals, and
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1 year guarantee

TRIPLERS £4.50 inc. p&p

The UNIVERSAL TRIPLERcan be used in most G.E.C., I.T.T., Pye, Rank, Decca & Continental sets.

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TELEVISION

THORN COLOUR TVs

Most models. Excellent condition. Working or untested.

★ **Philips 550/660**
★ **Decca 1051/1052**
★ **Pilot (JVC) etc.**

Phone or call for competitive prices. Regular supply.

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COMPLETE FULL-SIZE SETS any published service sheets £2 + LSAE except CTVs/Music Centres from £3 + LSAE. Manuals from 1930 to latest. Quotations, free 50p magazine, price lists, unique technical publications for sale. Repair data/circs almost any named TV/VCR £8.50 by return. TIST, 76 Church Street, Larkhall, Lanarks ML9 1HE. Phone (0698 883334).

"RADIO AND TELEVISION SERVICING" books, new editions for the last 6 years always in stock. Prices on request. BELLS TELEVISION SERVICES, 190 Kings Road, Harrogate, N. Yorkshire. Tel. 0423 55885.

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A.D.ELECTRONICS Dept EM11
SECURITY MANUFACTURERS
217 Warbreck Moor,
Aintree, Liverpool L9 0HU
Tel: 051-523 8440

WANTED

WANTED TA7153P I.C. for Toshiba colour TV. Phone (evenings) Newcastle 860676.

WANTED CONTINUED

WANTED: Buy/borrow/copy – circuit/manual: Telequipment D53 scope, LAWRENCE, P.O. Box 4, Camborne, Cornwall.

WANTED. We will clear any amount of colour sets from small Rental Companies, Hotels, etc. Please phone P & R Domestic Electrical Clearance Supplies, Weston Super Mare (0934) 514047.

WANTED CRT 510JGB22TC01 with bonded yoke for Sharp C2051, reasonable. Cheltenham 0242-517048.

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WANTED PHILIPS PM5334 Television Sweep Generator. Telephone 01-328 7641.

G11's WANTED in 1's or 100's. Let us know what you have. Please telephone: TV SALES on Watford 45590.

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Thorn 3500 Power supply £2.00
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Rest of panels, 3500 at .... 80p each
Philips G8 Power supply £1.00
Line panel £2.00

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Add 15% VAT on goods, plus p&p.
1 panel £2.00; 2 panels £2.50; 3 panels £3.00 etc.
For further details telephone:
(0203) 714213

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Please insert the advertisement below in the next available issue of Television for .... insertions. I enclose Cheque/P.O. for £ ....
(Cheques and Postal Orders should be crossed Lloyds Bank Ltd and made payable to Television)

NAME ....

ADDRESS ....

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Send to: Classified Advertisement Dept.
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Classified Advertisement Dept., Room 2612, King's Reach Tower, Stamford Street, London SE1 9LS. Telephone 01-261 5846.
Rate
35p per word, minimum 12 words. Box No. **70p** extra.

Company registered in England. Registered No. 53626. Registered Office: King's Reach Tower, Stamford Street, London SE1 9LS.

5/84

SERVICE PAGES

FOR SALE – CONT.

110 MONO TELEVISIONS £75 the lot. Buyer collects. Telephone Lincoln 754280.

SCOPEX 14D – 10V little used £195. Manor Supplies MkV generator £55. Redbourn 2884.

JAPANESE COLOUR TVs, Panasonic, Hitachi, Mitsubishi, Toshiba, Sharp. Fully refurbished – to trade only. J. M. PEARSON TELEVISION 0484 863489.

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Discount for van load, direct from sources.

Makes	Example Prices Non-Workers	Working
Philips G8's, 2 chip Bush/Murphy	£16	£25
Thorn 3000, 3500, 8500	£14	£25
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Bush T20's, Philips G11's	£50	£70
GEC Solid State/Pye 18", 22"	£19	£30
ITT CVC 5/8/9	£14	£30
Decca/GEC/Pye-Hybrid	£ 5	£10

Mono in batches of 20 at £2.00 each. Discount for quantity. Other makes available on request.

SPECIAL OFFER! Philips G8's, 26" £5 Thorn 3500, 26" £5

MS ELECTRONICS
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Shop & Business busiest main road into Central London.
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New unused, some opened and erased with library labels removed.
LVC120 **£10** LVC90 **£7.50** LVC60 **£5.**

New and boxed LVC Cassettes
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1500 Format Cassettes Used/Tested
VC60 **£6** VC45 **£5**
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(plus VAT)

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VAT Reg. No. 335 7096 45.

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SERVICE SHEETS CONTINUED

TECHNICAL INFO SERVICES
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Giant TV & VCR DIAGRAM MANUALS

Brit CTVs	3 vols £45
Vol. 1 Decca G.E.C. ITT	£17
Vol. 2 Philips Pye Redif.	£17
Vol. 3 Rank Bush Thorn	£17
Foreign CTVs (now updated)	2 vols £32
Mono (Stand + Port)	2 vols £32
Early VCR (VHS/Philips)	£17
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New T.V. Rep. Manuals **£7.50 each** 1983 Brit. CTV or Foreign CTV 4
Complete set of 15 TV Rep Mans for **£105**

Unique T.V. Repair course **£9.50**
The only practical radio servicing and repair course **£9.50**

Large SAE brings FREE 50p magazine inc. service sheet/details of unique T.V. publications. Any quotation plus price lists, etc.

Full size service sheets £2 + l.s.a.e.
CTVs/Music Centres £3 + l.s.a.e.

Worlds largest collection of service manuals 1930 to date. From **£4.50** to **£35 each.**
e.g. Autovox/G8/A823 **£7.50 each**
Integrated TV repair system **£195.**
Contains over £250 normal prices.

FOR FAST QUOTES RING 0698 883334

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2 METRE PARABOLIC DISHES
Glassfibre Construction
Suitable for 4 and 12 GHz **£290**
Polar Mounts and Feed Supports Available.
Send S.A.E. for Details
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Tel: 0580 291090

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Next to the set fitting
B45H/G-UHF TV, gain about 20dbs, Tunable over the complete UHF TV band. **Price £8.70.**
AMPLIFIED SET TOP AERIALS for UHF TV, trebles the gain. Price £11.70
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Access/Visa Cards Welcome SAE Leaflets

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Send 50p for our new 1983 catalogue and price list.
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Tel: 0992 50478.

TO ADVERTISE IN THIS SPACE
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01-261 5846

All diodes at 10p or less in this list 20 of one type **£1.00**

OA 47	8p
OA 90	8p
IN 60	5p
IN 541	5p
IN 914	3p
IN 2069a	10p
IN 2070	10p
IN 4001	3p
IN 4002	3p
IN 4003	4p
IN 4004	4p
IN 4005	4p
IN 4006	4p
IN 4007	5p
IN 4148×40	£1
IN 4448×40	£1
IN 4742	10p
IN 4722	10p
IN 4751	10p
IN 5235	10p
IN 5254	10p
IN 5349	10p
IN 5392	10p
IN 5393	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 210	10p
ITT 921	10p
ITT 923	10p
ITT 1075	10p
ITT 2001	10p
ITT 2002	10p
ITT 4150	10p
ZE 1.5	10p
ZF 3	10p
ZF 3.3	10p
ZF 4.3	10p
ZF 10	10p
ZF 11	10p
ZF 12	10p
ZF 15	10p
ZF 33	10p
ZF 43	10p
ZF 47	10p
ZF 82	10p
ZPD 3.9	10p
ZPD 4.7	10p
ZPD 5.6	10p
ZPD 10	10p
ZPD 47	10p
ZPY 8v2	10p
ZPY 12	10p
ZPY 16	10p
ZPY 24	10p
ZPY 43	10p
ZPY 47	10p
ZPY 56	10p
ZTE 2	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
BAV 10	10p
BAV 21	10p
BAW 21	10p
BB 103	10p
BB 105A×12	£1
BB 105B×12	£1
BB 105G×12	£1
BB 121a	10p
BRC 83c13	10p
BZX 46c22	15p
BZX 61 9-1	6p
BZX 61c110	6p
BZX 61c15	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
BZX 84c6v8×10	30p
BZX 85c8v2	10p
BZX 88c0v7, 3v9, 4v3, 6v2, 8v2,12	10p each
CV 8617	10p
Wire 3300/50 Ends	25p

Min 12 volt Relays	75p

Y 716	10p
Y 729	30p
Y 730	10p
Y 827: 6A/1KV	20p
Y 860	30p
Y 933	5p
Y 969	50p
Y 997	30p
R 1038	40p
R 1039	40p
R 2009	80p
R 2010b	£1
R 2029	50p
R 2210	60p
R 2257	60p
R 2265	50p
R 2305	50p
R 2306	50p
R 2322/2323	pair 80p
R 2323	15p
R 2396	50p
R 2461	80p
R 2030	50p
R 2443=BD124	40p
R2737	40p
R2738=TIP41	30p
R2775=TIP41c	40p
R3129=TIP47	40p
S 2008b	80p

BU 105/04	80p
BU 108	£1
BU 124	50p
BU 126	80p
BU 180a	65p
BU 204	70p
BU 205	£1
BU 206	£1
BU 207	£1
BU 208	80p
BU 208 on heat sink	70p
BU 208A	£1.10
BU 208D	90p
BU 222	£1
BU 326	£1
BU 407	60p
BU 426V	60p
BU 500	£1.10
BU 508A	£2
BU 526	75p
BUX 84	50p
BUW 84	30p
BUY 71	£1

TIC 106a	30p
TIC 116m	40p
TIC 116n/Y 1003	35p
TIC 126N	40p
TIC 206m	30p
TIC 225S	40p
TIC 226E	40p
TIC 226m	30p
TIC 236m	30p
TICV 106D (T092 case 2A/400V)	10p
TIP 29	20p
TIP 29C	25p
TIP 30	35p
TIP 30A	35p
TIP 30B	40p
TIP 30C	45p
TIP 31	30p
TIP 31A/RCA 16334	35p
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
TIP 48	40p
TIP 49	30p
TIP 57	30p
TIP 100	30p
TIP 102	30p
TIP 112	30p
TIP 115	50p
TIP 117	50p
TIP 120	35p
TIP 125	35p
TIP 130	30p
TIP 131	25p
TIP 136	30p
TIP 140	50p
TIP 147	50p
TIP 640	50p
TIP 2955	35p
T 6032	30p
T 6036	40p
T 6040	40p
T 6047	40p
T 6049	40p
T 6051	40p
T 6052	40p
T 9004	40p
T 9005	40p
ZTX 102c	10p
ZTX 107	10p
ZTX 108c	10p
ZTX 109k	5p
ZTX 213	5p
ZTX 341	10p
ZTX 342	10p

SPECIAL OFFER CVC 21
Chassis complete **£35**
Computer Transformer 20v/2.25A; 20v/1.5A; 17/.5A; 19/.5A; 28/.05A **£3**

ZTX 384	10p
ZTX 451	10p
ZTX 550	10p
MJ 2253	60p
MJ 3040	60p
MV 2209	10p
SP 8385	50p

Voltage Regulators

+5V/UA78PO5SC	30p
−5V/LM79MO5CP	25p
−8V/79M08c	30p
+6V/78M06c	30p
+10v/78LA10	20p
LM 337	30p
LM 342/18	30p
−12V/MC 7912	20p
+12V/LM 340T12	50p
+15V/78M15	15p
+18V/MC78M18	20p
+24V/78M24	30p
MC 7724cp	40p
MC 7824	40p
TIS 90	10p
TIS 91	20p
TIS 92	20p
TIS 93	20p

CB Radio transistor
16119 2A/40v.50Meg
5 for £1.

U 19885	40p
U 3832	15p
U 3845	15p
MR 508	10p
MR 501	10p
MR 502	10p
BCW 71R	30p
BYF 1202	10p
BYF 1204	10p
BYF 3126	40p
BYF 3214	40p
BYX 10	6p
BYX 36/600	35p
BYX 38/300	25p
BYX 55/350	10p
BYX 55/600 (Bead)	10p
BYX 71/350	20p
BYX 71/600	50p
BYX 72/300	20p
BYV 95B	10p
BVY 95C	12p
BYV 96D	10p
BYZ 106	10p
BPW 41	15p
BYW 56 2A/1000v	8p
BZY 93c75	50p
BZV 15/18	30p
BZV 15/30	30p
BZW 70c6v2	10p
Bush thyristor RCA 76122	£1
ITT computer bookset 2020	£2
G8 20 turn 100K pot	35p
Transformer 240v/20v-500Ma	75p
Viewdata torroidals	£6
CVC 20 tube base	£2
Mitsumi tape motor	75p
Sankyo tape motor	75p
Swiss made 250rpm/240V motor very small	75p
Mono scan coil 110° small neck	£1.50
Infra red led LD57CA	15p
Mono scan coil	£3
G 8 transductor	£1
AT 4041/41 transductor	£1
2K5 Lin pot with 40mm spindle	20p
1982 Hitachi Ae isolator	50p
Mullard FM decoder 1401	£1
Philips service pack, flat films, 57 condensers 56nf-2.2uf	£2
VHF 3 Transistor rotary tuner DX-TV	£1
15K-20 turn pots	20p
Thorn panel 6×100 pot + changeover switch (Irish)	50p
Battery converter TA 75 for colour TV. 12/24v Thorn 3787	£12
Thorn 3500 2A cut out	75p
Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit	£6

SPECIAL OFFER
Decca-TTT etc.
FEO4/1/250AC/4
Mains filters
(grey type) × 4
£1

BRIDGES

SKB 2/08 L5A	30p
KBL 005	30p
KBL 02	30p
KBP 04	30p
W02	15p
W004	15p
W005	20p
GEC remote panel. Main transformer 3/ic SAA 1025/SN 74141/TBA 231	£6
AT 2076/55 GEC split diode transformer	£10
AT 2048/11 LOPTI Mullard	£2.50

PHILIPS DIY HOME SECURITY ALARMS KITS
Send for details. Prices **£54 to £112.**

10 Mixed TV & radio speakers
£5 + £2 post

8Ω 4" speakers	£1
4700/10v × 10	50p
68/16 × 10	50p
150/16 × 10	50p
47/25 × 10	50p
220/25 × 10	50p
1/250 × 10	50p
8000/30v	50p
470/40v × 10	£1
22/100v × 10	£1
100/350v	70p
400/350v	70p
.47/500v	25p
1/600v	25p
.022/1kv	10p

Philips GP422.4CH (£40 cost) **£6**
Stereo Dynamic Cartridge

12 Volt Aerial Changer over Relays **£1**

GEC Hitachi
V/Cap tuner, after 1979 Series **£13**
6 Push Button Unit for GEC 2100 Series Replacement for Touch Button Unit **£12**

Mullard
Broadband
R.F. power modules

VHF. BGY33 **£15**
UHF. BGY22E
£5 PT4236C
£5 PT9783

Various Tools and Accessories

G11 Neon Switch	£1
GPO 5 way plug	25p
12v screwdriver tester with lead + croclip	25p
Mains timer. 13 amp — up to 2 hours: easy to use, plugs into socket	£3
Sellotape PVC Electric Insulation 25mm × 20M 50p; 50mm × 20M	70p
Telescopic aerials (radio)	£1
UHF Radio Aerial	50p
Xcelite pliers	£3.90
Xcelite snips	£5
Xcelite cutters	£3.90
GKN Supascrew kits	£2.50
VU meter	45p
Pull up large aerial	75p
"V" TV aerial	£1
Soldering iron 6v/23w	£2.50
Portable TV aerial	75p
Phillips snips	£2
2 way baby alarm/intercom with long leads	£5
Phillips universal battery tester/charger, fuse/bulb tester	To Clear £4
Volt/ohm test meters 1000 ohm/volt	£5
Eisenmann NICAD CHARGER 5.5V/150 ma	£2
12V Nicad pack. "AA"	£2.50
Hitachi TP 007 Battery pack 7.2v/1.6A	£7
"AA"/1.25V Nicad	£1
"C" Nicad	£2
"D" Nicad	£3
Duracell PP3	60p
70ML Silicone Sealer (clear)	£1
¾" × ¾" microphone/speaker	50p
Continental 2 pin plug with 5½ft mains lead (black & blue)	5 for £1
7" Ferrite rod with LW/MW coils	50p
Xcekute 5" bent nose plier	£3.50
De-solder pump + 2 nozzels	£5.20
Plastic box for i.c.s with anti-static pad 6"×3"×½"	75p
Can of handy oil 'mobil'	40p
Flat Red LED	12p
500gm 60/40 solder reel	£7
Clearweld glue pack	30p
Dual v/u meter -20 – +10db	£1
15 service manuals, Thorn 3504 & 3448, etc	£2.50
3 × C90 Cassettes	70p
Can Freezer	£1.75
K30 thermistor 232266298009	75p

75R/25 Watt	25p
18R/11 Watt	25p
120R/17 Watt	20p
Front End Music Center. VHF/MW/LW 13"×3½"	£5
Output Stage for music center	£5
Both items	£9
circuit supplied (as previous ad)	
SONY 1400KV Chroma Panel	£6
SONY 1400KV Tuner unit	£3.50
SONY 1400KV Touch button unit	£3.50
3 books, Electronic Systems/Guide to Print Circuits/1st Steps in TV	£1.40
Texas Viewdata Decoder VDP 12/80 Issue 3 with all IC's	£10.00

Quantity Reductions

BY204/4	25 for £1.00
BY206	25 for £1.00
BD132/238	20 for £2
W005 bridge	20 for £2
G11 touch button red	6 for £1
BY210/600	25 for £1.00
BY298 3 amp/fast/R	20 for £1.50
BD239	20 for £2.00
MR856	25 for £1.50
BU126	10 for £6.00
BU205	10 for £8.00
BU105	10 for £6.00
2SC2122A	10 for £8.00
BF458	10 for £1.00
BD136	10 for £1.25
BF224	20 for £1.40
OA90	40 for £1.00
BYX10	100 for £4.00
KT3 multicaps	10 for £7.50
50 High voltage ceramic condensers	£1.50
Mixed Mounting Kit for Power Transistors	50p
300 Condensers	£1.50
300 Resistors	£1.50
150 Electrolytics	£2.00
15 Bulbs	40p
Video lamps	20 for £5, 200 for £25
Antistatic Discloth	5 for £1
100 Diodes	£1.50

100 Fuses	£2.00
100 W/W Res.	£1.50
BF 199	20 for £1
BC 547	100 for £4
10 × 20 Turn 100k pots. Rank	£2
Thorn 9 volt power supply regulated	£3.00
BF 470	20 for £2
Metal BD 124	10 for £8
20 Slider Knobs	70p
6 Mixed UHF Aerial Isolating Sockets, some with long leads. Fit ITT, GEC, Philips, Pye	£1.00

Mixed Packs

50 Mixed AC series Transistor	£4.50
15 Thorn service manuals	£3
15 Panel mount rocker switch 250V/10A	£1.50
25 Panel Mount Bulbs & Neons	£1.50
Mixed ribbon cables	£1.00
25 LED red/yellow/green	£1.50
201/C Holders	£1.20
20 Large LED Red	£1.00
20 Small LED Red	£1.00
10×20 Turn 100K Pots	£1.00
100 Transistor	£2.50
20 Convergence Pots	80p
100 Sticks	£1.00
10 Thermistors	50p
20 Slider Pots	£1.00
30 Presets	50p
15 VDR + thermistors, degaussing, HT, etc.	£1.00
40 glass reed switch	£1
10 press to make switch	70p
40 Pots	£1.50
10 Gun Switches	50p
5 Tube Bases	£1.00
1,000 Diodes, Condensers, Resistors on Bandolier	£3.00
Lucky Dip 600 gram	£1.00
Jungle Bag 5Kg	£5.00
20 Knobs	£1.00
40 Pots, ¼"+6mm spindles for audio/TV	£3
20mm Fuse Holders Chassis Mount	10 for £1

SENDZ COMPONENTS
TO ORDER SEE BACK PAGE

SENDZ COMPONENTS

TO ORDER SEE BACK PAGE

Thorn Spares

9000 tube base and panel	£1.50
9000 Front Panel	£5
9000 Front Panel (remote)	£8
8800/9000 remote unit U705 receiver	£6
9000 Frame panel	£8
9000 Cyclops panel	£1.50
8000/8500 timebase panel	£8
8000/8500/9000 chroma panel	£15
8800 convergence panel	£6
8500 convergence panel	£6
4000 Frame panel	£5
4000 Power supply	£3
1600 Mains lead, switch	
3500 6 push button + cable form	£1.50
T605 1vNPN T066 80v/6A	10p
9000 Sound output panel	£1
3500 Focus unit	£1.50
4000 thick film.	
00S1-010-E003	£1
00S1-012-E002	£1
00S1-012-0108	£1
00S1-018D	£1
3500 Power Supply	£5
3500 2amp thermal cutout	75p
3500 IF panel	£2
3500 Frame panel	£4
3500 Video panel	£5
3500 Line panel	£5
3500 A1 Diode	20p
Export 3500 IF panel	£2
Remote unit, 11ic, transformer, relay + 5 volt unit	£2
IC board with set of SN74LS	£1
4000 Tube base	£4
3500 A1 pots	50p
Beam limiter panel	£1.50
3500 Power panel complete	£1
3 Way regulated adaptor 240V 6V/7.5/9V/300mA	£3.50
Rank/Toshiba preh unit 0354	£9.50
2 banks of 3 PB unit, Pye 731	£2
4 Push button unit preh	£1.00
6 Push button VHF/UHF for v/cap. GEC-Decca type	£7.00
7 Push button for CVC5 ITT	£8.00
KT3 12 Push button unit	£2.00
KT3 (Export) 12 P.B.u	£2
6 Push button Unit Thorn	£1.00
6 Push button unit for GEC 2040 and ELC 1043/05	£6.00
Hearing aid unit	£3
6 Push button unit PYE 713	£7.00
7 Lamps for P.B./Unit	10p

Mains Droppers

Pye 731 3+56+27R	50p
Pye 3R5/15R/45R	50p
Thorn 50/17/1K5	£1.00
120/20/20/48/117	£1.00
270/10/6 for Thorn 4000	50p
18/320/70/39	£1.10
Thorn 50-40R-1K5	50p
Ae Socket & Lead	
GEC, ITT, Philips, Pye	25p
7×3¼ Thorn	£1
Rank Toshiba Tube Bases	30p

Speakers

6×4 G11	25 ohm	70p
5¼×2¼	3 ohm	£1.00
5×3	80 ohm	70p
5×3	50 ohm	50p
5×3	35 ohm	70p
5×3	15 ohm	80p
6×4	15 ohm	£1.00
7×3	70 ohm	£1.00
5×3	8 ohm	70p
7×3	16 ohm	£1.00
5" dia	16 ohm	£1.00
5" dia	8 ohm	£1.50
6½" dia	4 ohm	£1.50
6½" dia	3 ohm	£1.50
2¾" dia	8 ohm	75p
3" dia	8 ohm	75p
KT3 speaker		75p
3" dia	15 ohm	60p

Diodes

BY 127	10p
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 210/400	5p
BY 210/600	8p
BY 210/800	10p
BY 223	£1
BY 224/600: 4.8A/600v bridge	50p
BY 226	15p
BY 227	15p
BY 228	20p
BY 229/400	30p
BY 234	10p
BY 237	5p
BY 238	15p
BY 254	10p
BY 255	30p
BY 298	10p
BY 299	10p
BY 406	8p
BY 527	20p
BY 407a	10p
BY 602	10p
F 247	10p
XK 3102	50p
XK 3123	50p
Hitachi 2A/1500V metal case wire end	20p

Line Transformers

G8 Trans. Philips	£7.50
G11 Split Diode	£12.00
CVC820 Split Diode ITT	£10.00
Thorn B/W AD5308F + Stik + Lead	£1.50
GEC 2040	£5.00
GEC 2110	£7.00
Mullard AT 2036	£1.50
Pye mono	£3.00
Rank mono T704A	£3.00
CVC32 ITT	£7.50
GEC Portable Line Trans.	£3.00
EHT Split Diode Leads	£1.00
EHT Cable/Metre	20p
Ex panel "14" Fidelity portable	£5

Triplers

11 TEZ Rank	£3.00
G9 Philips	£4.00
GEC 2110	£4.00
9000 Thorn	£6
9500 Thorn	£4.50
2040 GEC	£3.50
GEC TVM25 Tripler	£2.00
Universal Tripler	£6.00
TVK 76/9	£3.00
G8 Philips	£4.50
Decca 80 100	£4.50
Grundig TVK 52	£2.50
11TBQ	£3.00
11THY	£4.00
D22 for Pye 18" colour portable	£4.00
LP 1193/63	£4.00
BG 100/41	£3.25
BG 100/61	£3.25
T/text ultrasonic rec'r panel	£14.00
Video cassette lamps on lead. 12-14V.	50p or 3 for £1.00
GEC 8 touch unit assy complete with all I.C.'s + pots	£4.00
G11 E.W. coils	£1.00
G11 Transient Suppressors 245V	10 for £1.00
G11 Scan Coils	£5.00
G11 100K tuner pots	12 for £1
KT3 IF panel	£6.00
KT3 line OSC transformer	£1
KT3/K30 infra-red receiver head	£3
K30 drawer unit with IC's (home)	£10
K30 drawer unit with IC's (export)	£10
KT3 AE Sockets	25p
KT3 receiver panel	£8
KT3 line driver transformer	50p
Decca 80/100 IF panel	£5
NPN PNP 80V 6 Amp TO66 O.P. Trans.	pair 25p
5 button touch tuner BBC1/2 ITV1/2 video with ic SAS 560T/570T	£7.00
Control panel 5 sliders + mains lead	£1.50
G11 8 touch button unit replaces old 6 P.B.U.	£24
Tube base + base unit for 820 Euro chassis	£4.00
GEC Line O/P Trans. & Rec Stick for Portable	£3.00
CVC 20/25/30/35/40 decoder panel	£10
CVC 20/25/30/35/40 decoder panel (untested)	£5
CVC 40/45 IF panel	£5
40K Transducer	50p
PHILIPS NE511N	£1.20
LM337M Reg.	30p
20 GEC Black Spark Gaps	£1.00
G11 Line Driver Transformer	35p

International Rectifier EHT Diodes G770/HV34 6KV	3 for 8p
6A/600V Stud Diodes	20p
6A/1000V Stud Diodes	20p
BTW 30/50	50p
BTW 92/800R	£3
25A473 PNP C/P	10p

Complete new GEC portable chassis M1201H/M1501H with P.B.U./v.cap/LOPTI	£10
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 Timebase panel with LOPTI	£10.00
Pye 731 line O/P panel with transformer + tripler	£12.00
Pye 731 Chroma/IF	£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
Panel 6101	£15.00
Panel 6330	£15.00
G8 Tuner Unit + Panel	£9.00
G8 IF Panel	£12.00
G8 Convergence Panel (late type)	£12.00
G8 Line O/P Panel	£12.00
G8 Power Supply	£9.00
G8 6 Sloping PBU	£12.00
G8 IF & Chroma	£15.00
G8 Chroma	£8.00
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	£10.00
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
GEC Convergence panel	£1
Universal Focus. Fits Pye, Thorn and Decca Units.	
Large Type	75p
Decca Small	75p
KT3 Focus Unit	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

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
2.2/63	5p
15/63	5p
47/63 Bipolar	15p
100/63	6p
2200/63	50p

DISPLAYS

4040 Clock	£1
7seg Red LED	50p
4 digit LCD 88:88	£1.00
2 digit LED 8.8	50p
2 digit LED ÷1.8 with panel + MC14511	£1.00
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
.39/250V	15p
4n7/250 tested 5KV	25p
22/250	15p
47/250	10p
100/250	20p
G11 470/250V	£1.75
500/250	50p
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	10p
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
20n/2KV	15p
2n0/2KV	15p
2n2/2KV	15p
7500pf/2KV	10p
4n7/2KV	15p
8n2/2KV	15p
20n/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

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 Transductors 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

Thorn 3500	
175/100/100/350v	£1.75
KT3/200/25/25/385v	£1.00
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

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 31	£1.50
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	£2.00
CMP 30	£2.00
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 40	£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
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
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/K30 T/Text	£18
KT3/K30 Full remote	£16
KT3 Power supply	£4