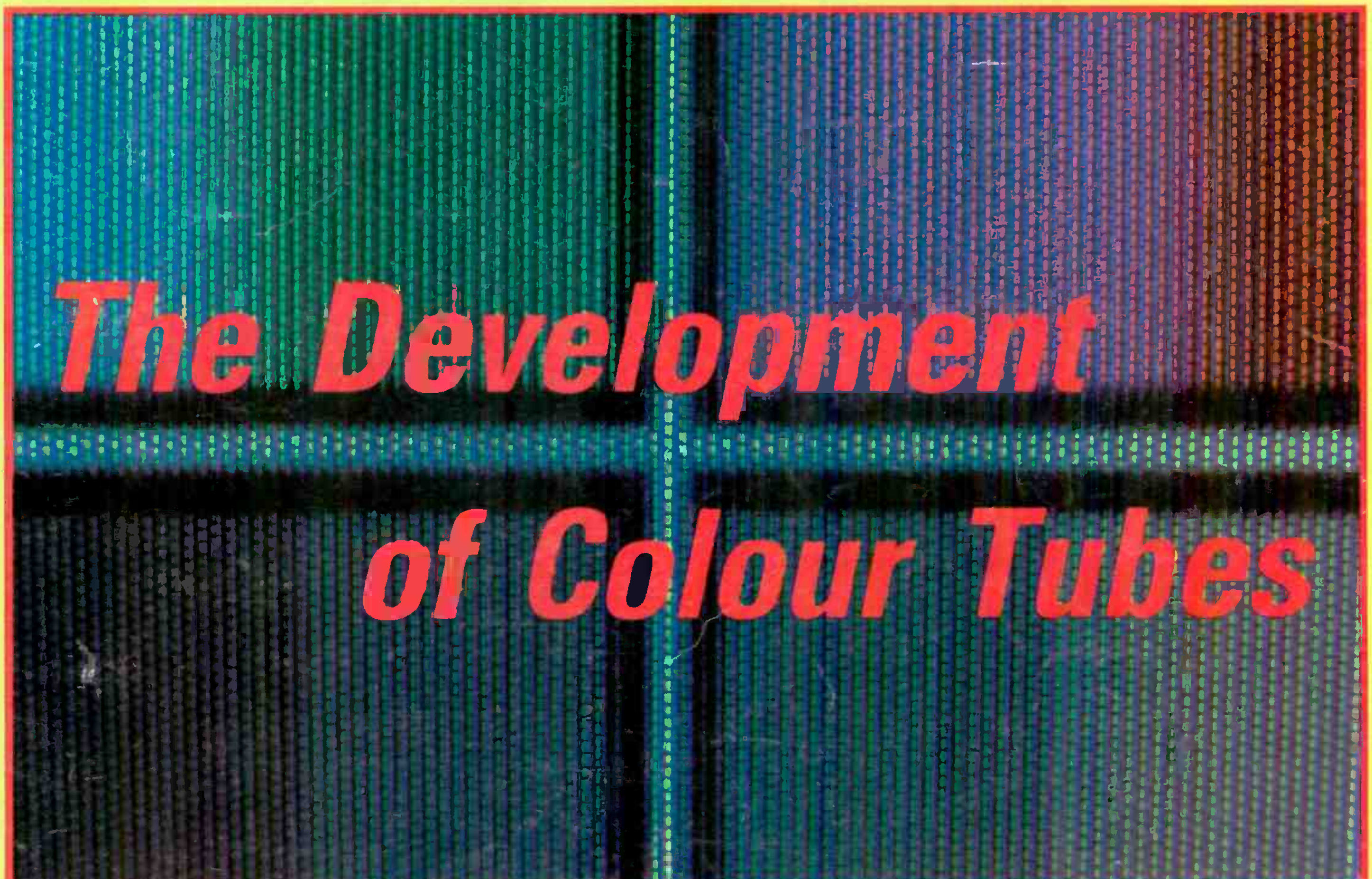
JUNE 1986

Australia $2, New Zealand $2·50, Malaysia $5·75 £1·20

TELEVISION

SERVICING·PROJECTS·VIDEO·DEVELOPMENTS



Also inside:

Servicing the NordMende F10 and F11 Chassis

Video Signal Processing

Microcomputer Servicing • DX-TV

VCR Clinic • TV Fault Finding

THE 'TELEVISION' PHOTO SERVICE

So many readers have taken advantage of this award-winning service that the economies made are being passed on to you. Despite inflation, prices for Superprints are the same as for last year, and prices for standard size prints are even lower! Here is the price range—and remember, Superprints give you 30 per cent more picture area.

No. of Exposures	Superprints (inc. 15% VAT)	Standard size prints (inc. 15% VAT)
12—15	£1.65	£1.49
20—24	£2.20	£1.99
36	£2.95	£2.49

Plus 30p post and packing.
Extra set of prints (any size) £1.40.

RELIABILITY AND QUALITY

All our prints are made on super high-gloss Kodak paper. They are checked at every processing stage for accurate colour reproduction by the Kodak Monitoring Service—a Gold Award Winner in both 1984 and 1985. After allowing for postal and peak-period delays, you should normally expect your prints by First Class return post after seven to ten days.

ALL YOU HAVE TO DO

Send your film together with cheque or postal order in the Freepost envelope enclosed with this issue. Or fill in the coupon below and send together with your film and remittance in a strong envelope to: Readers Photo Service, FREEPOST, PO Box No. 42, Brunel Road, Newton Abbot, Devon TQ12 4XJ. All popular makes and sizes of film are accepted, and you have a full money-back guarantee. Credit is given for prints that do not come out.

PERSONALISED SERVICE

Readers know we care for their prints. If you have any queries, phone 0626 67150.

SPECIAL FILM OFFER

Even if you do not have an exposed film ready for processing, you can obtain films from us at highly competitive prices Fresh Kodacolor VR Film for colour prints from only £1.99. Konica SR High Resolution Film for colour prints from £1.50 and when you order three you get another one FREE.

To take advantage of this offer, you must use the special order form on this page.

Sizes of Photos (Approx.)

Superprint sizes: 4"x4" (126) 4"x5" (110 and Disc) 4"x6" (135)

Standard print sizes: 3.5"x3.5" (126) 3.5"x4.5" (110 and Disc) 3.5"x5" (135)

USE THIS LABEL IF YOU HAVE NO ENVELOPE OR PASS TO A FRIEND. IT IS USED TO ENCLOSE YOUR PRINTS.

TO ORDER NEW KODACOLOR FILM

Please write quanity required in the box(es) below.

	size	each	quty	amount
Kodacolor V R film for Colour Prints	126.24	£1.99		
	110.24	£1.99		
	135.24	£1.99		
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	15 Disc	£1.99		

Cheque/PO payable to READERS PHOTO SERVICE £

Name

Address

Post Code

TO ORDER NEW KONICA FILM

Please write quanity required in the box(es) below.

	size	each	quty	4 for 3	amount
KONICA S R film for Colour Prints	126.24	£1.50		£4.50	
	110.24	£1.50		£4.50	
	135.24	£1.50		£4.50	
	135.36	£2.20		£6.60	
	15 Disc	£1.50		£4.50	

Cheque/PO payable to READERS PHOTO SERVICE £

Name

Address

Post Code

TO SEND FILMS FOR PROCESSING

I enclose .... films for processing.
Please send (tick boxes)
SUPERPRINTS ☐
Standard Prints ☐
EXTRA SET OF PRINTS ☐
I enclose cheque/PO for
£............................made payable to READERS PHOTO SERVICE.
ENCLOSE ORDER FORMS & PAYMENT FOR NEW FILMS TOO IF REQUIRED.

Name

Address

Post Code

RS 1004

If you are not satisfied with your order please return it for rework credit or refund Our liability for loss or damage is limited to the cost of unexposed film and any prepaid processing Additional liability is undertaken at a supplementary charge Minimum order value £1.00 Prices and materials correct at time of printing and are subject to change without notice This service is operated in association with Nashua Photo Products Ltd Brunel Road Newton Abbot Devon TQ12 4PB Registered no 1021605 England

TELEVISION

June 1986

Vol. 36, No. 8
Issue 428

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.

SUBSCRIPTIONS
An annual subscription costs £14 in the UK, £17 overseas (by surface mail). Send orders with payment to Quadrant Subscription Services Ltd., Oakfield House, Perrymount Road, Haywards Heath, Sussex, RH16 3DH.

BINDERS AND INDEXES
Send orders for binders (£4·50) and indexes (75p) to the Editorial Office, Television, IPC Magazines Ltd., King's Reach Tower, Stamford Street, London SE1 9LS. Prices include VAT and postage. Add 60p for overseas orders.

BACK NUMBERS
Some back issues published during the last six months are available from the Editorial Office at £1·40 inclusive of postage and packing. Address as above.

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

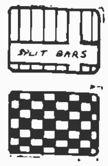
this month

OUR NEXT ISSUE DATED JULY WILL BE PUBLISHED ON JUNE 18

MANOR SUPPLIES

MKV PAL COLOUR TEST GENERATOR FOR TV & VCR.

TEST DEMONSTRATIONS AT 172 WEST END LANE



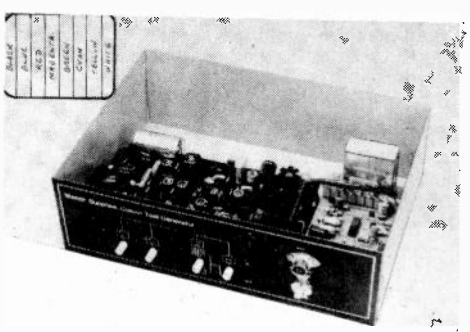
- ★ 40 different patterns and variations.
- ★ Broadcast transmission accuracy (fully interlaced sync pulses with correct picture blanking).
- ★ EBU colour bars, BBC colour bars, whole rasters & split bars (specially useful for VCR service), white, yellow, cyan, green, magenta, red, blue and black.
- ★ Chequerboard.
- ★ Mono outputs with border castellations, cross hatch, grey scale, vertical lines, horizontal lines and dots. UHF modulator output plugs straight into receiver aerial socket.
- ★ Additional video output for CCTV & VCR.
- ★ Facilities for sound output.
- ★ Easy to build kit, standard parts. Only 2 adjustments. No special test equipment required.
- ★ Mains operated with stabilised power supply.
- ★ All kits fully guaranteed with back-up service.
- ★ Also available with VHF Modulator.

Price of Kit	**£70.00**
Case (10″×6″×2¼″) app.	**£8.60**
Optional Sound Module (6MHz or 5.5MHz)	**£3.90**
Built & Tested in Case including Sound Module	**£108.00**

SPECIAL TEST REPORT 'TELEVISION' DEC. 1982

Post/Packing £2.50
Add VAT 15% TO ALL PRICES

PAL COLOUR BAR GENERATOR (Mk4)



- ★ Output at UHF, applied to receiver aerial socket.
- ★ In addition to colour bars R-Y, B-Y etc.
- ★ Cross-hatch, grey scale, peak white and black level.
- ★ Push button controls, battery or mains operated.
- ★ Simple design, only five i.c.s on colour bar P.C.B.

PRICE OF MK 4 COLOUR BAR GENERATOR KIT £30.00. CASE £8.60. BATT HOLDERS £4.20. MAINS SUPPLY KIT £4.20 (Combined P&P £2.20).

MK 4 (BATTERY) BUILT & TESTED £58.00 + £2.20 P & P.
MK 4 (MAINS) BUILT & TESTED £68.00 + £2.20 P & P.
VHF MODULATOR (CH 1 to 4) FOR OVERSEAS £5.75.
EASILY ADAPTED FOR VIDEO OUTPUT & C.C.T.V.

ADD VAT 15%

THORN TX9 MK2/3, TX10, teletext
Mullard Decorder panel + Interface **£35.00** p.p. £1.80
THORN TX10, PHILIPS G11 PRESTEL, TELETEXT
Mullard Units VM 6230, 6330 plus Line Coupler & Interface **£38.00** p.p. £2.50
EXTERNAL TELETEXT ADAPTOR
(RADOFIN) with cable remote control. Fully tested. **£150.00** p.p. £3.00. Plugs into aerial socket of any T.V.
SPECIAL OFFER (shop customers only).
SURPLUS 'AYR' TELETEXT EXTERNAL ADAPTOR UNITS.
Ideal for experimental use **£50.00.**

TV SERVICE SPARES

BACKED BY TWENTY YEARS EXPERIENCE & STAFF OF TECHNICAL EXPERTS

LOPTs, TRIPLERS, PANELS, TUNERS, SELECTORS ETC.

SPECIAL OFFER Ex rental T.V. Sound & Vision Tuner Units. Ideal as front end for Monitors, Portable Video, HiFi, etc. Deluxe Cabinet, mains operated, 8 position selector, Saw Filter IF. Only **£15.00** p/p £2.80.
SPECIAL OFFER Mullard/Philips quality UHF modulator (audio & video input) ex new equipment **£5.00** p.p. £1.00.
PHILIPS G11 PANELS (tested).
Power, frame, IF, decoder **£18.00** each p.p. £2.00. Scan Panel **£28.00** p.p. £2.80.
PHILIPS G11 PANELS ex rental (untested).
Power, frame, IF, decoder **£10.00** each p.p. £2.00.
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THORN 9000 Fault Finding Guide **£1.00** p.p. 30p.
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8800/9800 (2-button) **£10.00; TX9 ULTRASONIC** (3-button) **£15.00; TX9, TX10** Infra red **£18.00; TX9, TX10** Infra red Teletext **£20.00,** p.p. £1.20.
TX10 Remote & Tuning control panel (1515) **£9.40** p.p. £1.50
TX9/TX10 Teletext interface panel (1524) **£5.00** p.p. 80p.
THORN TX10 Facia Control Panel incl. Infra Red Remote Control receiver **£7.50** p.p. £1.50.
THORN TX10 Series Facia Control Panel with 8 position Channel Selector **£6.50** p.p. £1.50.
SAW FILTER IF AMPLIFIER PLUS TUNER complete and tested for T.V. Sound & Vision. **£28.50** p.p. £1.20.
THORN TX9, TX10 Saw Filter IF Panel. **£5.00** p.p. 80p.
PAL DECODER KIT (Video to RGB) for Monitors **£27.00** p.p. £1.00.
PAL ENCODER KIT (RGB to Video) **£18.50** p.p. £1.30.
TELETEXT DECODERS New & Tested Mullard VM 6101 **£30.00,** Texas XM11 **£40.00,** KT3 Tested **£30.09,** Untested **£5.00** p.p. £1.60
CROSS HATCH UNIT KIT, Aerial Input type, incl. T.V. sync. and UHF Modulator, Battery Operated, also gives Peak White & Black Levels, can be used for any set. **£12.00** p.p. 80p. (Alum. Case **£2.90,** De Luxe Case **£6.80** p.p. £1.40.) **ADDITIONAL GREY SCALE** Kit **£2.90** p.p. 45p.
UHF SIGNAL STRENGTH METER KIT £22.00 Alum. Case **£2.90.** De Luxe Case **£8.60** (Built & Tested **£46.50**) p.p. £2.30.
CRT TESTER & REACTIVATOR KIT For Colour & Mono complete with Case, Panel Meter Indicator – can be adapted for latest CRTs **£29.50** p.p. £2.80.
BUSH A823 Convergence, Time Base Panels **£5.00** each. p.p. £1.80.
BUSH Z718 BC6100 series IF Panel **£5.00** p.p. 90p.
BUSH A816 IF Panel (Surplus) **£1.00** p.p. 90p, 5 for **£4.00** p.p. £1.40.
GEC 2040 Decoder Panels, **£1.50** p.p. £1.80.
GEC 2110 PANELS Frame **£8.50** p.p. £1.40. Sound **£2.50** (tested) p.p. 80p.
GEC 20AX Line Time Base **£18.00.** IF-Decoder **£12.50** p.p. £2.00.
PYE 691-7 CDA Panels. Makers tested stock. **£6.00** p.p. £1.45.
THORN TX9 Panels ex factory for small spares. Includes I.Cs & Semiconductors etc. **£3.00** p.p. £1.80.
THORN TX9 Panels salvaged ex factory for spares incl. LOPT & Mains Transformers. **£10.00** p.p. £2.80.
THORN TX9 Panels ex factory salvaged complete cond. **£20.00** p.p. £2.80.
THORN 3000/3500 Power supply P.C.B. **£3.50** p.p. £1.00.
THORN 8000, 8500, 8800 IF Decoder Panels Tested **£10.00** p.p. £2.30.
THORN 8000/8500 IF/Decoder Panels salvaged **£3.20** p.p. £1.80.
THORN 9000 IF/Decoder Panels Salvaged. For spares **£2.50** p.p. £1.80.
THORN 9000 Frame Time Base **£8.50** p.p. £1.80.
PHILIPS G8/G9 IF/Decoder Panels for small spares incl ICs **£2.50** p.p. £1.60.
G11 PANELS, Ex Rental SCAN (incl LOPT) **£28.00** p.p. £2.50 (tested).
G11 PANELS, Power, Frame, IF, Decoder, **£18.00** each. p.p. £2.00 (tested).
GRUNDIG 8630 Series Varicap Tuners **£5.00** p.p. £1.00.
U321. ELC1043/5 **£7.80** p.p. 80p. Makers Controls PYE CT200 4PSN **£7.50,** BUSH 4PSN **£4.80,** DECCA 4PSN **£5.80,** 6PSN **£6.80** p.p. 80p. etc.
BUSH "TOUCH TUNE" Varicap Control Z585, 710 **£3.80** p.p. £1.00.
VARICAP UHF-VHF ELC 2000S **£9.80** p.p. £1.00.
UHF/625 TUNERS, many different types in stock. DECCA Bradford 5 position, MULLARD 4 position **£2.50,** JAP Rotary **£4.80** p.p. £1.80.
TV SOUND IF Panels **£6.80** p.p. £1.00.
LOPT TESTER, Service Dept approved **£15.90** p.p. £1.20.
LOPTS New and guar. P/P Mono **£1.35,** Colour **£1.50,** Bobbins **80p.**

BUSH, MURPHY 774 series	**£9.80**	**R.B.M.** T20, T22	**£9.80**
BUSH, MURPHY A816 series	**£9.80**	**R.B.M.** T20, T22 Bobbin	**£5.60**
FERG., HMV, MARCONI, ULTRA		**DECCA** Bradford (state Mod No)	**£8.80**
1500,1590,1591,1612,1613,1712	**£4.80**	**DECCA** 80, 100	**£8.80**
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PHILIPS 170, 210, 300 series	**£7.65**	**ITT** CVC45	**£9.80**
PYE, INVICTA, EKCO.		**PYE** 691-697 (state model no.)	**£10.00**
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OTHERS AVAILABLE, PRICES ON REQUEST.
TRIPLERS Full range available. Mono & Colour.
Special Offer: THORN 3000/3500 EHT Tripler **£2.50** p.p. £1.30.
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THORN TX10 focus control **£8.80** p.p. 80p.

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THOUSANDS OF ADDITIONAL ITEMS, ENQUIRIES INVITED
LARGE SELECTION TESTED COLOUR PANELS POPULAR MODELS

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NEAR: W. Hampstead Tube Stn. (Jubilee) Buses 28, 159, C11 pass door
W. Hampstead Brit. Rail Stn. (Richmond, Dalston, Stratford, N. Woolwich)
W. Hampstead Brit. Rail Stn. (St. Pancras, Bedford)
Access from all over Greater London.
Mail Order: 64 GOLDERS MANOR DRIVE, LONDON NW11 9HT
PLEASE ADD VAT 15% TO ALL PRICES INCL P+P

P. V. TUBES

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ADD 87p per order P+P (U.K.). Heavier parcels e.g. cable, service aids, degaus. coils please allow £1.50 P+P (U.K.). Export orders charged at cost. First Class Mail is used whenever possible. Add 15% VAT to total except where it states zero rate.

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. 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. In some cases we may have to supply an equivalent.

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AC107	35
AC126	34
AC127	34
AC128	34
AC128K	40
AC141	62
AC141K	39
AC176	35
AC176K	35
AC186	41
AC187	38
AC187K	46
AC188	35
AC188K	46
AD142	92
AD143=OC28	82
AD161	54
AD162	54
AD161/62 MP	1.15
AF106	49
AF114	89
AF118	1.20
AF121	75
AF124	48
AF125	53
AF126	53
AF127	53
AF139	63
AF178	1.54
AF239	60
AF279	1.56
AL102	4.90
AU106	7.50
AU110	3.01
AU113	5.20
BC107	20
BC108	20
BC109	20
BC114	12
BC115	17
BC116A	35
BC117	30
BC118	24
BC119	36
BC139	32
BC140	32
BC141	30
BC142	30
BC143	31
BC147	13
BC148	9
BC149	12
BC157	16
BC158	16
BC159	15
BC160	52
BC161	32
BC170B	15
BC171	15
BC172	15
BC173	16
BC174	10
BC177	27
BC178	26
BC182L	15
BC183L	15
BC184L	15
BC186	35
BC187	25
BC204	10
BC208	13
BC209	10
BC212	15
BC212L	15
BC213	15
BC214	15
BC237	14
BC238	14
BC251A	18
BC252	12
BC261	33
BC262	30
BC300	50
BC301	53
BC303	33
BC307	20
BC308	25
BC323	99
BC327	22
BC328	18
BC337	18
BC338	18
BC461	42
BC527	35
BC547	13
BC548	13
BCX32 = BC637	39
BC549	10

BC550	10
BC557	10
BC558	9
BC635	19
BC637	23
BC639	30
BC640	32
BCY72	13
BD115	45
BD116A	90
BD124P	84
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	1.60
BD166	52
BD179	70
BD182	1.20
BD183	1.18
BD201	85
BD202	91
BD203	80
BD204	99
BD222	46
BD223	56
BD225	47
BD232	82
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	69
BD508	80
BD509	86
BD510	86
BD278A	81
BD517	60
BD519	1.08
BD520	75
BD535	82
BD536	91
BD696A	1.49
BD697	1.24
BD698=702	1.50
BD701	1.63
BD707	95
BDX32	2.10
BF115	38
BF117	36
BF125	26
BF127	47
BF154	15
BF158	18
BF160	27
BF167	24
BF173	36
BF177	52
BF178	46
BF179	42
BF180	39
BF181	39
BF182	36
BF183	29
BF184	42
BF185	36
BF194/394	16
BF195	16
BF196	16
BF197	16
BF198	18
BF199	21
BF200	35
BF224	40
BF225	20
BF241	38
BF256	60
BF257	34
BF258	34
BF259	34
BF262	84
BF263	81

BF271	24
BF273	24
BF274	24
BF336	40
BF337	41
BF338	41
BF355	56
BF362	68
BF363	72
BF371	30
BF392	35
BF422	34
BF423	46
BF435 = BF491	35
BF457	35
BF458	43
BF459	58
BF460 = BF462	86
BF469	63
BF470	66
BF597	16
BF757	54
BF758	54
BFR39	27
BFR40	30
BFR79	85
BFR90	1.74
BFT42	42
BFT43	42
BFW10	60
BFX29	40
BFX84	42
BFX85	30
BFX86	30
BFX88	46
BFY50	32
BFY51	32
BFY52	32
BFY90	95
BR100	34
BR101	95
BR103	83
BR303	1.46
BRC4443	94
BRC4444	98
BRY39	56
BRY55	45
BRY56	57
BSR59	1.80
BSV57B	89
BT100	1.65
BT101	1.20
BT102/500	1.20
BT106	1.60
BT108	1.69
BT109	1.31
BT116	1.87
BT119	3.66
BT120	3.66
BT151/800	2.07
BU104	2.00
BU105	1.58
BU124	1.90
BU126	1.75
BU204	1.50
BU205	1.87
BU206	1.80
BU208	1.60
BU208A	1.65
BU208D =BU800	2.20
BUW81A	3.84
BU208/02	2.10
BU326A	2.00
BU407	1.70
BU426	3.07
BU500	2.50
BU526	2.46
BU508	3.20
BU806	1.40
BU807	2.94
BU826	4.95
BUW84	1.45
BUX84	1.50
E1222	40
MCR101	45
MCR220	1.50
ME0411	20
MJE340	68
MJE520	50
MJ3000	1.98
MPSA92	35
MR814	45
MR854	55
MR475	2.46
MR479	2.60
OT112	1.91
OT121	1.91

R2008B	1.90
R2010B	1.92
R2265	1.50
R2322	84
R2323	67
R2461	1.50
R2540	3.20
RC4558	2.20
RCA16334	90
RCA16029	1.18
RCA16039	1.18
RCA16092	1.18
RCA16040	96
RCA16041	84
RCA16334 =ON447	90
RCA16335 =ON448	90
RCA16957	2.88
TIC45	90
TIC46	60
TIC47	72
TIL32	65
TIL78	48
TIP29C	43
TIP30A	47
TIP30C	43
TIP31C	55
TIP32C	42
TIP33B	75
TIP34B	1.06
TIP41C	47
TIP42C	50
TIP47	93
TIP120	65
TIP161	2.15
TIP2955	90
TIP3055	63
TIS91	32
TU106/02	1.80
2N696	21
2N918	82
2N2904	51
2N2905	28
2N3054	60
2N3055	79
2N3702	16
2N3703	16
2N3705	10
2N3706	10
2N3708	17
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	1.82
2SC1096	1.72
2SC1172Y	5.50
2SC1173Y	1.69
2SC1306	2.73
2SC1307	3.00
2SC1449	1.67
2SC1520	68
2SC1678	2.67
2SC1909	2.90
2SC1953	1.44
2SC1986 =2SC1061	2.94
2SC2028	1.82
2SC2029	2.60
2SC2078	2.90
2SC2091	1.34
2SC2166	2.73
2SD870 (Sony)	6.35
DEC1	2.20
DEC2	2.20
THY15/80	2.20
THY15/85	2.20
Transistor mounting kit TO66, TO3, TO220AB	30
STR441	6.50
STR451	6.50
STR6020	8.50

INTEGRATED CIRCUITS

AN214Q	3.91
AN240	3.84
AN318	6.37
AN262	4.10
AN301	5.15
AN7150	3.97
AN6340	7.85
AN6341N	8.97
AN6344	7.85
BA521	2.80
BA536	3.00
CA555	46
CA556	84
CA741	25
CA748	45
CA1532	4.20
CA3065	1.80
HA1151	3.89
HA1342	2.49
HA1306N	2.60
HA1366WR	2.80
HA1392	3.95
HA11219	4.21
HA11244	4.04
LA3350	1.59
LA4031P	3.21
LA4032P	3.15
LA4102	3.37
LA4112	3.25
LA4400	3.05
LA4422	3.28
LC7130	5.93
LC7120	5.87
LC7137	5.50
LM1011	3.25
LM1340T	75
LM8361= MM5387ANN	3.69
MB3712	2.60
MC1307	1.99
MC1310P	1.84
MC1327	1.70
MC1330P	1.47
MC1351P	2.93
MC1349	1.99
MC1350	1.50
MC1352	1.75
MC1358P	1.50
MC1495L	3.00
MC14011BCP	66
MC14049UB	43
MC7742	1.35
MC7812	1.35
ML231	
ETTR6016	2.20
ML232	2.20
ML236	5.35
ML237	2.50
ML238	6.00
ML239	2.50
ML920	4.12
ML922	3.29
ML928	2.18
MM5387ANN	4.15
MRF475	2.50
MRF477	10.00
MSN5807	7.87
MS1513L	2.80
MS1515L	3.28
SAA1025	8.50
SAA1124	5.34
SAA1250	4.99
SAA1251	5.75
SAA5000	6.15
SAA5010	6.30
SAA5012	6.50
SAA5020	5.90
SAA5030	8.25
SAA5050	8.50
SAA3210	2.93
SAF1032	6.30
SAF1039	7.77
SAS560S	2.07
SAS570S	2.07
SAS660	3.25
SAS670	3.25
SAS580	2.90
SAS590	2.90
SL901B	7.00
SL917B	9.25
SL1310	1.80
SL1327Q	1.20
SL1430	1.58
SL1432	3.36
SL76544	2.05
SN76023N	2.00
SN76110N	1.42
SN76115N	2.27

SN76131N	2.00
SN76226DN	2.72
SN76227N	1.18
SN76533N	1.70
SN76033N	2.49
SN76544N	2.35
SN76650N	1.24
SN76660N	80
SN76666N	1.52
SN76530A	1.47
STK015	7.36
STK032 = STK078	13.25
STK433	5.65
STK435	9.06
STK436	6.50
STK437	7.85
STK439	8.40
STK459	9.50
STK441	11.57
STK461=465	12.60
STK463	14.30
STR441	6.50
STR451	6.50
STR6020	8.50
SW153	3.90
TA7050P	95
TA7051P	95
TA7063P	2.20
TA7074P	3.46
TA7108P	3.43
TA7120P	2.43
TA7129AP	3.76
TA7130P	1.93
TA7146P	4.67
TA7193P	5.67
TA7171P	8.90
TA7172P	8.90
TA7173P	8.90
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
TAA570	3.98
TAA310	2.83
TAA320	2.00
TAA550	55
TAA630	3.90
TAA8400S1	1.96
TAA661B	1.20
TBA120A (A),(S),(AS),(SA).	1.49
TBA120B	1.30
TBA120SB	1.37
TBA120T	1.49
TBA120U	1.49
TBA1440G	1.56
TBA395	1.75
TBA396	1.75
TBA440N (TBA1441)	2.75
TBA440P	2.50
TBA480Q	1.82
TBA510	3.00
TBA520(Q)	1.68
TBA530(Q)	1.38
TBA540	1.76
TBA560(Q)	1.93
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	1.38
TBA820	1.70
TBA820M	1.25
TBA890	3.94
TBA920(Q)	3.00
TBA950(2X)	3.25
TBA970	4.09
TBA990	1.90
TBA14406	2.44
TCA760	2.30
TCA270SQ	2.50
TCA800	5.95
TCA830	3.44

TCA900	2.20
TCA910	2.20
TCA940	1.95
TDA440	2.20
TDA1002	1.95
TDA1003A	5.50
TDA1006A	2.50
TDA1005	3.60
TDA1010	3.30
TDA1011	4.00
TDA1035	4.70
TDA1037	2.95
TDA1044	4.37
TDA1060A	4.44
TDA1062	1.56
TDA1083	1.68
TDA1170S	3.00
TDA1190	3.50
TDA1190P	3.50
TDA1180	2.91
TDA1200	2.95
TDA1220A	2.12
TDA1270	3.95
TDA1327	1.70
TDA1352B	1.60
TDA1412	1.50
TDA1415	1.40
TDA1470	4.67
TDA1770	5.60
TDA1908A	1.95
TDA2002	2.80
TDA2003	1.20
TDA2004	2.52
TDA2006	1.78
TDA2010	2.40
TDA2140	5.95
TDA2150	2.22
Superceded by TDA2151	3.25
TDA2190	3.30
TDA2020	4.66
TDA2030	2.80
TDA2522	2.66
TDA2523	3.40
TDA2524	2.25
TDA2525	4.00
TDA2530	2.70
TDA2532	2.90
TDA2540	3.84
TDA2541	3.84
TDA2560	3.50
TDA2571	4.90
TDA2576	3.75
TDA2576A	3.75
TDA2577	4.73
TDA2581	3.30
TDA2582	2.60
TDA2593	2.95
TDA2600	6.90
TDA2610	3.20
TDA2611A	2.35
TDA2640	2.92
TDA2652	7.31
TDA2653	5.90
TDA2680	3.40
TDA2690	2.72
TDA2710	5.67
TDA2720/1	6.77
TDA3190	2.00
TDA3500	6.90
TDA3560	6.00
TDA3561	6.66
TDA3562	8.60
TDA3571	3.75
TDA3651A	4.50
TDA4420	5.55
TDA4600	2.95
TDA4600-2D	2.95
TDA9503	4.21
TEA1002	3.50
TEA1009	1.86
UPC554	2.63
UPC566H	2.95
UPC575C2	3.40
UPC576H	2.60
UPC585	3.06
UPC587C2	2.34
UPC1025H	2.95
UPC1026H	1.24
UPC1028H	2.52
UPC1032H	94
UPC1042C	1.56
UPC1156H	4.26
UPC1158H	3.50
UPC1163H	2.48
UPC1167C2	2.70
UPC1168C	3.20
UPC1176C	2.53

UPC1177H	3.15
UPC1178C	4.21
UPC1180C	1.84
UPC1181H	1.62
UPC1182H	2.95
UPC1183H	2.48
UPC1185H	3.66
UPC1186H	1.60
UPC1188H	4.99
UPC1190G	1.20
UPC1198C	4.00
UPC1200V	1.18
UPC1211V	2.70
UPC1212V	1.34
UPC1215V	1.66
UPC1216V	1.20
UPC1217G	2.24
UPC1218H	1.80
UPC1223C	2.20
UPC1225H	2.00
UPC1226C	1.50
UPC1227V	1.20
UPC1228H	54
UPC1230H	4.39
UPC1238V	1.89
UPC1245V	1.35
UPC1350C	4.15
UPC1353C	4.76
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

COMPUTER SPARES

2732	3.30
2764	1.87
27128	3.13
4116	1.10
4532/20NL	3.00
4164	1.60
6264	2.75
6522	4.09
Z80ACPU	2.14
8271	60.00
ZTX213	17
ZTX313	27
ZTX650/1	35
LM1889	2.00
74LS260	0.55
UHF modulator UM1233	2.20
Double sided heavy duty tape	5.75
Micro pliers	4.80
Micro cutter	5.00
Solder suckers anti static Min.	4.50
Std.	5.40
Large	6.20

VOLTAGE REG.

7805	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

DIODES

AA119	9
BA102	17
BA115	13
BA145	17
BA148	17
BA154	6
BA155	14
BA156	15
BA157	20
BA317	26
BAX13	4
BAX16	8
BB105G	30
BY122	96
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
BYX55/600	30
BYX71/600	90
BY224	2.00
OA47	20
OA91	10
OA95	6
OA202	11
IN914	4
IN4001	4
IN4002	4
IN4003	4
IN4004	5
IN4005	5
IN4006	10
IN4007	10
IN4148	5
IN4448	10
IN5401	12
IN5402	14
IN5403	12
IN5404	12
IN5405	13
IN5406	16
IN5407	16
IN5408	20
ITT2002 = BAX16	
Y969 – Disc.	
REP BZX85 30V	
General Purpose Triac	95
SKE4F	£1.19
SKE5F	£1.19

ZENER DIODES

BZV15 C12	1.24
BZX61 130V	28
BZX61 Range (1.3W)	20
BZX79 Range (400mV)	10
BZY88 Range (400mV)	10
BZY93, 90 (18V)	1.18

I.C. SOCKETS DIL to DIL

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

DIL to QUIL

14 way	32
16 way	34
18 way	37

QUIL to QUIL

14 way	32
16 way	36

We try very hard to stock all that we advertise but if for any reason beyond our control we do run out of anything we will inform you as quickly as possible. Some prices may change because of product availability.

THERMISTORS

VA1104	90
VA1040	75
VA8650	55
VA1039	35
GEC DUAL POS.	1.68
GEC DUAL THERM. CKI	1.98

OFFICIAL ORDERS ACCEPTED FROM SCHOOLS, LOCAL AUTHORITIES ETC.

CRYSTALS & FILTERS

6MHz	74
5.5MHz	74
4.3MHz	1.39
8.8MHz	1.48
9.94MHz	6.00
10.692MHz	6.00

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
Panel Clips 3mm	04
5mm	04

P. V. TUBES

104 ABBEY STREET, (0254) 36521
ACCRINGTON, LANCS BB5 1EE. 32611

SONY PARTS

SEMICONDUCTORS

Diode CV12E	GEN	2.34
Diode GH3F	KV-GEN	1.42
Diode IS1555	GEN	25
Diode U05G	KV1810UB	96
Diode V11N	KV1810UB	96
Diode 10E2	GEN	25
Thyristor SG-264A	KV-GEN	4.08
Thyristor SG629	KV1810UB	6.42
Thyristor SG-6533	KV-GEN = SG613	13.20
BX342	SLC7UB	4.08
CX104A	KV1810UB	5.28
CX136A	VTR-GEN	7.74
CX143A	SLC5/7UB	7.20
CX186	SLC5UB	5.28
M51231P	KV2200UB	2.34
STK2129	STRYX50L	13.20
TCP4621AF6	SLC6UB	13.87
TDA2578A	KV2752UB	3.24

Please ask for any part not listed.

UPC 1394C	KV2060/62U	2.34
UPD 546C107	SLC7UB	16.98
UPD 547C049	SLC7UB	8.94
TL494CN	SLC7UB	5.28
2SA 771	TAF5A	2.34
2SA 835	GEN	1.42
2SA 1027R	ICF-C820L	25
2SA 1175	SLC7UB	89
2SB 733	KV2204UB	96
2SB 740C	TCK88B	96
2SB 856	GEN	1.42
	SY8-724-375-01	
2SC 403C	GEN	25
2SC 867A	GEN	2.34
2SC 1034	GEN	5.28
2SC 1061 = 2SC1986	GEN	2.94
2SC 1114	GEN	5.28
2SC 1124	GEN	96
2SC 1316	GEN	3.18
2SC 1362-7	GEN	25
2SC 1364	GEN	25
	SY8-729-341-34	
2SC 1413A	KV-GEN	7.38
2SC 1475	KV1810UB	25
2SC 1982	GEN	1.42
	SY8-725-800-00	
2SC 2009	GEN	25
2SC 2278	GEN	96
2SC 2335 Kit	SLC7	7.38
2SC 2369	SLC5/7UB	3.18
2SC 2551	KV-GEN	98
2SC 2785	AG-7UB	25
2SC 3153	KV2060UB	4.08
2SD 257	ST5150	2.34
2SD 725	KV2204/2704	8.94
2SD 773	BM715T	25
2SD 774	SL/HMK	96
2SD 870	KV2704E	6.42
2SD 1164	SLC6UB	96
2SD 1497-02	KV2252/2752	4.08
2SD 1497-06	KV2252/2752	4.08

SUNDRIES

UHF Tuner BT-871	KV1810UB	37.20
Booster Antenna	SLC7UB	31.38
RF Modulator	SLC6UB	60.38

SONY REMOTE CONTROLS

SLC5UB	19.80
SLC6UB	17.40
SLC7UB	42.00

VIDEO/AUDIO HEADS

Ace Assembly	SLC7UB	24.10
Ace Assembly	SLC6UB	47.22
	SYA-676-104-6A rep	
	SYA-676-205-5A rep	
Video Head DRS-21R	SLC9UB	43.20
Video Head DSR-35A	SLC20/30/40UB	41.34
Video Head DSR-36R	SLC5/C6/7UB	42.00
Video Head DSR-43A	SL8000UB	46.74
Head Record-Playback	PP128-3602C/GEN	13.87
Head Record-Playback	181-3602D TC/HMK3000	4.12

SPECIFIC COMPONENTS

Philips G8 knobs sm/lg	50
90° transductor	2.60
Thorn 1591 speakers sm	6.20
lg	6.20
Thorn 1500 controls	59
390K frame 470K line	each
Focus control Thorn/GEC	2.95
Thorn 9000 focus unit	8.40
Thorn 8500 focus unit	4.75
Thorn Tx10 focus cont.	10.20
Decca bridge trans.	1.97

MECH. REPLACEMENT PARTS

Drum Assembly Main	SLC7UB	192.52
Idler Kit/Rewind Kit	SLC7/C5UB	5.95
Idler Kit/Rewind Kit	SLC6UB	3.95
Forward Assembly	SLC6UB	3.18
Gear Kit	SLC9UB	8.94
Guide Pin Kit	SLF1/C9UB	5.28
Pinch Roller	TC-GEN	96
Pinch Roller	TC204SD	1.42
Pinch Roller	HMK44/44B	96
Pinch Roller	TCK55	96
Cassette Holder Assembly	TCK44	1.42
Lever Forward Assembly	WM2	96
F/Wheel Assembly	WM2	3.18
Limiter Assembly	SLC7UB	2.34
Idler Assembly	SLC7UB/C5/3000	96
Brake Assembly	SLC7UB	1.42
Pulley Loading Assembly	SLC6UB	96
Thrust Bearing Assembly	HMP70	3.18
Screw Cassette Lid	WM2	25
Coil Spring	WM2	25
Battery Lid	WM2	96
Lid Timer	SLC7UB	96
Gear Kit	SLC9UB	
Threading Gear	SLT6ME	96
C5 C7 Capstan Motor		34.00
C7 Drive Motor		32.95

BELTS

Belt	WMR2	96
Rubber Belt	TC-GEN	96
Take Up Belt	TC-GEN	96
Drive Belt	TC-GEN	96
Midway Pull Belt	TC-GEN	96
Capstan Belt	TC92	96
Capstan Belt	TC135/136SD	96
Flat New Belt	TC186SD	96
Capstan Belt	TC-GEN	96
Capstan Belt	HST300	96
Take Up Belt	HMK3000UK	96
Belt Capstan	HMK3000UK etc	96
Fast Forward-Rewind Belt	V02850P	1.62
Forward Belt	V02850P	1.02
Motor Belt	V02850P	1.62
Capstan Belt	VP2000	4.32
Forward Belt	SLC7UB/SLC5UB	25
Capstan Belt	SL8000UB	96
Extension Belt	SL8000UB	2.34
Drum Belt	SL8000UB	1.52
Fast Forward Idler Belt	SLC7UB	96
Threading Belt	SLC7UB	25
Capstan Belt	SLC7UB/CS	96
Eject Belt	SLC7UB	25
Counter Belt	SLC7UB	25
Fast Forward Belt	SLT7ME	96
Forward Belt	SL8000UB	96
Belt	SLC6UB	96
Fast Forward Belt	SLC6UB	96
Counter Belt	SLC6UB	96
Threading Belt	SLC6UB	96
Relay Belt	SLC6UB	96
Capstan Belt	SLC6UB	96
Belt	PS-5520 etc	3.18

SWITCHES

Switch, Filter	KV2022UB	96
Switch, P.B. Channel	1820/2 & 1340	18.86
Switch, Push Power	KV-GEN	1.20
Switch, Push	SL8000UB	96
Switch, Push Button Power	KV14/2060UB	3.68
Switch, Power	KV2022UB	4.08
Switch, Slide Record	SL8000UB	96
Switch, Slide Record-Playback	SL8000UB	1.42
Switch, Push	KV1612UB	4.08
Switch, Power	KV-GEN	5.50
Button, Stop/Eject	WM4	96
Knob, Control	SLC7UB	96

MANUALS (Zero VAT)

Instruction Manual	SLC9UB	2.00
Instruction Manual	SLC6UB Mk 2	2.00
Instruction Manual	SLC7UB	2.00
Instruction Manual	SLC5UB	2.00
Instruction Manual	SL6UB	2.00
Instruction Manual	KV2212UB/E2	2.00
Instruction Manual	KV2705UB	2.00
Service Manual	HMK3000	8.25
Service Manual	KV1810UB Mk 1	8.25
Service Manual	KV1400UB	8.25
Service Manual	SLC7UB	8.25
Service Manual	SLC5UB	8.25
Service Manual	SLC6UB	8.25
Service Manual	SLC9UB	8.25
Service Manual	SLC6UB Mk 2	8.25

IF Gain module	9.00	Decca Speaker 8R	3.75
C.D.A. Panel	20.00	G11 47K pot plus switch	85
G8 rear conv. panel	23.00	15R fused res. G9	55
Decca 30 width cont.	50	G11 line lin coil	3.80
Decca 2M2 HT cont.	25	G11 pot G2 R.G.B.	5.30
Pye 731 HF choke	6.50	G11 line scan panel	54.00
Delay lines DL20, DL60, DL50, DL700	2.20	G11 power panel	37.50
CRT tube base	1.40	G11 timebase panel	37.50
EHT final anode cap	53	G11 bridge trans.	2.35
6.3V CRT boost trans.	5.80	G11 EW correc. coil	1.95
Focus rod	1.25	G11 final anode lead	3.20
Focus holder	2.20	G11 focus unit	6.80
AFC unit G8	8.82	G11 39R 3W resistor	70
		G11 RGB 10G diodes	69

THORN/FERGUSON

SEMI-CONDUCTORS

Diode GL4850	TX10	74
Thyristor TIC45X	TX9	1.18
Diode 19022W	TX9	43
(Thyristor T9053V) (Thyristor T9054V)	TX9 = T9054V TX9	1.10
AN6360	3V29	6.81
HA11741	3V32	23.22
M293	TX90	7.10
M50790SP	3V35	6.98
M54544L	3V32	3.80
MC13002	38030	4.98
MC14493	TX9/TX10	2.74
MN1219	3V36	11.43
TDA1236	TX10	3.44
TDA3652	TX10	6.00
TDA4500	TX90	5.84
SL490	TX9/TX10/TX100	1.89
DTC144WF	3V35	30
R2540	ICE9000	3.20
TIP112H	TX90	69
T5051V	TX9	3.43
T6069V	TX9	38
T6071	TX100	1.46
T9063V	TX9	3.64
19064V	TX90	1.14
UP0553C 164	3V29	20.76
UP07519G 031 036	3V36	17.13
UP07538C 020	3V38	11.06
10 Volt TO5	3V29	8.74

MANUALS Please check for availability

Service Manual	TCE1690/1691	5.60
Service Manual	TCE1790	1.14
Service Manual	TCE9600	10.05
Service Manual	TCE9800	7.54
Service Manual	TX9	29.04
Service Manual	TX10	40.00
Service Manual	TX90	11.30
Service Manual	TX100	11.20
Service Manual	3V00 Stocks in soon	17.50
Service Manual	3V16	26.24
Supplement to 3V00 Stocks in soon	3V22	1.28
Service Manual	3V23	30.62
Service Manual	3V24	28.42
Service Manual	3V29	29.00
Instruction Manual	3V29	3.28
Service Manual	3V00	17.50
Instruction Manual	3V29	3.28
Service Manual	3V30	14.91
Instruction Manual	3V30	2.65
Service Manual	3V31	25.84
Instruction Manual	3V35	1.63
Service Manual	3V35/3V36	27.20
Supplement to 3V35	3V38	1.24
Supplement to 3V35/3V38	3V39	90
3V42		23.94
3V43		30.72

V.C.R. BELTS

Counter Belt 1	3292/3V00/3V16/3V22	60
Counter Belt 2	3292/3V00/3V16/3V22	60
Reel Drive Belt	3292/3V00/3V16/3V22	1.00
Relay Belt	3V00	2.79
Capstan Belt	3292/3V00/3V01/3V16/3V22	3.28
Unloading Belt	3292/3V00/3V16/3V22	60
Drum Motor Belt	3292/3V00/3V16/3V22	2.79
Cassette Drive Belt	3V23	60
Capstan Belt	3V29/3V30	1.62
Loading Belt	3V23	60
Loading Belt	3V29/3V30	60
Loading Belt	3V35/3V36/3V38	60
Tape Spool Drive Belt	3V35/3V36/3V38	60
Take Up Clutch Belt	3V29/3V30/3V35/3V36/3V38	60
Capstan Belt	3V35/3V36/3V38	1.21

VIDEO HEADS

Upper Drum Assmb	3292/3V00	35.94
Upper Drum Assmb	3V22	35.94
Upper Drum Assmb	2200/3660/3V16/3V23/3V24/3V31/3V35/3V36/3V38/3V39	35.94
Upper Drum Assmb	3V29/3V30	35.74

VIDEO LAMPS

Tuning Indicator Lamp	TX9	62
Cassette Lamp	3292/3V00	3.66
Cassette Lamp	3V16	1.53
Cassette Lamp Holder	3V16	60
Cassette Lamp	3V23	1.95
Cassette Lamp Holder	3V29/3V30/3V31/3V32	60
Cassette Lamp	3V29/3V30	1.41
Cassette Lamp	3V31/3V32	1.60

PHILIPS KT3/K30 PARTS

KT3 positor	1.80
Mains electrolytic 225/25 380V	3.00
Selector unit Mod. 933	16.10
On/off switch Mod. 933	3.84
Tripler	12.80
Luminance chroma panel	28.00
2003 UF module	17.94
U321 IF module	16.20
R.G.B panel	12.87
Sound panel	10.62
Power panel	21.48
Mains input panel	17.16
Line sync panel	21.19
Mark II chroma panel	19.80
Sound module	10.20
LOPT	9.70
Focus unit	3.68

V.C.R. MOTORS

Capstan Motor	3292/3V00/3V01/3V16	51.45
Drum Motor	3292/3V00/3V01/3V16/3V22	43.49
SMP Reel Motor	3V23	32.79
Cassette Housing Motor Assembly	3V23	10.32
Capstan Motord	3V23	52.81
Loading Motor	3V23/3V24/3V29/3V30	8.56
Capstan Motor	3V29/3V30	27.32
Reel Motor	3V29/3V30	32.79
Lower Drum Motor Assembly	3V29/3V30	78.72
Cassette Motor	3V35/3V36/3V38	6.92
Mode Control Motor	3V35/3V36/3V38	5.95
Capstan Motor	3V35/3V36/3V38	23.90

REMOTE HANDSETS

T723 Non Text	3767/3788	38.60
T725 Non Text	20A2/2282/3781/37041/37081/37101/3714/37351/37361/37371	19.40
T731 Text and Stereo	20A4/2284/37063/37093/37463/37493	20.01
T736 Text	20A3/2203/3795/3796/37003/37103/37353/37363/37373/37953/37963	31.60

SWITCHES

On/Off Switch	TX9	2.98
On/Off Switch	TX10	2.74
Focus Unit	TX10	10.20
8 Way Tuner Unit (Not Drawer)	37141	12.88
8 Way Tuner Unit (Not Drawer)	37360	13.50
8 Way Tuner Unit (Not Drawer)	37340/37370	20.44
Volume Control	38030	1.74
6 Button Switch Assmb	3722/4722/6722/8000	20.70

TRANSFORMERS & INDUCTORS

Line Output Transformer	TCE9000	25.53
FHT Transformer	TX10	33.80
Line Output Transformer	TX10	15.00
Line Output Transformer	TX9	23.85
Line Output Transformer	38030	6.18
RFI Choke	TX9	3.45
DC Input Choke	TX9	15.36
Mains Transformer	TX90	15.03
Linear Line Coil	TX9	1.77
RFI Input Choke	TX9	60

MECHANICAL SPARES – V.C.R. REPLACEMENT

Take Up Rubber Tyre	3292/3V00	60
Rewind Tyre	3292/3V00	60
Timing Gear Assembly	3V00	3.97
Audio Control Head Sub Assembly	3292/3V00/3V01/3V16/3V22	42.38
Fast Forward Idler	3292/3V00/3V16	1.63
Fast Forward Tyre	3V00/3V16	60
Pinch Roller	3292/3V00/3V01/3V16/3V22/3V23	7.30
Stop Solenoid	3V16	10.42
Pause Solenoid	3V16	16.60
Take Up Idler Assmb	3V00 up to Serial No. 19006 3V16 up to Serial No. 16509 3V22 up to Serial No. 27700	7.54
Take Up Idler Assmb	3V00 Serial No. 19007 onwds 3V16 Serial No. 16510 onwds 3V22 Serial No. 27701 onwds	5.28
Rewind Idler	3V16	8.52
Take Up Tension Brkt	3V23	80
Roller Assembly	3V23	4.08
Take Up Spool Idler Assmb	3V29/3V30	2.12
Pinch Roller	3V29/3V30	8.66
Idler Counter Pulley	3V29/3V30	60
Cassette Housing Assmb	3V29/3V30	20.85
Take Up Clutch Assmb	3V29/3V30	2.36
Spool Carrier Idler Assmb	3V35/3V36/3V38	2.73
Cassette Housing Assmb	3V35/3V36	36.74
Lower Door Spring	3V35	60
IF Panels	TX10	23.52
Cassette Cover	3V29/3V30	4.34

TUNERS/MIXERS BOOSTERS

Mix Booster	3292	30.62
Mix Booster	3V29	24.70
RF Convertor	3V29	59.32
Mix Booster	3V31/3V32	24.50
UHF Tuner	3V35/3V36	38.12
RF Convertor	3V35/3V36/3V38	36.08
UHF Tuner	3V39	21.87
Varicap Tuner	TX9/TX10	16.34

K30 LOPT	17.50
K30 focus unit	2.90
K30 EHT lead	8.30
Selector unit 1002 (early)	11.20
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Euro decoder panel 1234	46.00
Power supply 1234	23.50
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On/off switch	2.60
Selector unit 1002 (late)	9.90
K30/K35 sound panel	12.50
K35 tuner drawer	10.00
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ELC104305 Mullard	12.50
ELC1043-06	8.40
ELC2003	16.50
Philips G8/G9	10.50
Philips G11 (U321)	9.90
U322	7.20
U341	9.50
U342	8.50
TX10 Tuner	8.75

PUSH BUTTON ASS.

Decca 4 way	7.93
6 way	9.17
GEC 2110 6 way	10.92
GEC Slim 6 way	10.29
GEC/ITT/PYE 7 way	16.67
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Rank A823	12.36
Rank T20A	11.21
Hitachi 4 way	12.36
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Philips KT3	16.67
Philips KT30	13.22
ITT CVC 8/9 (mod)	13.80
ITT 6 way with VCR	8.90
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GEC Conversion kit	16.50
Decca 4/6 way conversion kit	17.50
Thorn 8500 Push Button	6.50

SWITCHES & ACCESS

On/off gen. purpose 4A	80
G8 on/off	1.98
G11 on/off	1.58
G11 on/off remote	1.58
Gen. purpose rotary	66
Thorn Tx 9/10	2.98
GEC 2040	98
Thorn 1591 push on/off	2.90
Rank tuner buttons (while stocks last) 1½"×½", 2"×½", 2"×⅜"	20
GEC 2110 tuner neons	35
Thorn 3500 A1 beam	86
GEC 2110 A1 cont. R/B/G	58
ITT CVC5 on/off	1.24
ITT mains switch + solenoid	4.50
Rank mains switch + solenoid	4.50
Rank T20 on-off switch	1.95

MIDGET CONTROLS

Insulated Spindle Length 44mm

Log or Lin Without Switch 5K-10K-25K-50K-100K-250K-500K-1M	54
With D.P.S.T. Switch **Log**: 5K-10K-25K-50K-100K	1.26
250K, 500K, 1M, 2M	
Dual gang Controls	1.25
16mm Rotary Controls 10K, 22K, 10K, 100K, 1M	

THICK FILM RESISTOR NETWORK

THORN 3500 (5 pin connection)	1.98
PYE 731 (6 pin connection)	2.20
THORN 9000 (Circuit Ref. R704/7)	2.15

CONVERGENCE POTS

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

METRIC CONVERGENCE POTS

PHILIPS G8 5R-10R-15R-20R-50R	60

SKELETON PRE-SET POTS / SLIDER POTENT

SKELETON PRE-SET POTS	SLIDER POTENT
Standard or miniature	Lin or Log
Horizontal or Vertical 100R-2M2 16p	470R-1K-2K2 10K-47K-470K 75p

MULTITURN POTS

100K	65
GEC TE	65
PHILIPS G8	
DECCA, RANK	65

THERMAL CUT OUT

THORN 3000 2A Metal	2.68
GEC 2040 Metal	2.50

LINE OUTPUT TRANS.

R.B.M. T20A	13.95
R.B.M. A774 Mono	11.74
R.B.M. Z718 22"	19.50
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PHILIPS G8	8.75
PHILIPS G9	9.50
PHILIPS G11	15.00
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PYE 713/731	10.00
PYE 725 90°	10.50
PYE 169	10.00
DECCA 80	8.58
DECCA 100	8.58
DECCA 1700	9.00
DECCA 1730	8.58
DECCA 2230	8.58
GEC 2110	16.75
GEC 2040	9.50
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ITT CVC 25/30/32	8.65
ITT CVC 20	8.60
THORN 3000 EHT	9.95
THORN 3000 SCAN	7.95
THORN 8000	17.50
THORN 8500	17.50
THORN 3000/3500 Mains	10.00
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THORN 1691	9.68
THORN TX10	15.00
THORN TX9	23.85
THORN 1615	9.75
PHILIPS KT3	9.70
RANK BUSHRANGER Early T16A	£10.00
RANK BUSHRANGER Late T18A	£10.00
PYE 741	8.20
B+O (2000, 3000)	14.69
B+O (3000 EHT)	25.00
ITT CVC 45	9.50

RECTIFIER TRAYS

THORN 950 Mk II	4.25
THORN 1400 3 Stick	5.20
THORN 1500 3 Stick	5.20
THORN 1500 5 Stick	5.99
THORN 1600	6.50
THORN 3000/3500	7.98
THORN 8000	6.95
THORN 8500/8800	7.15
THORN 9000	8.70
DECCA 1730/1830	5.48
DECCA 30	6.76
DECCA 80	7.12
DECCA 100	7.50
UNIVERSAL	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	7.12
PHILIPS G8 Long Focus 550	7.12
PHILIPS G9	6.37
Pye/Philips K3 Tripler	12.50
PYE 691/3	7.58
PYE 713/4 Lead	8.79
PYE 713 Doubler 5 Lead	8.79
PYE 731/725	8.75
R.B.M. A823 (plug in) AV	8.75
KORTING (similar to Siemens TVK1)	7.32
ITT KB CVC5/9	7.50
ITT KB CVC20/25/30 (Mullard)	7.12
RRI T20	7.12
ITT CVC45	8.65
DECCA/TATUNG 120/130	6.50

RECTIFIER STICKS

TV11	90	TV18	1.10
TV13	1.26	TV20	1.43

REPLACEMENT ELECTROLYTICS

PYE 169 (200/200/100/32)	3.74
PHILIPS 320 (400/400/200V)	3.02
DECCA 30 (400/400/350V)	3.74
DECCA 80 (400/350V)	4.37
DECCA 100 (800/250V)	
PHILIPS G8 (600/300V)	2.53
PHILIPS G9 (600/300V)	2.44
PHILIPS G11 (470/250V)	3.19
PYE 691/7 (200/300/350V)	2.97
PYE 731 (600/300V)	2.55
RBM A823 (2500/2500/30V)	1.83
RBM A823 (600/300V)	3.12
RBM Z146 (300/300/350V)	3.91
RR1 T20A (220/400V)	2.20
ITT CVC5/9 (200/200/75/25)	3.28
ITT CVC 20 (220/400V)	2.20
GEC 2110 (600/250V)	2.14
GEC 2040 (1000/2000/35V)	1.31
GEC 2040 (300/300/150/100/50)	4.51
THORN 3500 (400/40V)	33
THORN 1400 (150/100/100/100/150/320V)	3.07
THORN 1500 (150/150/100/300V)	2.42
THORN 1500 (12/300V)	35
THORN 3500 (175/100/100/400/350V)	3.06
THORN 3500 (1000/63V)	95
THORN 3500 (1000/70V)	95
THORN 8000/8500 (2500/2500/63V)	3.72
THORN 8000/8500 (700/250V)	2.55
THORN 8000/8500 (400/350V)	2.82
THORN 9000 (400/400V)	3.61
GEC (200/200/150/50)	2.91
PHILIPS 69 2200/63V	1.38
THORN 4700 P/C 25V	1.32
THORN 1591/1691 4700/25V	1.32
G11 Capacitor 7N5 1500V	1.40

MAINS DROPPERS

DECCA 20	2.48
DECCA 27R/47R	1.40
DECCA 56R/6R8	1.40
R.B.M. A823 56R/68R	94
R.B.M. 161	82
GEC 2000/2018	70
GEC 27840	64
PYE 725/31 3R0/56R/27R	1.84
PYE 725 56R/27R	1.04
PHILIPS 210/5050 30R/125R/2k85	1.75
PHILIPS 210/5051 -/118R/148R	1.93
PHILIPS G8/5081 47R Section	72
PHILIPS G8/5083 2R2/68R	1.38
THORN 1400	1.52
THORN 1500	1.47
THORN 1600	1.77
THORN 3500	1.20
THORN 8000	1.24
THORN 8500	1.36
THORN 9800	1.30
DECCA 2R5	96
DECCA 3R9 Modulohm	60

WIREWOUND RESISTORS*

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

(Preferred values)*

CARBON RESISTORS*

¼W 3R3-8M2	30
½W 3R3-8M2	30
1W 10R-10M	46
2W 10R-10M	72

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

NEW VALVES

30FL2	1.70
DY802	98
DY86/7	66
ECC81	1.08
ECC82	98
ECC83	1.07
ECC84	80
ECC85	98
ECC88	1.35
ECF80	1.30
ECF82	88
ECH81	1.60
ECH84	1.66
ECL80	84
ECL82	1.30
ECL86	1.99
EF80	95
EF86	2.20
EF183	99
EF184	1.09
EH90	1.02
EL34	3.50
EL84	1.05
EY86/7	68
EY500A	2.25
EZ80/1	56
GY501	1.45
GZ34	3.50
KT66	8.50
KT77	8.50
KT88	12.00
PC92	3.00
PC97	1.65
PCC85	85
PCC805	1.40
PCF80	1.00
PCF200	1.35
PCF800	1.38
PCF801	1.13
PCF802	1.12
PCF805	1.80
PCF806	1.30
PCF808	1.63
PCH200	1.45
PCL82	1.20
PCL84	1.20
PCL86	92
PCL805	1.09
PD500	2.93
PFL200	1.86
PL36	1.87
PL81	94
PL83	1.43
PL84	84
PL504	1.65
PL508	2.90
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PY500A	2.30
PY800/1	69
UCH81	2.25
UCL83	1.82
UY85	1.35
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17DW4A	4.50
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12BY7A	3.75
12HG7	3.20

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, 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, 5A		1.90
20mm QUICK BLOW 315ma		
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

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CAPACITORS

Volts	Mfd	Price	63V	
6V3	33	9	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	41
	1000	27	470	56
	3300	53	1000	85
25V	10	11	2200	1.90
	22	13	100V 10	13
	47	15	22	15
	100	15	47	20
	220	29	100	36
	470	30	220	70
	1000	55	450 1	33
	2200	59	4.7	30
	4700	98	10	43
40V	10	10	22	80
	22	10	33	94
	400	48	600 0.1	41

Volts D.C.

250V 0.1mF	38p	
0.91mF	1.92	
400V 0.22mF	29	
600V 0.1mF	38	
1000V 0.01mF	24	
0.047mF	46	
0.033mF	33	
0.1mF	35	
0.22mF	66	
0.47mF	98	
1250V 0.1mF	59	
1500V 0.0047mF	32	
0.022mF	30	
0.033mF	62	
2000V 0.0052mF	1.20	
2500V 0.0022mF	50	

TANTALUM

6.3V	47mF	42
	100mF	98
16V	10mF	22
	22mF	28
	47mF	1.03
25V	22mF	46
35V	0.1mF	13
	0.22mF	13
	0.47mF	13
	1mF	13
	2.2mF	17
	4.7mF	25
	10mF	57

POLYESTER

250V 0.01mF	13p
0.1mF	16p
0.22mF	16p
400V 0.01mF	14p
0.1mF	17p
0.22mF	17p

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SPECIAL PRICES FLOPPY DISCS PLEASE ASK FOR PRICES

SERVICE MANUALS

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DECCA 80	5.35
70/90	3.90
100	4.80
PHILIPS G9	4.20
G11 now in stock	3.90
K30	3.90
KT3	3.90

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74LS00	58	74LS30	35	74LS90	1.22	74LS158	65
74LS02	58	74LS37	35	74LS92	65	74LS160	90
74LS03	58	74LS38	35	74LS93	60	74LS161	85
74LS04	58	74LS40	35	74LS107	80	74LS162	4.04
74LS05	58	74LS42	80	74LS109	58	74LS163	85
74LS08	58	74LS47	85	74LS112	50	74LS164	85
74LS09	58	74LS48	83	74LS113	44	74LS165	1.50
74LS10	58	74LS49	33	74LS114	70	74LS173	1.32
74LS11	58	74LS51	33	74LS122	96	74LS174	85
74LS13	37	74LS54	43	74LS123	80	74LS175	85
74LS14	46	74LS55	60	74LS125	85	74LS191	1.02
74LS15	33	74LS73	60	74LS126	60	74LS192	1.30
74LS20	35	74LS74	65	74LS132	63	74LS193	1.30
74LS21	35	74LS75	65	74LS138	83	74LS194A	75
74LS22	35	74LS76	65	74LS139	65	74LS197	95
74LS26	44	74LS78	65	74LS151	85	74LS240	2.20
74LS27	35	74LS83A	89	74LS153	85	74LS241	2.20
		74LS86	39	74LS155	65	74LS242	2.20
				74LS156	1.02	74LS243	2.20

74LS244	2.20
74LS245	2.30
74LS251	65
74LS253	95
74LS257	1.20
74LS258	95
74LS259	1.70
74LS273	1.90
74LS283	1.30
74LS293	1.20
74LS352	1.40
74LS353	1.40
74LS365	75
74LS366	82
74LS367	1.65
74LS368	65
74LS373	1.40
74LS374	1.55
74LS393	1.20
74LS670	1.78

'4000 B' SERIES CMOS

		4026	1.99	4068B	22	4510B	76	4538B	1.04		
		4027B	39	4069B	22	4511B	76	4539B	77		
4001B	21	4028B	64	4070B	22	4512B	72	4541B	96		
4002B	21	4029B	90	4071B	40	4513B	1.68	4543B	1.12		
4008B	72	4032B	1.04	4072B	22	4514B	1.88	4551B	96		
4011B	31	4035B	80	4073B	22	4515B	1.88	4553B	2.40		
4012B	21	4038B	99	4075B	22	4516B	76	4554B	1.20		
4013B	30	4040B	72	4076B	80	4518B	76	4556B	48		
4014B	74	4042B	58	4077B	22	4519B	64	4560B	1.76		
4015B	76	4043B	71	4078B	22	4520B	76	4561B	74		
4016B	42	4044B	71	4081B	22	4521B	1.68	4566B	1.20		
4017B	66	4046B	96	4093B	49	4522B	88	4580B	3.60		
4018B	72	4047B	70	4094B	1.56	4526B	88	4581B	1.84		
4010B	70	4049UB	32	4099B	1.20	4527B	1.20	4582B	80		
4020B	76	4050B	32	4160B	72	4528B	88	4583B	1.00		
4021B	76	4051B	72	4161B	72	4529B	1.04	4584B	40		
4022B	70	4052B	72	4162B	72	4530B	62	4585B	88		
4023B	21	4053B	72	4163B	72	4531B	72	4597B	1.84		
4024B	50	4060B	96	4502B	72	4532B	1.00	4598B	2.40		
4025B	21	4066B	43	4505B	1.88	4536B	2.64	4599B	2.00		

NEW MONO TUBES

MULL. A31/510 110° 12"	22.00
MULL. A34/510 110° 14"	26.50
A50/120WR 110° 20"	18.50
A61/120WR 110° 24"	20.50
VEGA 12" 90° (Jap Types)	15.00

NEW TUBES

ATX 56-001	95.00
ATX 51-00X	95.00
A56/610	95.00

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. Carriage cost on tubes £10 + VAT

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

G.G.L.COMPONENTS

108 SCOTLAND ROAD, CARLISLE, CUMBRIA CA3 9EY
PHONE (0228) 20358/39693

INTEGRATED CIRCUITS

TYPE	PRICE (£)
AN214	1.95
AN301	3.45
AN303	3.45
AN305	3.50
AN7110	1.93
AN7114E	2.33
AN7115	2.37
AN7116	2.35
AN7145	3.25
BA312	1.25
BA511A	1.95
BA521	1.85
BA532	1.95
BA536	2.55
HA1166	2.65
HA1322	2.10
HA1338	2.78
HA1339	2.40
HA1342A	2.20
HA1366 W/WR	1.95
HA1374	2.45
HA1377	3.80
HA1388	4.20
HA1397	3.90
LA1201	1.75
LA1230	2.30
LA1365	2.45
LA3350	1.65
LA4101	1.50
LA4102	1.95
LA4400	2.50
LA4430	2.45
LA4440	3.55
LA4445	2.65
LA4460	2.95
LA4461	2.95
MB3712	2.30
MB3713	2.25
ML231B	2.35
ML232B	2.55
SAA1250	3.85
SAA1251	4.95
SAA5010	5.10
SAA5012	5.70
SAF1032P	3.25
SAF1039P	4.55
SAS560S	1.95
SAS570S	1.95
SAS580S	2.40
SAS590S	2.40
SL1430	1.95
SL1432	1.75

TYPE	PRICE (£)
STK0039	6.45
STK0040	5.95
STK0050	7.50
STK077	7.25
STK078	7.45
STK082	9.75
STK2129	8.50
STK415	9.66
STK430	7.75
STK4332	5.95
STK433	6.50
STK435	6.75
STK437	7.25
STK439	7.55
STK441	8.50
STK459	7.35
STK461	7.95
STK463	9.30
STK465	9.95
TA7193P	4.30
TA7204P	1.90
TA7205AP	1.40
TA7208P	1.95
TA7222AP	1.85
TA7223P	2.85
TA7227P	2.95
TA7310	1.55
TA7313	1.45
TAA550	.43
TBA120AS	.95
TBA120SB	.90
TBA120T	1.25
TBA120U	1.00
TBA520	1.30
TBA530Q	1.00
TBA540	1.37
TBA550	2.45
TBA560	1.60
TBA720A	2.65
TBA750	2.45
TBA800	.80
TBA810	1.35
TBA820	1.40
TBA890	2.95
TBA920	1.50
TBA950	2.65
TCA270	1.55
TCA940	1.55
TDA2030	1.95
TDA2190M	6.95
TDA2576A	3.95
TDA2577	4.85
TDA3651AQ	3.75
TDA3652	4.35

TYPE	PRICE (£)
TDA440	3.25
TDA1006A	2.95
TDA1035T	2.75
TDA1037	1.95
TDA1044	3.10
TDA1170	1.80
TDA1270	2.20
TDA1470	3.65
TDA2002	1.85
TDA2003	2.33
TDA2004	3.15
TDA2006	2.25
TDA2020	2.95
TDA2522	1.80
TDA2523	2.25
TDA2530	2.10
TDA2532	2.20
TDA2540	1.95
TDA2560	1.80
TDA2578A	3.25
TDA2581	2.15
TDA2582	2.20
TDA2591	2.30
TDA2593	2.30
TDA2594	2.95
TDA2600	6.35
TDA2611A	1.50
TDA2640	2.40
TDA3560	5.10
TDA3561A	5.35
TDA3562A	5.50
TDA4500	5.85
TDA4600	2.85
TDA4600-16PIN	3.95
TDA9503	2.35
UPC555C	.70
UPC566C	2.10
UPC585C	1.40
UPC1031H	2.95
UPC1032H	.95
UPC1156H	2.45
UPC1181H	2.20
UPC1182H	2.20
UPC1185H	3.30
UPC1230H	3.95
UPC1238H	2.35
UPC1350C	4.50
UPC1353C	2.60
UPC1365C	5.05
UPC1394C	2.95
UPC2002H	1.85
7805	0.65
7812	0.65

TRANSISTORS

TYPE	PRICE
BC107	.14
BC108	.14
BC109	.14
BC141	.26
BC142	.23
BC143	.25
BC147	.09
BC148	.09
BC157	.10
BC158	.11
BC159	.11
BC237	.11
BC327	.11
BC328	.12
BC337	.11
BC338	.10
BC547	.10
BC548	.10
BC557	.10
BC558	.10
BC637	.35
BC638	.25
BC639	.25
BD124M	1.05
BD131	.33
BD132	.33
BD222	.50
BD225	.55
BD235	.32
BD236	.43
BD237	.40
BD238	.39
BD410	.50
BD437	.70
BD438	.78
BD439	.70
BD677	.70

TYPE	PRICE
BD701	.85
BD707	1.05
BF337	.28
BF338	.30
BF458	.30
BF459	.36
BF757	.75
BFR90	1.60
BR100	.18
BR101	.32
BR103	.55
BR303	2.95
BT106	1.15
BT116	1.30
BT151/800R	1.10
BU126	1.78
BU205	1.42
BU208A	1.45
BU208D	1.85
BU326A	1.48
BU407	1.12
BU407D	1.45
BU500	1.95
BU508A	1.95
BU526	2.00
BU807	1.30
BU826A	3.20
R2010B	1.45
R2540	2.35
TIP31C	.46
TIP32C	.47
TIP33	.80
TIP34	.95
TIP41C	.48
TIP42C	.48
TIP47	.75
TIP2955	.70
TIP3055	.70

TYPE	PRICE
2N3055	.50
2N3773	3.45
15/80H	2.25
15/85R	2.25
2SA771	2.35
2SA835	1.55
2SB618	2.45
2SC867A	3.25
2SC1034	4.85
2SC1061	1.15
2SC1114	4.75
2SC1124	.97
2SC1316	3.20
2SC1413A	3.95
2SC1739	2.45
2SC1942	2.95
2SC1962	1.65
2SC1969	1.95
2SC2078	1.55
2SC 2335 (Kit)	7.55
2SC2369	3.25
2SC257	2.45
2SD588A	1.97
2SD725	7.95
2SD870	5.95

LINE O/P TR.

DECCA 80	7.95
DECCA 100	8.50
ITT CVC 20	8.85
ITT CVC 25/30/32	8.95
ITT CVC 45	8.45
PHILIPS G8	8.75
PHILIPS G11	13.50
PHILIPS KT3	9.95
PHILIPS K30	16.50
RBM T20A	10.35
THORN 1615	12.35
THORN 1690/1	9.65

BUY WITH

THORN/SONY

LARGE RANGE OF SPARES FOR ABOVE MAKES OF TV/VIDEOS INCLUDING INSTRUCTION AND SERVICE MANUALS. PHONE OR WRITE FOR NEW LISTS. WE CAN ALSO SOURCE & SUPPLY OVER THREE THOUSAND I/Cs & SEMI CONDUCTORS.

SONY SPARES

C5/C7 Rewind Kit	4.65
C5/C7 Belt Kit	3.50
C6 Rewind Kit	4.35
C7 Pinch Roller	4.85
SG 613/6533	8.95
CX 143A	6.95
TDA 3652	4.35

Large range of Sony spares available

VALVES

PCF802	1.09
PCL82	.97
PCL85	1.03
PCL86	1.07
PL504	1.59
PL508	2.99
PL509/519	5.99
PY500A	2.25

E.H.T. TRAYS

DECCA 80	7.20
DECCA 100	7.35
ITT CVC 20/30	6.85
PHILIPS G8-550	7.90
PHILIPS KT3	7.95
RBM T20/T22A	7.35
THORN 8500/8800	7.60
THORN 9000	8.70
Universal	5.95

DIODES

TYPE	PRICE
BY127	.10
BY133	.15
BY164	.40
BY179	.65
BY210/800	.30
BY223	.86
BY227M	.23
BY229/600	.87
BY298/400	.24
BY299/800	.25
BYX10	.20
BYX55/600	.26
BYX71/600	.93
SKE4F2/06	.80
SKE5F3/10	1.45
W005	.55
1N4001-7	.07
1N5401-8	.16

HITACHI I/Cs

STR 441	6.95
STR 451	6.95
STR 6020	7.90

SUNDRIES

G8 TRANSDUCTOR	2.25
G8 ON/OFF SW.	1.40
G11 E/W Coil	1.65
G11 Lin Coil	1.80
G11 Bridge Coil	1.35
G11 EHT Lead	2.25
PYE IF Gain MOD	7.85
ITT On/Off SW	1.10
THORN On/Off SW.	1.00
CUT OUT 2A	1.95
TX10 FOCUS UNIT	8.95
VCR Pilot Bulb	.70

TV ELECTROLYTICS

DECCA 30(400/400)350V	3.99
DECCA 80-80/100(400)350V (800)250V	3.99
PHILIPS G8(600)300V	2.65
PHILIPS G9(2200)63V	1.45
PHILIPS G11(470)250V	2.20
RBM A823(2500/2500)30V	1.65
RBM T20A(220)400V	2.35
THORN1690/1(4700)25V	.94
THORN3500(1000)70V	.99
THORN9000(400)400V	3.10

PUSH BUTTONS/NEW TUNERS

DECCA/ITT 6 way	8.50
PHILIPS G8 S/L	14.90
PHILIPS G8 S/Q	14.75
PYE-G11 P/B	8.50
HITACHI 4 way	8.95
ITT CVC5 7 Button	10.40
ITT CVC8/9	12.80
1043/05	8.95
U321	8.75
U322	7.40

Available also a range of 2SA/B/C/D Transistors. Phone or write for lists.

ORDERING

Please Add 50p For P/P U.K. Add 15% VAT To This Total. Export Orders — Cost. DELIVERY BY RETURN ON ALL STOCK ITEMS.

MANTEL

No 1 for Quality TVs & Videos 100s of V.H.S. Videos in stock

Large Quantities of Late Model Thorn TVs. All with first class cabinets.

TELE-TEXT/ULTRASONIC/INFRARED/REMOTES

All at UNBEATABLE PRICES for QUANTITY & QUALITY

Also Philips G11/Pye G11/Basic/Remote/TELE-TEXT

Some examples of QUALITY working TVs

THORN 8800 ************************£25
THORN 8800 **(remote)** *******************£30
THORN 9000 ************************£30
THORN 9000 **(remote)** *******************£35
THORN 9600 ************************£40
THORN 9600 **(full feature remote)** ************£45

THORN 9600 TELETEXT ************* **from £75**
(VARIOUS MODELS)
THORN 9900 ************************£50
THORN 9900 **f/f remote** ******************£60
PHILIPS G11 ************************£55

(prices quoted are based on quantity)

NO DEALER TOO LARGE OR SMALL. SINGLES SOLD

Brand New Remote Control Hand Sets Available for the majority of British & European TV sets.

1000s of UNTESTED Colour TVs

I.E. DECCA 30s, GEC 2110, GRUNDIG, TANBERGS, G8s 520s-550s, Thorn 3500/8000/8500, TT, PYE, ETC.
(Many of these untested TVs just switch on)

ALL AT LOW LOW PRICES

VAN LOADS DELIVERED DIRECT FROM SOURCE RING FOR QUOTE

New TV Trolly Stands **£4.95** Also Video Stands **POA**

Colour TV panels & tubes available

All prices subject to V.A.T. *CALLERS WELCOME*

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NEW 1986 CATALOGUE is now available – range of components greatly increased – over 136 pages fully illustrated. Price £1.00 per copy (free upon request with orders over £15). Includes 50p Credit Note, Special Offer Sheets, Order Form and Pre-Paid Envelope. Order your copy now – will be sent within 7 days.

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ORYX PORTASOL PORTABLE GAS SOLDERING IRON

Powered by ordinary lighter fuel. 60 mins. cont. use, adj. temp.
10/60W. Price £13.90

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CHART RECORDER SPECIAL

Brand new 3 channel pen recorders complete with charts. Full spec. upon request. Once only price £40 + £10 p&p + VAT.

JUNE SPECIAL OFFER

4-WAY EXTENSION SOCKET —

3 pin Sockets — fused and with neon indicator

PRICE............................**£3.50 each**

With orders of £5.00 and over — only one per order

WATCH FOR JULY SPECIAL OFFER

MULTISECTION ELECTROLYTICS

THORN	850	100+300+100+16/300V	1.80
	1400	150+100+100+100+150/320V	2.70
	1500	150+150+100/300V	2.00
	3000	1000/63V	0.74
	3500	175/400V+100+100/350V	2.56
	8000	400/350V	2.10
	8000/8500	2500+2500/63V	1.99
	8000	700/250V	2.15
		1000/70V	0.80
	9000	400/400V	3.00
Timer Amp		4700/25V	0.95
DECCA 10/30		400+400/350V	3.20
	1700	200+200+400/350V	3.75
GEC	2047	2048 2083 2084 2104	
		200+200+150+50/300V	2.50
		600/250V	1.85
ITT/KB		200+200+75+25/350V	2.90
		220/100V	1.95
PHILIPS	G8	600/300V	2.20
	G8 G9	600/300V	2.10
	G11	470/250V	1.80
	G9	2200/63V	1.25
EKCO	T148	125+200+100+32/275V	2.65
	691 Series	200+300/350V	2.50
		600/300V	2.20
RANK		300+300/300V	1.75
	A823	2500+2500/30V	1.50
		220/400V	1.85
		600/300V	2.25

INTEGRATED CIRCUITS. (£) EACH

709	0.35	STK015	6.20
741	0.25	TA7146P	4.60
747	0.70	TA7203P	2.76
AN214Q	3.80	TA7204P	1.50
AN240P	3.42	TA7205AP	1.30
BTT6218	1.98	TA7222P	2.32
CA301AT	2.88	TAA550	0.50
CA358	0.66	TAA611A12	3.50
CA801CM	1.20	TAD100	2.90
CA3020	2.10	TDA120A	0.80
CA3065	1.60	AS/S/SB/T/U	0.80
CA3080E	0.68	TDA120B	1.30
CA3140	0.45	SA/SQ/UQ	1.30
HA1366W	1.59	TBA520	1.50
LA4422	3.20	TBA530	1.20
LC7131	4.90	TBA540	1.64
LC7137	5.40	TDA560C	1.50
LM324N	0.48	TDA800	0.80
LM380N8-P	1.15	TBA810S	1.20
LM380N14-P	1.80	TBA950/2A	3.05
LM1011N	3.20	TCA270SA	4.02
LM1488N	0.98	TDA1003A	5.50
LM3900N	0.85	TDA1004*	4.95
M51513L	3.18	TDA1006A	2.45
M51515L	3.18	TDA1035S	2.20
MC1307P	1.99	TDA1170S	1.99
MC1327P	1.50	TDA1352A	1.80
MC1330P	1.60	TDA2002	1.80
ML23213	2.10	TDA2020	4.00
ML23713	2.30	TDA2030	1.90
NE555	0.25	TDA2140	2.90
SAA1025	4.00	TDA2160	2.50
SAS560	2.50	TDA2522	2.75
SAS570	1.85	TDA2530	2.20
SAS580	2.85	TDA2532	2.80
SN76131N	1.99	TDA2560	3.20
SN76226DN	1.70	TDA2561	4.65
SN76227N	1.10	UPC57562	1.48
SN76660N	0.75	UPC741G	0.92
SN76666N	1.40	UPC1156H	2.75
		UPC1182H	2.75
		UPC1218H	1.80
		UPC1370C2	2.50
		UPC2002H	2.78

* LIMITED STOCK Telephone for details

DRY CELL BATTERIES

AA	1.5V	15p ea	10/12p ea
C	1.5V	70p pack of 2	
		10/68p pack of 2	
D	1.5V	80p pack of 2	
		10/75p pack of 2	
PP3	9V	65p ea	10/60p ea

Button Type for Multimetres — Set of 3 for £1.50

NI-CAD CHARGER

Universal Ni-Cad charger, charges PP3, AA, C, D
Price £5.17

Rechargeable Batteries

AA (HP7)	95p	10/ 85p each
C (HP11)	£2.14	10/£1.98 each
D (HP2)	£2.30	10/£2.10 each
PP3	£3.75	10/£3.65 each

Full range of Battery Boxes — all sizes — available.

SERVICE AIDS

Switch Cleaner	1.24
Circuit Freezer	1.40
Foam Cleanser	1.22
Aero Klene	1.14
Plastic Seal	1.34
Excel Polish	1.16
Antistat Spray	1.24
Aero Duster	1.48
Super 40	1.86
Video Head Cleaner	1.10
Fire Extinguisher	3.28
Silicone Grease	
Aero	1.50
Ditto Tube	1.66
Heat Sink	
Compound	1.10
Solda Mop	
0.12mm	0.74
Ditto 0.06mm	0.76
Industrial Reel	
0.12mm length	
10m	£2.90

SOLDERING SECTION

Soldering Station complete with 30W or 40W Iron (state which)	67.95
XS25 W Iron kit/complete with steel & plug attached	10.00
CS 18W, as above	9.90
Antex 15W iron	5.25
Antex 18W iron	5.50
Antex 25W iron	5.75
Antex elements	2.75
Antex bits	0.90
Antex stands	2.10
Soldersucker	4.50
Spare nozzles for Soldersucker	0.65

RESISTORS – CARBON FILM 5%

1/4W 1R0 to 10M (E12 Range)	2p each. 15p/10. 75p/100
1/2W 2R2 to 10M (E24 Range)	2p each. 15p/10. 75p/100
1W 10R to 2M2 (E12 Range)	7p each. 65p/10. 6.00/100
2W 10R to 2M2 (E6 Range)	8p each. 70p/10. 6.00/100

RESISTOR KITS – each value individually packed

1/4W pack 10 each value E12 – 10R to 1M 610 pieces	5.75
1/4W pack 5 each value E12 – 10R to 1M 305 pieces	3.35
1/2W pack 10 each value E12 – 2R2 to 2M2 730 pieces	7.95
1/2W pack 5 each value E12 – 2R2 to 2M2 365 pieces	4.75
1W pack 5 each value E12 – 2R2 to 1M 353 pieces	15.25
2W pack 5 each value E6 – 10R to 2M2 317 pieces	18.50

RESISTORS – WIREWOUND. Generally 5%

2.5W – 0.22 to 270R – Available in preferred values	0.15
4W – 1R0 to 10K – Available in preferred values	0.18
7W – 0.47R to 22K – Available in preferred values	0.15
11W – 1R0 to 22K – Available in preferred values	0.18
17W – 1R0 to 22K – Available in preferred values	0.24

TELEPHONE SPECIAL

BT App Telephone Plug + 3m Lead	£1.25
BT App Master Socket inc Wiring instrns	£2.85
BT App Secondary Socket	£1.95
4-way plug	30p each
BT 4-Core Cable per metre	15p/m
	£12.00/100m
Cable clips for above	100/75p

VOLTAGE REGULATORS

78L05/08/12/15	0.30
7805/08/12/15/18/24	0.45
7905/12/15/18/24	0.50
LMC17K	2.40
LMC17T	1.25
LM723	0.65

SONY T.V. & VIDEO SPARES

Idler Kit SLC5.SLC7 (Rewind Kit)	A-670-634-8A	£4.80
SLC6 (Rewind Kit)	A-670-639-1A	£3.06
Video Head SLC9UB	A-676-208-8A	£45.05
SLC5/C6/C7	A-676-212-9A	£43.05
Motor Kit MT General	X-354-931-41	£14.44
Limiter Assembly SLC7UB	X-365-331-00	£2.45
Power Switch KV General	1-554-820-11	£5.50

Diodes ICs Thyristors Belts Transistors Switches Remote Controls Instruction & Service Manuals

FUSES Prices per 10

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.**

POTENTIOMETERS

Carbon Track Rotary 0.25W Log & 1 in values. All 1/4in Spindle 20ml body dia Shaft 2" long

4K7.2M2 Single Gang Log	.40	10/3.50
1K – 2M2 Single Gang Lin	.30	10/3.50
5K – 2M2 Single Gang DP Switch Log	1.05	10/9.50
5K – 2M2 Double Gang Log & Lin	1.25	10/10.50

REPLACEMENT TV MAINS DROPPERS

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
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

Plus Many More. Please enquire.

ZENER DIODES

400mW Plastic	3V–75V	8p each. 10/75p.
1.3W Plastic	3V–200V	15p each. 10/£1.40
1.5W Flange	4.7–47V	£1.26 each*
2.5W Plastic	7.5–75V	54p each*
20W Stud	7.5–75V	£1.35 each*

*Only available while stocks last

HV Disc Ceramic (!)
1kV 1.5nF 18p
8kV 10, 47, 56, 82, 100, 120, 150, 180 30p

ZENER DIODE PACK

400mW – 5 each value – 11 values – individually marked and packed – 55 Zener Diodes. Price £3.50 each.

VALVES

Enquiries are welcomed for any other valve not listed here.

Type	Price (£)	Type	Price (£)
AZ31	4.50	KT88(G.E.C.)	19.00
AZ41	1.98	PC88	1.40
DAF96	1.00	PC92	3.00
DF96	0.75	PC900	1.40
DK96	2.65	PCC88	0.80
DM71	2.95	PCC89	0.75
DY86/87	0.66	PCC189	0.85
DY802	0.95	PCF80	0.95
CV850	2.50	PCF82	0.95
CV4015	2.50	PCF84	0.75
E180F	6.50	PCF86	1.25
EABC80	0.98	PCF87	0.50
EAF42	1.50	PCF200	1.95
EB91	1.30	PCF201	1.95
EBC41	2.00	PCF800	1.20
EBF80	0.75	PCF801	1.05
ECC81	1.00	PCF802	1.05
ECC82	0.90	PCF805	1.60
ECC83	1.00	PCF806	1.20
ECC84	0.80	PCF808	1.60
ECC85	0.95	PCL82	1.00
ECC86	2.80	PCL83	2.50
ECC88	1.25	PCL84	1.00
ECC189	0.85	PCL86	0.90
ECF80	1.20	PCL88	2.50
ECF82	0.85	PCL805	1.05
ECF83	1.90	PD500	2.90
ECF86	1.70	PFL200	1.85
ECH35	3.75	PL33	1.50
ECH81	1.40	PL36	1.75
ECH84	1.50	PL82	0.75
ECL85	0.75	PL95	2.00
ECL86	1.75	PL504	1.40
EF80	0.75	PL508	2.70
EF86	1.80	PL519/509	5.25
EF91	2.00	PL802	5.50
EF95	1.68	PY81/800	1.10
EF183	0.90	PY82	1.75
EF184	1.00	PY88	0.80
EH90	0.98	PY500A	2.20
EL34	3.25	PY801	0.85
EL36	1.98	UABC80	0.85
EL81	6.95	UAF42	1.25
EL84	1.00	UBC41	3.00
EL85	4.75	UBC81	1.50
EL86	0.90	UCC85	0.75
EL509	7.85	UCF80	1.20
EL519	7.95	UCH42	2.50
EM80	0.85	UCH81	2.00
EM84	1.75	UCL82	1.80
EM87	2.56	UCL83	1.80
EY51	0.90	UF41	1.25
EY86/87	0.85	UF89	2.50
EY88	0.75	UL84	1.25
EY500A	2.50	UY85	1.15
EZ41	2.80	2D21	1.75
EZ81	0.80	6AT6	1.25
GY501	1.40	6AV6	1.50
GZ32	1.20	6C4	1.00
KT66(G.E.C.)	18.00	6GH8A	1.20
KT77	11.50	6J5GT	1.80
		6K7G	2.00
		6K8G	2.75
		6KD6	6.50
		12AU6	2.00
		30FL2	1.70
		30FL12	1.80

TRANSISTORS - DIODES

Type	Price (£)	Type	Price (£)	Type	Price (£)
AC127	0.28	BC118	0.16	BC516	0.48
AC128	0.30	BC119	0.28	BC547	0.12
AC128K	0.34	BC125	14	A or B	0.10
AC141	0.58	BC140	0.27	BC548	0.12
AC141K	0.38	BC141	0.24	A B or C	0.10
AC142	0.56	BC142	0.24	BC549	0.10
AC142K	0.38	BC143	0.26	A or B	0.10
AC151	0.45	BC147	0.18	BC550	0.10
AC152	0.45	BC147B	0.14	A or B	0.10
AC153	0.57	BC148	0.10	BC557	0.10
AC153K	0.46	BC148B	0.12	BC558A	0.10
AC176	0.30	BC149	0.10	BCY70	0.10
AC176K	0.38	BC149C	0.14	BCZ10	3.21
AC187	0.28	BC157	0.10	BCZ11	2.60
AC187K	0.38	BC158	0.12	BD124P	0.70
AC188	0.28	BC159	0.12	BD129	0.90
AC188K	0.38	B/C	0.12	BD130Y	0.68
ACY22	1.50	BC160	0.30	BD131	0.36
AD142	0.88	BC161	0.30	BD132	0.36
AD143	1.10	BC168B	0.20	BD135	0.26
AD149	0.72	BC169C	0.16	BD136	0.26
AD161/162	1.20	BC170A/B/C	0.16	BD137	0.28
AD162	0.52	BC171A/B	0.12	BD138	0.30
AF114	1.20	BC172/B/C	0.12	BD139	0.30
AF115	2.10	6C177/A/B/C	0.24	BD140	0.28
AF116	2.10	BC182/A/B/C	0.10	BD142	1.26
AF121	0.56	BC182L	0.12	BD145	1.82
AF124	0.42	LA LD LC	0.10	BD150A	0.72
AF125	0.58	BC183A/B/C	0.10	BD160	1.58
AF126	0.58	BC183L	0.10	BD165	0.65
AF127	0.38	LA LB LC	0.10	BD183	0.70
AF139	0.40	BC184	0.10	BD201	0.52
AF178	2.28	A B CL LC LB	0.10	BD202	0.57
AF239	0.50	BC207	0.15	BD204	0.50
AF279S	1.68	BC212A/B/C	0.10	BD222	0.80
AL100	5.40	BC212L	0.09	BD225	0.40
AL102	4.50	LA LB	0.10	BD232	0.45
ASY80	5.20	BC213A/B/C	0.10	BD234	0.30
ASZ17	2.00	BC213L	0.10	BD235	0.38
AU110	2.80	LA LB LC	0.10	BD236	0.38
AY102	4.40	BC237	0.10	BD237	0.38
B40C200	1.03	BC238	0.12	BD410	0.76
BA110	0.88	6C251A/B	0.14	BD434	0.58
BA115	0.14	BC262	0.20	BD438	0.58
BA121	0.40	A B	0.28	BD439	0.85
BA129	0.38	BC301	0.30	BD441	1.00
BA148	0.16	BC302	0.30	BD507	1.05
BA155	0.12	BC303	0.30	BD520	1.20
BA157	0.28	BC307A	0.18	BD687	0.88
BB105B	0.30	BC317A	0.12	BD707	0.88
BB105G	0.48	BC323	0.90	BDX18	1.00
BB110B	0.42	BC327	0.16	BDX32	1.48
BC107	0.10	BC328	0.12	BF115	0.32
A or B	0.12	BC337	0.12	BF117	0.50
BC108	0.10	BC338	0.12	BF119	0.82
A,B or C	0.12	BC350A	0.24	BF120	0.38
BC109	0.10	BC351	0.16	BF125	0.42
A,B or C	0.14	BC440	0.30	BF127	0.41
BC115	0.12	BC441	0.40	BF154	0.14
BC116	0.12	BC461	0.58	BF157	0.46
BC117	0.22	BC478	0.24	BF160	0.23
				BF167	0.32
				BF177	0.42

Type	Price (£)	Type	Price (£)	Type	Price (£)
BF178	0.26	BU126	1.40	ORP12	0.85
BF180	0.27	BU133	1.90	R2008B	1.20
BF181	0.27	BU204	1.30	R2010B	1.20
BF182	0.32	BU205	1.30	R2540	2.71
BF183	0.32	BU206	1.50	TIP30A	0.32
BF184	0.30	BU208A	1.40	TIP31C	0.39
BF185	0.28	BU326S	1.75	TIP32	0.35
BF194A	0.15	BU407	1.10	TIP33A	0.55
BF195	0.12	BUX80	3.70	TIP34A	0.70
BF224J	0.20	BUY20	2.75	TIP41C	0.42
BF240	0.30	BUY69A	2.60	TIP42	0.44
BF241	0.30	BUY69B	1.98	TIP47	0.42
BF244A	0.30	BY100	0.80	TIP121	0.63
BF257	0.22	BY103	0.50	TIP2955	0.70
BF258	0.18	BY122	0.60	TIP3055	0.58
BF259	0.30	BY126	0.10	TIS88	0.50
BF262	0.34	BY127	0.08	TIS90	0.27
BF263	0.38	BY133	0.06	Y728	0.14
BF270	0.30	BY135	0.35	Y969	2.80
BF271	0.28	BY164	0.45	IN4001	0.04
BF273	0.22	BY179	0.56	IN4003	0.05
BF274	0.22	BY182	0.60	IN4004	0.05
BF294	0.46	BY184	0.38	IN4006/7	0.07
BF336	0.32	BY187	0.65	IN4148	0.04
BF337	0.28	BY189	6.75	IN5400	0.12
BF338	0.28	BY198	0.64	IN5402	0.13
BF355	0.37	BY199	0.72	IN5405	0.16
BF371	0.27	BY206	0.14	IN5406	0.17
BF450	0.28	BY207	0.16	IN5408	0.19
BF457	0.36	BY210/400	0.21	2N2122A	0.34
BFR51	0.36	BY210/600	0.24	2N2222	0.30
BFR61	0.32	BY210/800	0.28	2N2904A	0.48
BFR90	0.68	BY227	0.22	2N2926G	0.14
BFT41	0.68	BY228	0.25	2N3053	0.30
BFT43	0.86	BY238	0.65	2N3054	0.60
BFY50	0.22	BYX10	0.20	2N3055	0.65
BFY51	0.22	BYX36/150	0.40	2N3703	0.10
BFY52	0.22	BYX36/600	0.48	2N3773	2.80
BFY90	0.80	BYX48/300	0.70	2SB337	1.80
BFY90S	1.34	BYX55/600	0.30	2SC1098	0.84
BR100	0.25	BYX71/600	1.18	2SC1172Y	1.70
BR101	0.40	C106D (400V)	0.48	2SC1173Y	0.88
BR103	0.50	E1222	0.30	2SC1279	0.50
BR303	2.75	E5024	0.30	2SC1306	0.92
BRY39	0.50	MCR106/5	0.30	2SC1413A	2.70
BRY56	0.42	ME0413	0.70	2AC1449	0.80
BSX20	0.30	ME6002	0.26	2SC1507	0.60
BSY52	0.35	MEU21	0.62	2SC1678	1.00
BSY95A	0.25	MJ400	0.45	2SC1758	0.68
BT100A/02	0.90	MJ2955	1.00	2SC1909	1.20
BT101/300	2.75	MJ3000	1.80	2SC1923	0.30
BT101/500	3.25	MJE340	0.46	2SC1945	2.88
BT102/300	3.60	MJE520	0.44	2SC21953	0.70
BT106	1.15	MJE2955	1.60	2SC1957	0.70
BT116	1.20	MJE3055	1.40	2SC1969	2.80
BT119	3.30	MPSA05	0.30	2SC2028	0.73
BT138/600	1.30	MPSA12	0.30	2SC2029	2.70
BT151/560R	0.30	MPSLO1	0.34	2SC2078	1.05
BTY79/400R	2.80	MPSUO5	1.05	2SC2091	0.70
BU104	1.80	MPSUO6	1.18	2SC2098	2.90
BU105	1.20	MR502	0.40	2SC2122A	3.20
BU108	1.75	MR854	0.88	2SC2314	0.80
BU124AE	0.98	OA91	0.07	2SC2335	1.50

74LS

74LS00	0.24	74LS126	0.50
74LS01	0.24	74LS132	0.60
74LS02	0.24	74LS135	0.26
74LS03	0.24	74LS136	0.42
74LS04	0.24	74LS138	0.44
74LS05	0.24	74LS139	0.58
74LS08	0.24	74LS145	0.93
74LS09	0.24	74LS147	1.64
74LS10	0.24	74LS148	1.28
74LS11	0.24	74LS151	0.70
74LS12	0.24	74LS153	0.70
74LS13	0.33	74LS155	0.55
74LS14	0.48	74LS157	0.45
74LS15	0.24	74LS158	0.58
74LS19	0.44	74LS160	0.62
74LS20	0.24	74LS161	0.68
74LS21	0.24	74LS162	0.70
74LS22	0.24	74LS163	0.68
74LS24	0.28	74LS164	0.74
74LS26	0.24	74LS165	1.10
74LS27	0.24	74LS166	1.50
74LS28	0.24	74LS168	1.48
74LS30	0.24	74LS170	1.40
74LS32	0.24	74LS173	0.98
74LS33	0.24	74LS174	0.75
74LS37	0.24	74LS175	0.70
74LS38	0.24	74LS190	0.82
74LS40	0.24	74LS192	0.98
74LS42	0.50	74LS193	0.98
74LS47	0.79	74LS194	0.75
74LS48	0.85	74LS195	0.74
74LS51	0.24	74LS196	0.84
74LS55	0.24	74LS197	0.96
74LS73	0.30	74LS221	0.85
74LS74	0.33	74LS240	0.80
74LS75	0.44	74LS241	0.80
74LS76	0.38	74LS242	0.94
74LS83	0.88	74LS243	0.94
74LS85	0.82	74LS244	0.80
74LS86	0.35	74LS245	1.20
74LS90	0.48	74LS247	1.00
74LS91	0.90	74LS251	0.75
74LS92	0.54	74LS257	0.73
74LS93	0.54	74LS258	0.75
74LS95	0.60	74LS259	1.20
74LS96	1.20	74LS266	0.55
74LS107	0.40	74LS237	1.20
74LS109	0.44	74LS279	0.70
74LS112	0.44	74LS283	0.80
74LS113	0.40	74LS353	1.10
74LS114	0.39	74LS365	0.50
74LS122	0.68	74LS366	0.50
74LS123	1.00	74LS367	0.50
74LS124	1.15	74LS368	0.50
		74LS373	1.00
		74LS374	1.00
		74LS375	0.70

CMOS

4000	0.19	4066	0.44
4001	0.24	4068	0.24
4002	0.24	4069	0.24
4006	0.68	4070	0.24
4007	0.24	4071	0.24
4008	0.59	4072	0.24
4009	0.44	4073	0.24
4010	0.39	4075	0.24
4011	0.23	4076	0.68
4012	0.24	4077	0.24
4013	0.35	4078	0.24
4014	0.58	4081	0.24
4015	0.58	4082	0.24
4016	0.38	4085	0.58
4017	0.54	4086	0.58
4018	0.59	4089	1.22
4019	0.59	4093	0.37
4020	0.78	4094	0.70
4021	0.58	4095	0.93
4022	0.68	4096	0.98
4023	0.30	4097	2.65
4024	0.49	4098	0.78
4025	0.24	4099	0.75
4026	0.89	4161	0.96
4027	0.44	4162	0.96
4028	0.44	4163	0.96
4029	0.73	4174	0.96
4030	0.33	4175	1.00
4031	1.28	4195	0.99
4033	1.25	4501	0.38
4034	1.40	4502	0.58
4035	0.68	4503	0.38
4036	2.48	4507	0.45
4038	0.73	4508	1.28
4039A	2.70	4510	0.54
4040	0.58	4511	0.54
4042	0.48	4512	0.54
4043	0.42	4514	1.10
4044	0.48	4515	1.20
4049	0.38	4516	0.60
4050	0.34	4517	2.70
4051	0.68	4518	0.48
4052	0.58	4520	0.05
4053	0.58	4521	1.10
		4522	1.20
		4526	0.58
		4527	0.64
		4528	0.68
		4531	1.20
		4532	0.64
		4536	2.50

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CAN YOU HELP?
A friend of ours requires a volume-on/off knob and a turnlock-tuning knob for a Philips RM712 car radio. Can anyone supply these? Does anyone know the agents or a source of spares for Tensai TVs?

CORRECTION
A correction to the c.r.t tester/booster circuit published last month appears on page 493.

FRONT COVER
This month's cover photograph shows a close up of a test pattern displayed on the screen of a PIL type tube.

More on Spares

No apologies for returning to the subject of spares so soon: it's likely to be an increasing headache for all concerned – setmakers, stockists, repairers and customers. Let's look at it first from the setmaker's point of view, prompted once more by Ferguson who have just announced that spares for the 14in. colour portable Model 3787 will no longer be supplied by them – nor will any repair work be undertaken. That's the popular little Movie Star portable fitted with a NordMende chassis, dating from the period in the early seventies when thryristor line output stages were all the rage amongst Continental setmakers.

The fact that these sets are now some ten years old highlights the problems. A setmaker of any size will have introduced a vast range of models over such a time scale. Just think of some of the permutations – different tube sizes and tuning arrangements, remote control, teletext and more recently stereo sound capability. Dealers and their customers expect to be able to order spares of every description: not just droppers, LOPTs and various safety specials but knobs that fall off and various bits of trim. Anything in fact that might be required to restore a set in for service to its original condition. This implies the need to stock thousands and thousands of different TV spare parts – spares also for a wide range of VCRs, radio and audio equipment. In terms of storage space and handling the costs involved are enormous. It's no use saying reorder when necessary from component manufacturers. They too alter their ranges, while the cost of ordering small quantities is prohibitively high even for the largest setmakers. Then there's the fact that many components are supplied to meet the specification for a particular model/chassis. We're thinking not just of safety components but of items shaped to fit particular PCB assemblies, cabinet mouldings and so on. There have been jokes in the past about computers running the show and part numbers as long as your arm: they just serve to emphasise the difficulties.

The vastly increased reliability of modern chassis hasn't helped in this respect. Cool running and low power consumption mean that sets can be expected to give years and years of service with comparatively few breakdowns. It's also a fact that a ten or fifteen year old set can still look quite new. But failures are inevitable from time to time and then the hassle starts. Just what is a fair time after which to put up the no longer available sign? Ten years sounds a nice round figure and seems to be the sort of time scale manufacturers now have in mind. After all if you've had ten years' service from a set you've not done badly, particularly in view of the modest initial price of consumer electronics equipment. But one has to admit that though this sounds reasonable it's not likely to assuage the customer who can't get his set repaired for want of some perhaps fairly minor item.

The repairer doesn't have to go back to the original maker for parts of course, though special items, whether to meet a safety requirement or an exacting performance specification – flyback tuning capacitors, the chopper and line output transistors used in some sets, and so on – are likely to cause problems. Increasingly, setmakers are farming out the supply of spares to specialist distributors. This ensures that spares are readily available around the country and has the advantage from the stockists point of view that he's not obliged to hold stocks of any and everything that might be required. He knows that a good range of tuners, LOPTs, triplers, droppers, electrolytics and transistors will meet the vast majority of calls for parts. Experience will provide a guide to what to stock for particular models and the independent distributor has no obligation to search for an obscure item for an unusual set. For the most part repairers can, as they've always done, rely on various standard component lines. We hope that doesn't sound too complacent, being all too well aware of the frustrations that can arise when a customer can't be provided with the sort of service you aim to give.

When you come to think of it the service nowadays being provided by specialist component suppliers is remarkably cheap and efficient. While a setmaker buys components in bulk to feed to his computer-controlled production lines the stockist has to locate, pack, despatch and invoice items on an individual basis. It's amazing how they manage to do it and not surprising that a special screw, belt or plastic moulding can bring with it quite a hefty bill. This all reflects the incredibly tight costing that modern mass production brings with it: what costs the setmaker pennies must cost you pounds.

The problems all too lightly touched upon above are likely to involve us all in increasing problems of one sort or another. A year or so back some readers were contemplating the idea of providing computerised fault finding and data services, but no computer will solve the problem of the missing part. Anything for which there's an obvious need is likely to be made available by someone or other – think of the universal tripler and the solid-state PL802 for example. Alternatives for most electronic components could probably be found – if only one could lay hands on the original performance specification and they could be made to fit the bracket, board or other mounting requirement!

INDEX TO VOLUME 35

Copies of the index to volume 35 (November 1984 – October 1985) of *Television* are now available from the editorial office at 75p each. The index includes full lists of VCR Clinic and TV Fault Finding items. Would readers please note that indexes are not available until approximately six months after the last issue concerned. We've already had a number of requests for the index to volume 36 – despite the fact that four issues have still to be written, prepared and printed . . .

Modern Receiver Circuitry

Part 3: Video Signal Processing

J. LeJeune

The use of integrated circuits has enabled some sophisticated techniques to be adopted in TV receivers, techniques that might not have appeared had the use of discrete component circuitry continued. For a good few years now video signal processing in TV sets has been carried out in i.c. form: while RGB output chips have been devised, the advantage at the end of the video chain still lies with discrete component circuitry, due to the dissipation and high voltages involved.

Filtering the Video Signal

The output obtained from the vision detector of a colour receiver consists of the baseband luminance signal (50Hz-5·5MHz), the chrominance signal on its 4·43MHz carrier with sidebands extending some 1·1MHz on either side, and the 6MHz intercarrier sound signal which is a beat frequency between the vision and sound i.f. carriers (39·5MHz and 33·5MHz). We'll return to the sound signal in a later article. The chrominance subcarrier and its sidebands are interleaved with the upper luminance signal frequencies: because of the line structure of the TV picture, there are gaps in the luminance signal spectrum into which the chrominance signal is slotted.

The various components of the vision detector's output have to be separated for individual processing. Filtering arrangements vary from chassis to chassis but a typical way of going about this is shown in Fig. 1. The composite video signal is fed to the base of transistor Q1 via the bridged-T notch filter L3/C6/C7/R10 which removes the 6MHz intercarrier sound signal. The chrominance signal feed is via C2, the attenuator R8/R7 and C4 to the following signal processing i.c., with the series rejector circuit C3/L2 included to remove the l.f. video components – this arrangement is used in preference to a lossy bandpass acceptor circuit. C2 is of low value to contribute to the filtering. Q1 provides the sync and luminance feeds. It's made unresponsive to signals at the 4·43MHz chroma subcarrier frequency by the inclusion of the parallel tuned circuit L1/C1 in its emitter circuit: this introduces frequency selective negative feedback, reducing the stage gain at 4·43MHz. The unbypassed resistor R5 provides overall negative feedback – Q1 has low gain but good linearity and is primarily used as a buffer to prevent interaction between the sound and chroma subcarrier rejectors. Delay line DL1 is incorporated in the luminance signal path to compensate for the different bandwidths of the chrominance and luminance signal circuits.

Luminance-chroma Processing Chip

Today's sets generally use a single chip to process both the chrominance and luminance signals. A good example of this type of i.c. is the Mullard TDA3560. Fig. 2 shows a block diagram of this widely used i.c.

Processing of the luminance signal is straightforward: amplification with d.c. clamping to restore the correct conditions following a.c. coupling (C5, Fig. 1), d.c. contrast control, then matrixing with the colour-difference signals to provide R, G and B signals for the output stages.

Before we look at the processing of the chrominance signal let's just recap on its composition. Two colour-difference signals, B – Y and R – Y, are transmitted. At the transmitter these signals amplitude modulate two 4·43MHz subcarriers which have a phase difference of 90° – this means that when one subcarrier is at its peak the other is at zero. The two signals are then added to give the composite chroma signal – the technique is known as quadrature amplitude modulation. There's further complication with the PAL system since the phase of the R – Y signal is shifted by 180° on alternate lines. About ten cycles of 4·43MHz subcarrier (the colour burst) are transmitted during the post line sync pulse back porch period to act as a reference for the decoding process. The only modulation on this carrier is the 180° PAL signal swings, as a result of which the phase of the burst swings ±45° on alternate lines.

Within the TDA3560 the chroma signal is fed first to a gain-controlled amplifier (a.c.c. – automatic chrominance control). The control potential is obtained by rectifying the colour burst since this is not amplitude modulated. The burst signal has to be separated from the chroma signal for this purpose: this is done by using a suitably timed line pulse to open a gate. The separated burst signal is also applied to a phase detector which is part of a phase locked loop controlling the phase and frequency of a reference oscillator. In earlier decoders this oscillator operated at 4·43MHz: for reasons that will become clear shortly in the TDA3560 and similar chips the frequency is 8·86MHz.

Returning to the chroma channel itself, the signal is next subjected to saturation and contrast control – the latter so that the correct luminance to chroma ratio is maintained. The control stage is gated by the burst gate pulse so that operation of the contrast and saturation controls does not affect the amplitude of the burst. The chroma signal then leaves the i.c. for application to the delay line circuit which serves two purposes: it separates the B – Y and R – Y components of the signal and, by averaging the signal over pairs of lines, converts any phase error to slight desaturation. The separated signals are then

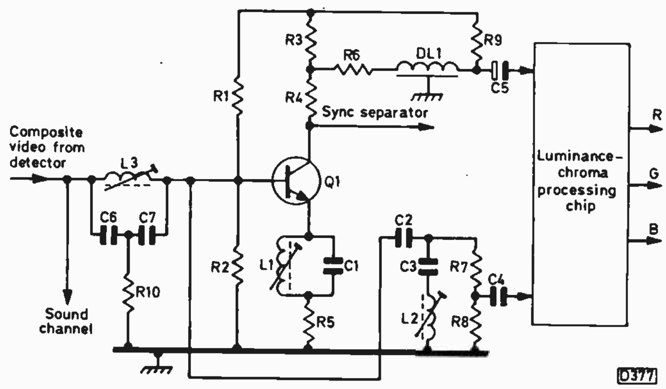


Fig. 1: Separating the outputs from the vision detector.

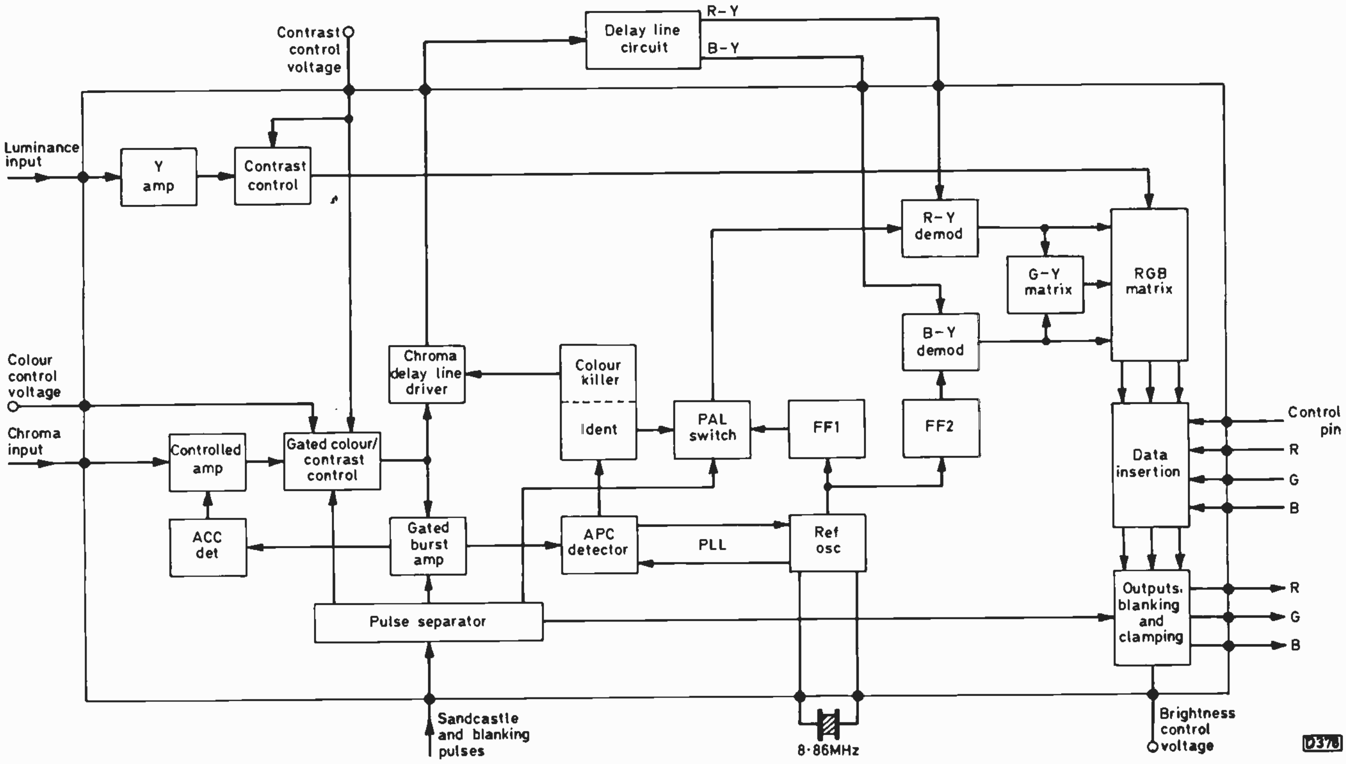


Fig. 2: Block diagram of the TDA3560 luminance and chroma signal processing chip.

applied to two synchronous demodulators. These require inputs from the reference oscillator, which takes us back to the a.p.c. loop.

The main purpose of the colour burst is to synchronise the reference oscillator which drives the synchronous demodulators. These operate on the sample-and-hold principle, sampling the modulated colour-difference signals at the peaks of the carriers to detect their amplitudes. The reference signal drives to the demodulators must have a phase difference of 90° – the same as the original carriers at the transmitter. In earlier decoders this was achieved by incorporating a 90° phase shift network in one of the reference signal feeds. The use of an 8·86MHz oscillator avoids the need for this and provides more accurate results: its output is fed to two flip-flops which provide

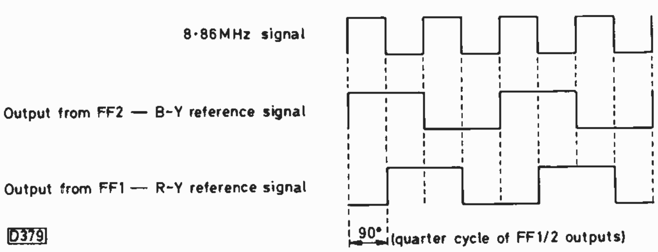


Fig. 3: Obtaining quadrature reference signals to drive the R – Y and B – Y demodulators by using two flipflops to divide by two the output from an 8·86MHz oscillator. FF2 is positive-going edge triggered to produce an in-phase 4·43MHz signal; FF1 is negative-edge triggered to produce a signal with a 90° phase difference.

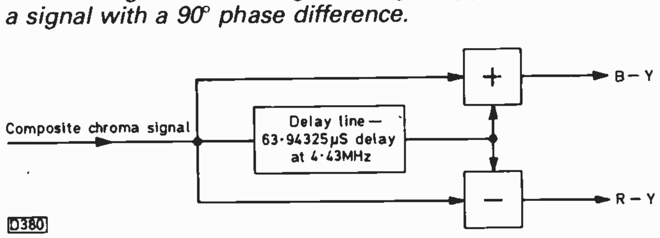


Fig. 4: Principle of the chroma delay line circuit.

division by two. By taking opposite polarity outputs from the flip-flops two drive signals with an exact 90° phase difference are obtained. See Fig. 3.

It's also necessary to invert the drive to the R – Y demodulator on alternate lines to counter the effect of the 180° switching at the transmitter. This must be synchronised with the switching at the transmitter. The burst swings provide an identification signal for this purpose: the 7·8kHz (half line frequency) ident signal synchronises the PAL switch (inverter) which is driven by line frequency pulses.

The presence of the burst/ident signals is a convenient way of establishing that the transmission is a colour rather than a monochrome one. No burst means no colour: the colour-killer then switches off the chroma delay line driver stage. If this is not done the a.c.c. circuit will operate the chroma amplifier at maximum gain and the monochrome display will be marred by colour noise.

Fig. 4 shows the operation of the delay line circuit. The composite chroma signal is fed directly and via the one-line duration delay line to add and subtract networks. Because of the R – Y signal inversion (180° shift) on alternate lines the R – Y signal cancels out in the adder circuit while the B – Y signal cancels out in the subtract circuit.

Matrixing and Data Insertion

The third colour-difference signal (G – Y) is obtained by matrixing the demodulated R – Y and B – Y signals. The luminance signal is then added to obtain RGB signals. These pass to the data insertion circuit which consists of three fast electronic changeover switches – they can operate at 10MHz. The state of all three switches is controlled by the voltage at the insertion control pin – 1·5V at this pin changes the switches from off-air RGB to external inputs, the mode generally used for teletext. For mix-mode teletext a monochrome version of the text is fed

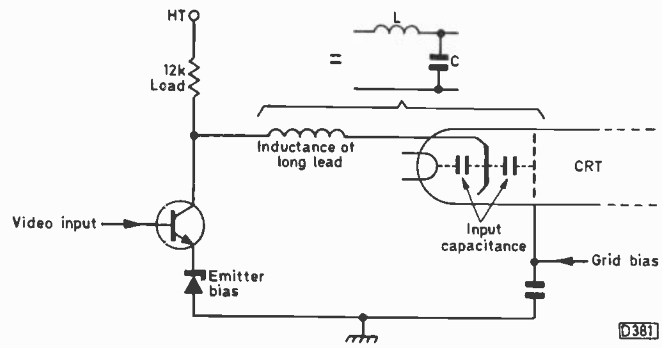


Fig. 5: How long video leads and a tube's input capacitance form a low-pass filter that attenuates h.f. components of the signal.

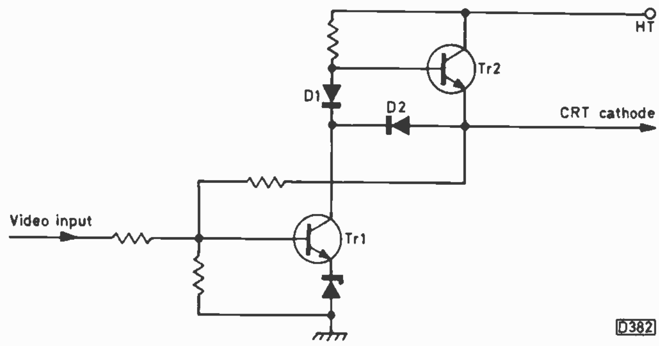


Fig. 6: Basic class AB video output circuit.

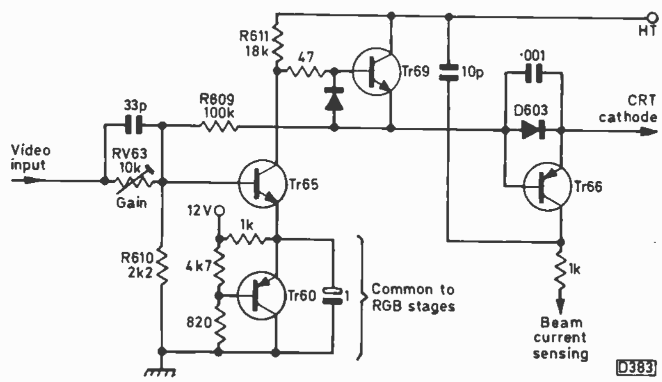


Fig. 7: Video output circuit used in the Thorn TX100 chassis.

to the insertion control pin. From the data insertion section the RGB video signals pass to the i.c.'s output stages where line and field flyback blanking is carried out.

Video Output Circuits

The external RGB output stages drive the tube's cathodes. For optimum results the tube's heater-cathode and cathode-grid capacitances must be charged and discharged in the shortest possible time. It helps to mount the RGB output stages on the tube base panel. This eliminates the long leads otherwise required – these long leads, in conjunction with the tube's input capacitances, form low-pass filters that affect the set's h.f. performance – see Fig. 5.

The problem with a simple class A output stage of the type shown in Fig. 5 is that while the tube's input capacitance is quickly discharged on a negative-going signal transition, when the output transistor is rapidly driven to saturation, on a positive-going transition when the transistor is switched off the capacitance has to charge via the load resistor, which is typically about 12kΩ in value. Class AB output stages are favoured as a way of overcoming this disadvantage. Fig. 6 shows the basic circuit. Adding the emitter-follower transistor Tr2 in Tr1's collector circuit provides a method of rapidly charging the tube's input capacitance on positive-going transitions. Another advantage of the circuit is reduced dissipation.

Fig. 7 shows one of the RGB output stages used in the Thorn TX100 chassis. The pnp transistor Tr60 is used to hold the emitters of all three output transistors at 2·5V. Video from the chroma-luminance processing i.c. is applied to the base of the output transistor Tr65 via RV63: negative feedback via R609 sets the gain of the amplifier and stabilises the d.c. operating conditions. No adjustment of the grey-scale black level is required because the stage is designed to operate with the later TDA3562A processor i.c. which incorporates automatic black-level control. If such adjustment was required, R610 could be made variable. Tr65 provides a peak-to-peak drive of 150V at the base of the emitter-follower transistor Tr69. Up to this point the circuit follows a similar arrangement to that shown in Fig. 6. The final transistor Tr66 serves a dual function. It provides signal coupling to the tube via its base-emitter junction, acting as an emitter-follower on negative-going transitions – diode D603 provides coupling on positive-going transitions. The other function is to provide feedback from its collector to the beam current sensing (in the TDA3562A chip) and beam limiting circuits. The feedback to the chip is part of the black-level correction system. The power consumption of the stage is around 600mV.

Grundig's Satellite TV Receiver

Steve Beeching, T. Eng.

Grundig will be launching a new satellite TV receiver during the May trade shows in London. I was pleased to be present at a prelaunch appraisal with a friend of mine who has already looked at a number of satellite receiver systems.

The receiving dish was pointed at Eutelsat-1 F1 (ECS-1). Various programmes are available from this satellite. All were very well received – with the exception of scrambled transmissions for which at the time decoders had not been made available.

The main television set was a Grundig Model M70 with a 28in. FS tube and a CTI decoder – this is an automatic PAL/NTSC/Secam decoder with a variable luminance delay line for correct luminance-chrominance registration (to put the red back on top of the snooker balls).

The pictures from the Italian channel RAI were stunning – not only because of the scantily clad ladies running about but also due to the shots being live from the studio and the wide TV bandwidth being used.

The satellite receiver itself is the size of a midi hi-fi unit – 320 × 70 × 270mm – which is quite compact. It's a 29-station programmable receiver with the capability to tune each programme through the full 950-1,750MHz bandwidth in 99 channel steps. Channel selection is by means of an IR remote control unit.

The range of controls and inputs is comprehensive. There are two dish aerial inputs at the rear, X and Y. While the inputs can be from separate dishes the intended use is with a dual head end at the dish, i.e. a dish with two low-noise converters fitted, one for vertical and the other for horizontal signal polarisation. Selection of either is programmable via each input.

There are two scart connectors and a six-pin AV DIN socket. One scart socket is for use with a VCR and the other for connection to the main TV set (with the AV DIN socket as an alternative). Through connection via a relay is available when the satellite receiver is off. When in operation the VCR can record the channel currently being received: so you can watch a terrestrial programme (BBC-1, ITV etc.) on the main TV set while recording a satellite TV broadcast.

The low-noise converters at the dish are each fed with 15V at 250mA via the connecting cables: the power supply to them can be switched off by a small switch at the rear of the unit. There's also a switch to select only input X in the event of a single low-noise converter being used.

The unit uses a standard VCR type modulator and combiner amplifier – there's an audio level preset mounted below the modulator. The terrestrial TV aerial can be plugged in and the output next to it connected to any standard u.h.f. TV set. The additional satellite TV outputs are modulated on to u.h.f. channels in the region ch. 31-39, adjustable. We found that the modulator was good enough to be able to decode Italian teletext on a standard receiver.

There's a four-state voltage output for dish switching: 0V dish 1, horizontal; 3V dish 1, vertical; 6V dish 2, horizontal; 9V dish 2, vertical. The switching is done at the head end by h.f. relays.

Each programme (1-29) can be set not only to the required satellite channel (1-99) but also for input X or Y, for de-emphasis d1 or d2 and for deviation h1 or h2. The inputs from the low-noise converters are in the band 950-1,750MHz (first i.f.). X or Y input selection is by switching voltages of +5V or −5V to bias on or off two pin diodes in the signal paths. After signal selection an a.g.c. stage caters for a range of between 47dB/μV to 75dB/μV. A second mixer then produces an output at 480MHz which, after two stages of i.f. amplification, is converted to baseband video by the f.m. demodulator. An a.f.c. output is fed to the microcomputer as a reference: the tuning is microcomputer controlled, using a phase-locked loop synthesiser. The input to the loop is from the local oscillator and the frequency of operation is set by the microcomputer: tuning drift is thereby eliminated, the range of control being sufficient to accommodate any drift in the low-noise converters.

The sound circuit caters for carriers at 4·5MHz or in the range 6-7MHz. A wideband phase-locked loop is used. Any channel can be set for 4·5MHz or 6·5MHz and stored in the memory. The 6·5MHz carrier can be in the range 6-6·5MHz: the phase-locked loop is arranged to demodulate within these limits without need for adjustment. The carrier is mixed to produce a 10·7MHz sound i.f. signal which is demodulated by a standard TBA120 chip with an error signal fed back to the mixer – all this path is within the PLL.

The ECS-1 satellite at present carries eleven channels. Two of these are on east spot beams and were thus very faint, two were scrambled and the others were received with excellent pictures – albeit a 2m dish was being used. No adjustments to the TV set or the satellite receiver were necessary – reception of the whole band was simply by changing channels via the remote control unit. Different signal polarisation, de-emphasis, sound carriers and colour systems were all taken care of. My friend remarked how good it was – and he's not easily impressed.

Letters

WHY NO TEST CARDS?

Despite following the normal TV engineer's traditionally moderate line, after the events this week I really feel it's time to put pen to paper in a letter of complaint to the broadcasting authorities. I hope it will in no small way be supported by your good selves and the majority of *Television's* readers. In a nutshell, where have all our test cards gone? Since their disappearance from the BBC channels in what seems an age ago I've noticed little complaint or comment in these pages. Why hasn't anyone questioned the need for two channels of text consisting of repeated information every ten minutes or so on most days of the week? Apart from the occasional "glimpse" on Channel 4 it seems that test cards are now considered to be pointless.

Anyone involved in front line servicing will know this situation is far from ideal. At the time of writing a typical morning's programmes consist of BBC-1 text, BBC-2 text, ITV black-and-white film, Ch. 4 text. This situation doesn't allow the engineer let alone the customer evaluate the performance of a TV set or VCR.

So please BBC reconsider your policy and bring back our Effy at least on one channel. A display even every half hour would help, but please don't consider her redundant. I and many other engineers will tell you that this is far from the truth.

Keith Lane,
Southsea, Portsmouth.

Editorial comment: Whenever this comes up the broadcasting authorities tend to comment that it's not their job to provide a pattern generator that's expensive in terms of power consumption. But a portable pattern generator doesn't allow the complete transmission path to be assessed. There seems to be no reason why the broadcasters shouldn't oblige the trade in the way suggested: the present situation is unsatisfactory indeed.

TELETEXT TROUBLES

I have some further news concerning XM11 teletext decoder problems. Suddenly, about three weeks before Easter, the problem I'd had with missing rows of data on BBC-2 vanished. Text has been fine on this channel ever since. The period of malfunction was about three months. A problem with ITV text, i.e. not getting it right first time, still comes and goes but I've now noticed that this occurs only with networked information – locally generated text from TVS is always right first time. Throughout this period of difficulty BBC-1 and Ch. 4 text have always been o.k.

So what can I conclude from this? First I don't believe anything has changed locally, neither do I think the receiver was ever suspect. The broadcasters assured me that everything was o.k. at their end, which prompted me to look into the possibility that something might be wrong at my end. I believe, from what I've heard, that the XM11 may be less tolerant of variations in transmission parameters than later designs. I feel that this is the root of the problem, even though the broadcasters would deny it.

The original fault showed every fourth row missing. Later this changed to every fifth row, before the problem disappeared altogether. Perhaps something changed as a result of a three-monthly maintenance schedule somewhere. I doubt whether I'll ever find positive proof of my suspicions and will just have to be thankful that the fault has gone away.

Keith Cummins,
Southampton.

MICROCOMPUTER FAULTS

Further to my letter in the March issue, here's some more information on microcomputer faults.

The Sinclair Spectrum's power supply seems to be responsible for a number of faults. The main item that fails is, as I stated, a ZTX450 transistor (TR4). On later versions of the board it's a ZTX650. TR5 (ZTX213), diode D15, the 7805 regulator chip and even the inductor itself have been known to fail. With all these failures there's no buzzing noise from the inductor. A screen full of horizontal black-and-white lines can be caused by failure of the Z80A microprocessor chip or the ROM. These components should be available from advertisers in the pages of *Sinclair User* magazine.

The BBC computer has a strip of stiff conductors that link the keyboard to the main board. Repeated movement of this strip due to the addition of ROMs to the expansion sockets located beneath the keyboard can lead to failure of areas of the keyboard.

VIC20 computers have given us the following faults. Every other numeral not working (1 o.k., 2 u/s etc.): the 6522A chip in position UBA1 faulty. Poor or no colour: suspect the modulator or the Commodore chip. Intermittent loss of picture at switch-on: the 7402 chip in position UB9 sensitive.

G. Jackson,
Hyde, Cheshire.

COMMODORE 64 TIP

Problems with home computers have been featured in recent issues. Here's one relating to the Commodore 64. It may save other readers a small fortune. The trouble is loading problems, with the computer not waiting for the play key to be pressed before going into the play or save mode. The I/O port for the cassette unit is in the 6510 CPU, along with the data direction registers. If you type in this one-line program:

10 print peek (1): GOTO 10

the computer should, if working properly and with no cassette keys depressed, respond with a solid row of 55s. What you're more likely to see is a row of continuously changing numbers. Obviously something weird and wonderful is going on inside the chip. Next shock, phone Commodore and ask the price of a replacement chip: twenty four pounds!

A small modification (bodge) has so far proved very successful however. R1 (3·3kΩ) is connected to pin 25 of the chip: it's a pull-up resistor connected to the cassette sense line. Wire a 47kΩ preset in series with this resistor

and adjust it until the row numbers stabilise at 55 (again all cassette keys up). The trick is also worth knowing since with many 64s this 40-pin chip is soldered in. It not only saves a fortune in chip, also a fortune in solder!
D.C.J. Tilley,
London E2.

RC HANDSET CHECK

Here's a tip I've been using for the past three years when servicing remote control handsets. If you have a suspect handset in a customer's house and would like to check that it's the unit and not the TV set take a radio – if you have a car radio this will do – and tune it to an MW station with no modulation. Press the buttons on the handset: if the unit is working you'll hear a whistle as you do so. If you use a car radio the handset must be near the aerial.
William G. Lockitt, Eng. Tech.,
Rhyl, Clwyd.

GRUNDIG SPARES

In the April Service Bureau column two possibilities were given for the problem of increasing sound with the Grundig 6010TD. These answers (manual control paddle-switches becoming leaky or a faulty SB2 memory module) were absolutely correct. You went on to say however that spares for these 13-14 year old sets are becoming difficult to obtain.

Well, a quick phone call to Grundig, using the number given in your TV/VCR spares guide, revealed that both the paddle-switch (part no. 29501.110.01) and the SB2 memory module (*correct* part no. 9.47041,1101) are available ex stock, as is the complete remote control receiver module (part no. 29301.012.01) for those who need the "module exchange" repair system.

Alternatively anyone requiring Grundig TV parts would be pleasantly surprised if he consulted your classified advertisement columns. Our company has had a small but regular advertisement for a number of years. We can supply *any* part for the 6010 and have a fairly comprehensive module exchange scheme for many sets from 1970 to the current chassis.

Grundig thyristor line timebase sets such as the 6010 tend to lead a healthy existence, with excellent colour, superb picture and decent sound – provided they are carefully treated for the dry-joint syndrome at intervals of about five years. They are far too good to pension off in the prime of life because of fears of scarce spares.
Les Austin, Ochre Mill Technical Services Ltd.,
Lower Moddershall, Stone, Staffs.

CRT BOOSTER CORRECTION

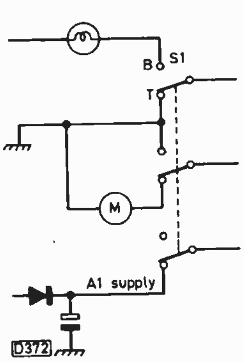


Fig. 1: Correction to the simple c.r.t. tester/booster circuit featured last month (see page 450). An extra pole on S1 switches off the first anode supply in the boost position.

Please note an error in the simple c.r.t. booster/tester circuit shown in my article last month. The 'boost/test switch S1 should be a three-pole two-way switch, the third pole removing the 90V supply to the first anodes during reactivation (see Fig. 1).
Jim Littler,
Wigan, Lancs.

HITACHI NP81CQ CHASSIS

In the April TV Fault Finding column fellow sufferer Les Grogan mentioned top cramp on these sets due to C608 going open-circuit. We've also had this fault. Another top cramp fault in this chassis and in the CPT2051 (not the E variety) also produces gross nonlinearity in the middle part of the raster. This is due to R614 (150kΩ) in the feedback network going open-circuit – a clue is given by the fact that the collector voltage of the top field output transistor is far too high. In one chassis (which one I forget) the set will be left tripping due to the guard circuit if R614 is removed to see whether this leaves the fault unchanged. Some chassis in this family use what looks like a half-watt job which usually doesn't fail: other sets use smaller resistors which do fail.
J.R. Armagh,
Portadown, Craigavon.

NORDMENDE FV/SK2 CHASSIS

I've had a couple of these sets in for repair lately. My patience was more than severely tried during the hours spent fixing them: perhaps some of the faults and symptoms may be of interest to others.

(1) Barrel distortion, i.e. bowing in from both sides. The trouble is in the EW modulator panel P. Check for open-circuits in resistor RP36 (1Ω safety type), coil LP30 or the EW modulator driver transistor TP04 (BD544B or 2N6107). The transistor *has* to be one of these two types. I tried several similar silicon pnp power transistors but they all broke down after a short period, taking the safety resistor with them. (*Editor's note:* some sets have a fuse in the RP36 position.)

(2) Dead set. This had me for a long time until eventually the second set came in and I was able to do some panel swapping. I'd originally thought that the trouble lay in the thyristor line output module U and had taken out every thyristor and tested it, all to no avail. The set just sat there dead until the horizontal line generator module Z was swapped. In went a new TDA2590 i.c. and the set sprang to life. I gritted my teeth.

(3) After a few minutes the set would lose tuning with jumping neons and hum on the field scan. Tapping hard in the bottom right-hand corner of the main PCB (track side) would restore normal operation for a few minutes. I eventually found that CA30 (2,200μF), the 36V supply reservoir capacitor, was coming adrift – the ring making contact for the negative side of the capacitor had parted from the main body.

(4) Touch tuning trouble with intermittent and jumping tuning (neons varying) was inevitably the SAS580/SAS590 pair. Correct tuning was obtained when these i.c.s were replaced.

It seems that the NordMende SK2 chassis is reliable but tricky to repair if you're not familiar with the circuitry. Both the faulty sets have now been working normally for some time, fortunately. Ploughing through has given me the confidence to work on the chassis again!
Des Walsh,
Carrigaline, Co. Cork.

Servicing the NordMende F10/F11 Chassis

Christopher Holland

Despite its prominence in several West European markets the NordMende brand name has made relatively little impact in the UK, though NordMende chassis have appeared in sets sold with other names on the cabinet – most notably the Ferguson 3787 colour portable. This lack of market impact has not been helped by the fact that different firms have acted as importers/agents at various times. In addition NordMende TV sets have traditionally been v.h.f./u.h.f. receivers, which means extra complication and cost in the UK market. NordMende is a leading brand in Ireland however and it's interesting that their colour chassis have always been at the forefront of TV receiver technology – some of the circuit techniques used in these chassis will be new to many TV technicians.

Chassis Specification

The F10/11 series chassis have been in production since 1981. They are to be found in other makes of set, notably Thomson and Saba. Hitachi have also used the F11 chassis in some of their sets for markets where v.h.f./u.h.f. receivers are required. The design brief was to produce an international chassis with a single mother board on to which colour decoder, tuner and sound decoder panels could be fitted to suit the requirements of individual countries. Remote control sets can be converted for teletext use by fitting the relevant panel. All sets have a scart socket for direct connection of composite video, RGB or audio signals.

The F10 chassis was designed for use with 90° tubes in sizes from 14 to 22in., the F11 for 110° tubes in sizes from 20 to 27in. The F11 thus requires a higher output from its power supply and an EW correction circuit. Otherwise it's essentially the same as the F10. There's a later version of the F11, the F11B: more on this later.

The notes in this article will be based on the F10 chassis, with F11 chassis differences noted in brackets as they arise. Most of the circuitry is fairly conventional, particularly the signal stages, and can be quite easily understood by referring to the appropriate circuit diagram. The only areas where these chassis vary greatly from normal practice are in the power supply and field output stages. We'll look at these in greater detail.

Power Supply Circuit

The power supply is of the step-up chopper type: the voltage level supplied to the chopper circuit by a mains transformer and bridge rectifier is raised to and stabilised at a level suitable for the line output stage which then produces other d.c. lines. Line flyback pulses provide the necessary switching. The principle of the chopper arrangement is shown in Fig. 1: the complete circuit is shown in Fig. 2.

The bridge rectifier delivers a d.c. level of 80V (F11 – 100V) to coil LP01. When the chopper transistor TP01 is switched on current flows through the transistor and this coil. Consequently energy builds up in the coil in the form of an electromagnetic field. When the chopper transistor is switched off by a flyback pulse from the line output transformer the voltage at its collector will swing positively due to the collapsing field around LP01. This positive-going pulse is rectified by DP14 which charges CP14 to produce the 109V h.t. line (F11 – 140V). As is usual with W. German sets, this is referred to as the U1 rail. Note that the h.t. obtained in this way results from a combination of the 80V (100V) d.c. supply and the switching action of TP01.

The centre-tapped secondary winding on the mains transformer supplies a bridge rectifier which provides a 24V line (F11 – 31V) to power the audio output stage. The centre-tap is used to provide an 11·5V line for start-up purposes. This feeds the emitter of TP21 via diodes DP21, DP24 and DP03, with a chassis return via RP26, RP24 and RP21. The current flowing through RP26 develops a voltage to switch TP21 on, as a result of which CP10 charges via DP12. This line starts up the TDA1950 sync/line oscillator chip via RP27. During the start-up period the collector of the line driver transistor TL01 is fed from the centre tap via DP13. Once the line output stage comes into operation a line output transformer derived 13V supply takes over from the 11·5V line, via diode DP15. RP25 is included in series with CP10 to provide a slow-start action.

When CP10 has charged sufficiently transistor TP05 will switch on, charging CP12 via RP23. The positive-going voltage developed across CP12 will eventually switch on TP06, and in turn TP02 and the chopper transistor TP01 will switch on. Positive-going line flyback pulses are fed to the base of TP04, which is thus switched on once per line scan, discharging CP12. Drive to the chopper transistor is thus provided by the sawtooth waveform generated across CP12. The charging of CP12 is controlled by TP05 whose base samples the h.t. voltage whilst its emitter is held at a constant voltage by zener diode DP20 and DP19. Regulation is thus achieved since TP01's switch-on time is determined by the conduction of TP05: TP01 is switched off by negative-going line flyback pulses which are applied to its base via diodes DP43 and DP42. Note that this power supply arrangement is very tolerant of varying mains supply voltages. The mains level is monitored via the 11V start-up tap on the mains transformer: diodes DP21, DP24, DP03 and resistor RP07 provide a d.c. bias at the base of TP04 proportional to the level of the mains

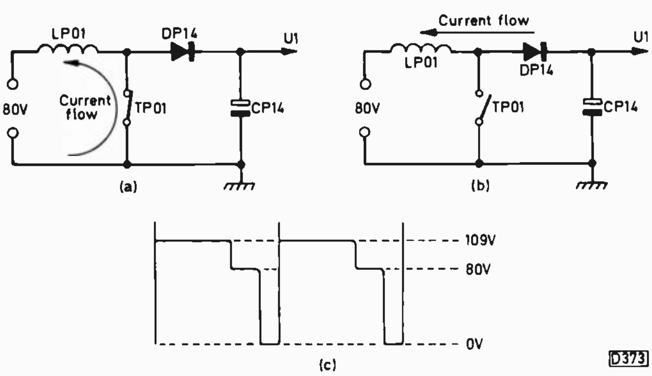


Fig. 1: Principle of the step-up power supply. (a) Chopper transistor on. (b) Chopper transistor off. (c) Waveform at the collector of TP01.

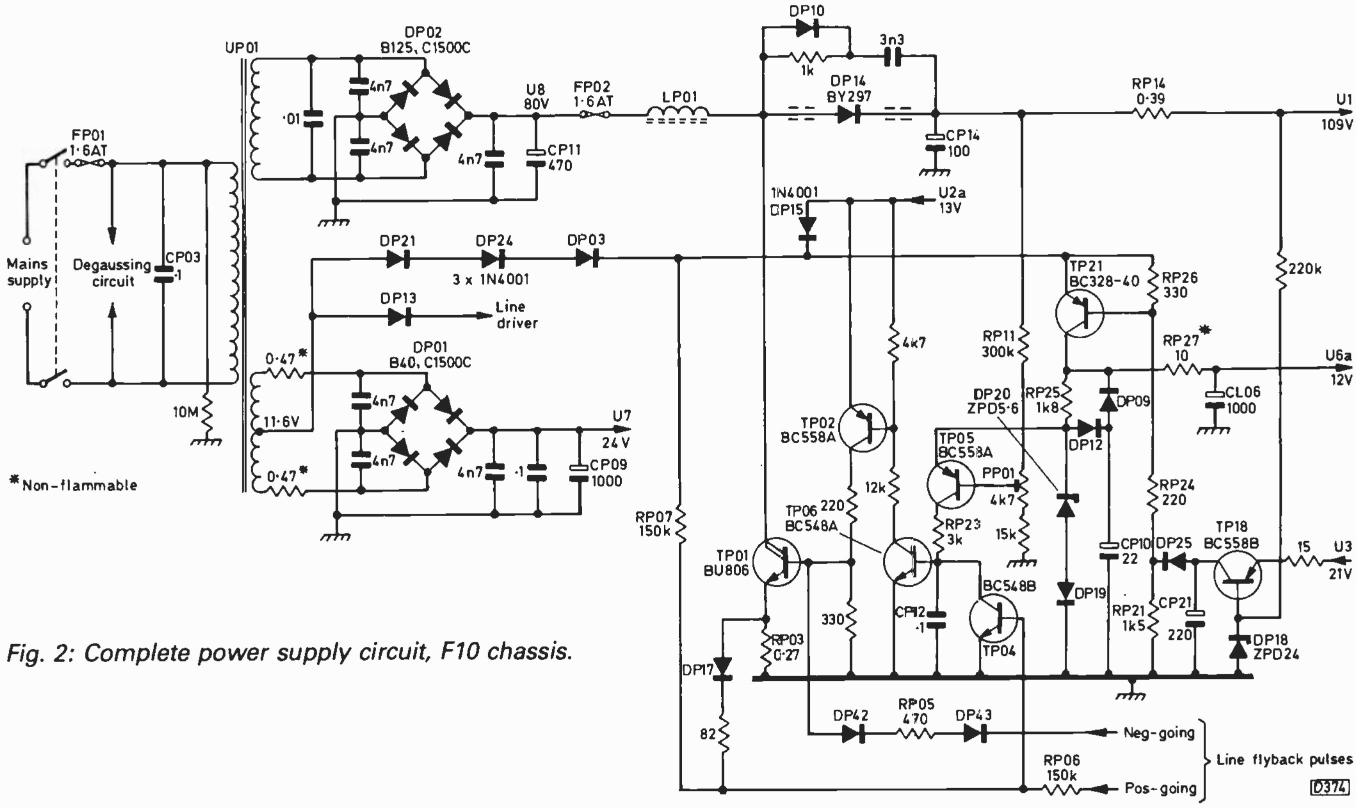


Fig. 2: Complete power supply circuit, F10 chassis.

input. The line flyback pulses thus switch TP04 on sooner or later as the mains input is varied over the range 150-260V.

There are a couple of other points to note in this power supply. First, in remote control sets TP21 is used to switch the set to the standby condition: in this condition resistor RP21 is not connected to chassis, so there's no voltage developed across RP26 and TP21 is switched off.

Secondly, transistor TP18 and zener diode DP18 provide excess voltage protection. The emitter of TP18 monitors the line output transformer derived 21V supply: should this rise above about 24V TP18 switches on and diode DP25 conducts. TP21 then switches off, removing the supply to the TDA1950 i.c. with the result that the line timebase closes down.

The Field Timebase

The field output stage uses a form of pulse-width modulation with a thyristor for the switching. It has great reserve of amplitude, which enables essentially the same circuit to be used with tubes from 14 to 27in. It also uses very little energy as the output switching is carried out at line frequency – note that no heatsinks are required.

The complete field timebase circuit is shown in Fig. 3. Field sync pulses from the TDA1950 sync/line oscillator i.c. are inverted by transistor TF02 and applied to the base of TF04. The field sawtooth waveform is produced by the charging circuit RF12/CF04: when the voltage across CF04 exceeds that at the slider of the hold control TF04/03 switch on to discharge CF04, producing the flyback. Transistors TF05 and TF09 simply act as amplifiers for the field sawtooth waveform, which appears inverted (negative-going) at the collector of TF06. Line pulses via DF06 and RF13 are added to this waveform. The result of adding these two waveforms is to produce a form of pulse-width modulation at the base of TF07 (see Fig. 4). TF07 in turn triggers thyristor DF08. When DF08 conducts, current flows via the thyristor, coil LP01, winding 4-7 on the diode-split line output transformer, the field scan coils and resistor RF21 to the U3 line. CF10 with the inductive components form a filter to integrate the pulse waveform. DF08 is switched off by the negative-going line flyback pulses applied to its anode by winding 4-7 on the line output transformer. DF09 is incorporated to ground the circuit during the field flyback. The power consumption is low since DF08 switches on for relatively short intervals of time.

Later Chassis

As mentioned earlier, the F11 110° chassis has been superseded by the F11B. The basic changes are that a different EW correction i.c. is used (a TDA4950 instead of a TDA4610) while much of the circuitry is now incorporated in a TEA2026 i.c. This device contains the line oscillator, the field timebase with the exception of the thyristor and the step-up chopper power supply circuit with the exception of the chopper transistor itself. The i.c. uses a 500kHz crystal oscillator with internal divider circuits, eliminating the need for line and field hold controls. If the chassis is fitted with a PAL/NTSC decoder panel in place of the standard PAL panel the presence of an incoming NTSC signal will be detected and the field frequency will be automatically switched to 60Hz.

In addition to the new version of the 110° chassis, the F10 is being replaced by the F12 for non-remote control 14in. sets and the F14 for remote control sets with 14-20in. tubes. Also the F15 was introduced recently, designed with the new generation of square tubes in mind. No F13 chassis you'll notice: I never realised before that the Germans are superstitious!

Servicing Aspects

As with other modern TV chassis designs the reliability of these sets is good. Stock faults are not something one can list. A few faults have occurred on several occasions however and the following notes should prove helpful.

Any line output stage problems that cause the d.c. supplies derived from the line output transformer to rise in value will result in TP18 conducting, thus switching off the line oscillator via TP21. In this condition the full U1 value of 109V (F11 – 140V) is not developed due to the absence of line pulses. As there's no load on the power supply the U8 80V supply will rise to almost 90V. Note also that if there's a power supply fault that prevents the step-up switching taking place, e.g. transistor TP01 open-circuit, the 80V present on the U1 line is enough to allow the line output stage to operate. The result is a small raster with a severe hum bar. These symptoms are a sure sign that the line timebase is operating correctly and that the fault is in the power supply.

Fault Notes

The following is a comprehensive list of the problems most likely to be encountered when working on sets fitted with these chassis.

Set dead, fuse FP02 blown: Check whether the chopper transistor TP01 is short-circuit. If it has to be replaced, check the other transistors in the power supply and resistor RP06 before switching on. A short-circuit line output transistor will also blow this fuse (the F10 chassis uses a BU208D, the F11 a standard BU208 and the F11B a BU508AV).

Set dead, fuse FP02 intact: Check for 80-90V (F11 100-110V) at the collector of the line output transistor. If absent check for broken tracks around the diode-split line output transformer – it's heavy and in early sets the PCB was not very well supported in this area. Check for 11V at the collector of the line driver transistor TL01. If there are no line pulses at pin 2 of the TDA1950 chip IL01 check the d.c. level at pin 14. This is normally 12V but 8V will enable the line oscillator to start up. The start-up voltage is obtained from the 11V tap on the mains transformer via transistor TP21. If sufficient voltage is present at pin 14 but there's no output at pin 2, change the i.c.

Set dead, remote control models: Check whether transistor TP21 is being switched off by the front remote control decoder panel. If so, suspect the 400kHz crystal first with microcomputer controlled systems.

Set pulsing on/off: Remove the field scan coil plug (connector BF01). If the set now starts up with field collapse there's no field sawtooth for modulation by the line flyback pulses so the line output stage is being loaded down. Check resistors RF12 and RF15 followed by the transistors in the field timebase. The culprit could also be thyristor DF08 loading the line output stage via winding 4-7 on the transformer.

If the set continues to pulse with the field scan coils disconnected check resistor RP11 in the power supply. If this is open-circuit the h.t. line will be too high. The supplies derived from the line output transformer will also be too high with the result that transistor TP18 will switch on. A fault of this type can be seen by monitoring the U1 line with an analogue meter: the voltage will flick between 80-130V as the set pulses on and off (F11 – 100-160V). If the power supply appears to be all right check for something in the line output stage causing TP18 to operate the trip circuit. The line output stage can be checked by disconnecting the base of the chopper transistor TP01: if the set now starts up, albeit with a reduced raster size and a hum bar, the line output stage is all right.

Line tearing with excessive h.t. ripple: Check the U8 supply reservoir capacitor CP11 – it could be dry-jointed. Also check CP12.

Field collapse: The usual field collapse symptom of a thin horizontal line across the centre of the screen is not often encountered with the type of circuit used in these chassis. If experienced check for something open-circuit between the anode of thyristor DF08 and the field scan coils via coil LP01 – this coil is a separate winding on the same former as the coil used in the switch-mode power supply and the PCB tracks to its pins should be checked.

Picture shifted upwards, with field roll: This is the most common field fault with these sets: it's caused by transistor TF09's d.c. biasing being incorrect. Check RL52 (15Ω – this is the U3 supply surge limiter resistor), RF20, RF21 and RF10, also the height preset control PF02. In earlier chassis PF02 was a 100Ω preset: it was changed to 47Ω with a fixed 47Ω resistor in series.

The transistors used in the field timebase seldom give trouble: unfortunately when they do they often appear to be good when checked with an ohmmeter, so substitution is the only effective test.

Uncontrollable field roll: Check transistor TF02 and capacitor CF01.

No raster except for a wide horizontal band near the bottom of the screen: Check whether the U4 (200V) supply surge limiter resistor RL51 (39Ω) is open-circuit.

E.H.T. but no raster: Check RL54 if the tube's heaters are out. If the tube's first anode voltage is absent or low (should be 350-400V) check the adjustment of the lower preset on the diode-split line output transformer: if adjustment is not possible the transformer will have to be replaced. Otherwise check transistor TV81 (BC557B) and resistor RV82 (10Ω) on the tube base panel. Note that a fault in any of the three RGB output stages on the tube base panel can cause the TDA3506 RGB matrixing i.c. IV02 to cut off all three guns, thus giving a blank raster.

Excessively bright raster with flyback lines and no luminance: Check for excessive first anode voltage. If this cannot be adjusted, or adjusts to the correct level then drifts again, replace the diode-split line output transformer. This fault can also be caused by failure of the TDA3506 RGB matrixing i.c. IV02: first check whether its d.c. supply resistor RV23 (10Ω) is open-circuit. In the unlikely event of IV02 failing after replacement check whether CV91 (0·001μF) on the tube base panel is short-circuit.

One primary colour weak: Check CV38, CV39 or CV40 (0·68μF) associated with the TDA3506 chip as appropriate. Could also be caused by the chip itself.

Excess of one primary colour: Check CV47, CV48 or CV49 (0·022μF) associated with the TDA3506 i.c. as appropriate.

No colour: Suspect the 4·43MHz crystal QC02 or the AN5620X colour decoder chip IC01 on the PAL decoder panel. If the positive-going line flyback pulses are missing at pin 7 of this i.c. check transistor TL41 (BC548B).

Raster but no noise spots: Suspect the combined tuner/i.f. block which produces a composite video signal at pin 23, but first check the d.c. supply to the tuner. Can also be caused by the TEA2014 video switching chip IV03 – this i.c. is used to switch off the video signals from the tuner/i.f. block and switch in the signal from the scart connector when the correct switching level is connected to pin 8 of this connector.

No tuning: Before changing the tuner block, check that the U1 supply is reaching the front panel where it feeds the 33V zener diode (the circuit reference number for this

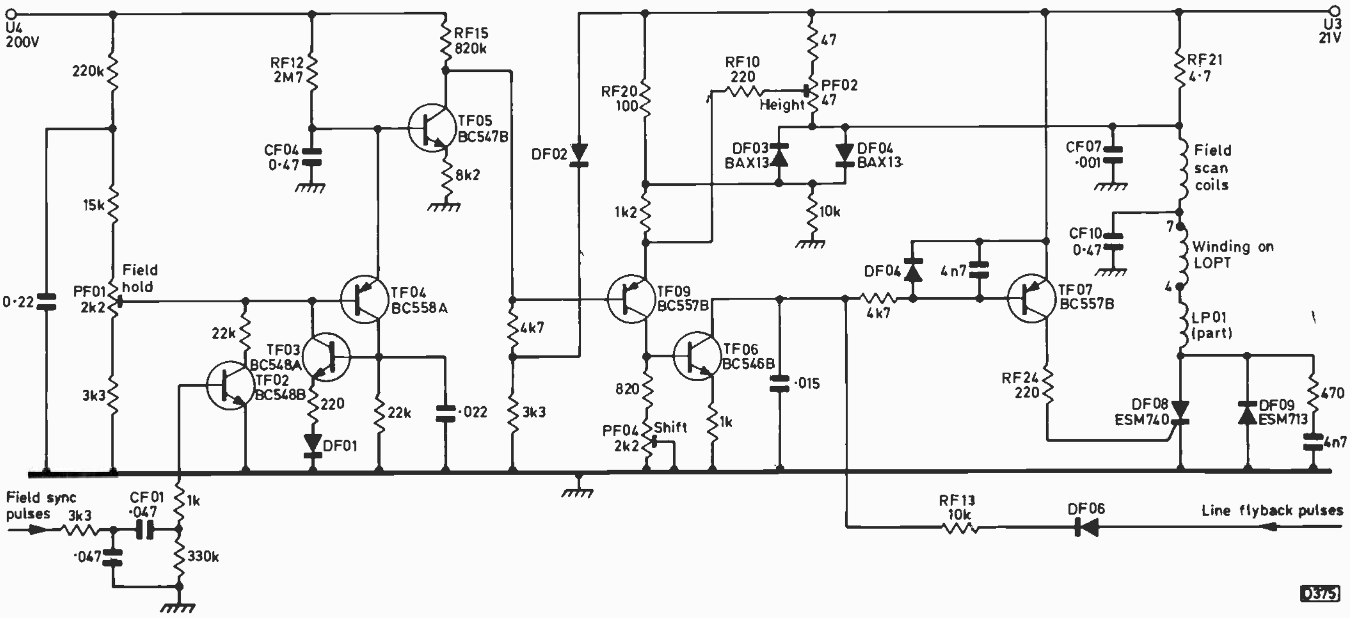


Fig. 3: Complete field timebase circuit, F10 chassis. RF12 is 3·3Ω in the F11 chassis – there are other minor variations.

diode varies with different models). If the U1 supply is not present at the front panel check RL53 (100Ω) and CP24 (0·01μF). Check the 33V zener diode itself, also the u.h.f./v.h.f. band selection circuit on the front panel. The usual culprit however is the tuner block itself. Note that it is also almost the only cause of tuning drift.

No sound: These sets all have a sound mute system which operates when no video signal is received. It compares the composite video signal with line flyback pulses within the TDA1950 chip: if the sync pulses in the video signal don't coincide with the flyback pulses pin 7 of this i.c. goes to 0V (it's normally at 11V) and the sound is muted via pin 2 of the TBA120UB intercarrier sound i.c. This muting circuit should be kept in mind when fault finding: for example, on a set with no sound and a video fault don't chase a sound fault as the muting circuit will operate due to the absence of the video signal. The muting circuit can also give clues however: for example, a set with no video but good sound means that the fault is in the latter part of the video channel, certainly after pin 6 of the TEA2014 switching chip IV03 (this is the take-off point for the video feed to the muting circuit).

Where there's no sound and the muting is not in operation, i.e. pin 7 of the TDA1950 chip is at 11V, check the TDA2006 audio output chip IS01. Note that many of these sets have been built with stereo use in mind: a second audio output chip is often fitted but not connected up – this is a convenient source of a replacement if you do not have one readily to hand.

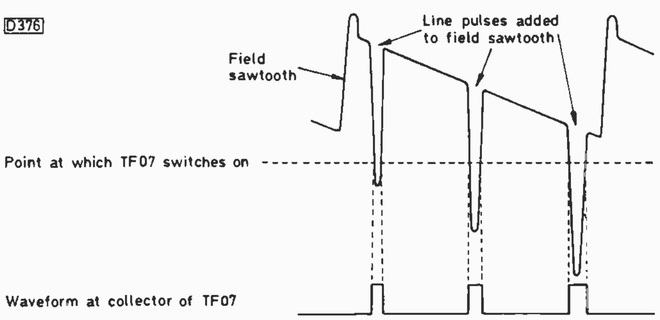


Fig. 4: Showing the way in which adding line pulses (three only shown) to a field sawtooth waveform gives pulse width modulation at the collector of TF07 so that DF08 is switched on progressively earlier as the field scan progresses.

Spares

The agents for NordMende sets in Ireland are Reynolds Electronics Ltd., Finnabair Industrial Park, Dundalk, Co. Louth (042 31 281). The UK agents are Hayden Laboratories Ltd., Hayden House, Chiltern Hill, Chalfont St. Peter, Gerrards Cross, Bucks SL9 9UG (0753 888 447).

Teletopics

AGREED UK STEREO TV STANDARD

The BBC has been carrying out tests on a digital stereo sound system of its own design since late 1983 – we last reported on the subject in this column in August 1984, after tests to confirm the system's compatibility with non-stereo receivers had been carried out. The system that's been evolved is called 728-Nicam (near instantaneous compansion) and has been agreed by the IBA. It's at present awaiting approval by the Department of Trade and Industry. Since transmitters are already installed at Crystal Palace a London area service could be started in a matter of weeks: it would take some years to convert all the BBC/IBA transmitters. It's understood that Thorn EMI Ferguson has a decoder chip set at an advanced stage of development and that incorporating stereo sound would add about £30 to the cost of a receiver.

The system uses a single carrier spaced at 6·55MHz above the vision carrier, with four-phase shift-key modulation: the transmitted data rate is 728Kbits/sec. The original analogue sound signal is sampled at a rate of 32,000 times a second, the samples being converted to 14-bit words. To get the signal into the spectrum space available 10 bits are transmitted along with a signal to indicate to the receiver the compansion that has taken place. As a result the receiver can reconstruct and decode the original 14-bit samples. One advantage of the system is its compatibility with the MAC standard proposed for satellite TV transmissions.

DBS PROGRESS

The IBA has now advertised for contractors to provide three new TV services by satellite transmission, to be receivable throughout the UK. Applicants have been invited to submit proposals by August 29th with a view to the IBA selecting and appointing contractors by the end of the year with services coming into operation by 1990. Applicants have been invited to apply for a contract to provide all three services – with a variety of programming between the three channels – to be financed either by advertising, by subscription or a combination of the two. Those proposing to provide fewer than three services are asked to indicate what forms of co-operation they would plan with other contractors. Applications have also been invited for contracts to provide teletext DBS services, both from those applying for the programme contracts and others. The government intends to introduce legislation so that the contracts would last for up to fifteen years, under the terms of the Cable and Broadcasting Act 1984.

Meanwhile the election of a new government in France has called into question the Maxwell group's plans (see last month) to provide programmes on two of the French TDF-1 satellite's channels. Mr. Maxwell maintains that he has a binding contract but the new government has indicated that it plans to cancel this, with six months' notice, and open the allocation of TDF-1's DBS channels to competitive tendering.

INTERNATIONAL TRADE

The effects of the rise in the value of the yen, mentioned in our leader last month, are already showing through. Matsushita has reported the first fall in sales and profits for eleven years, during the first quarter of its financial year which ended on February 20th. Consolidated profit fell by 19·3 per cent and sales by 8·7 per cent. Domestic sales fell by only 1·1 per cent while overseas sales recorded a decline of 16 per cent – sales of video/TV equipment fell by 17·2 per cent. Reduced colour receiver exports to China and a sluggish demand for components were given as contributory factors. Matsushita proposes to increase overseas selling prices and transfer some production to other south east Asian countries.

Sanyo is increasing the prices of its VHS VCRs in the UK by between £30 and £50 depending on model and predicts that other Japanese manufacturers will be doing the same.

The Thomson group is to cut its workforce in European colour receiver plants by between 20 and 25 per cent – about 1,000 jobs in W. German plants will go, 550 jobs in France and 300 in Spain. Last year Thomson's consumer electronics group made a loss of £30 million on sales of some £2·1 billion. The overall proposal is to cut the workforce from 8,500 to around 7,000. Thomson, whose brands include NordMende, Saba and Telefunken, is one of Europe's two largest CTV manufacturers: colour TV accounts for roughly fifty per cent of Thomson's estimated annual consumer electronics output. Europe's other major consumer electronics manufacturer, Philips, plans to close a number of TV manufacturing plants.

Matsushita has announced the development of a 1Mbit video DRAM. Mass production is expected to start by the end of the year. Two such chips are required to store a TV field.

THORN-JVC DEAL

An agreement has been reached between Thorn EMI Ferguson and JVC for the manufacture at Ferguson plants of colour receivers to meet JVC's requirements in the UK and continental European markets. Under the terms of the agreement a range of products incorporating JVC's newly developed BX chassis will be manufactured by Ferguson with technical and production support from JVC: the new manufacturing operation will be managed by Ferguson and will require substantial additional equipment and dedicated production facilities. A new production line to be installed at Gosport will be able to produce over 200,000 sets a year. Enfield will supply PCBs and High Wycombe cabinet mouldings.

ORION's UK PLANT

The Orion Electric Corporation of Japan is to set up a VCR/TV manufacturing plant at Kenfig Hill, South Wales – the 50,000 square feet factory was previously used by computer manufacturer Dragon Data. The first phase of the operation will be the installation of a production line for VHS VCRs: production is expected to be running at a rate of 10,000 machines a month by the end of the year. A CTV line will probably be added next year to produce sets for sale in the UK and continental Europe. Assistance tied to the number of jobs created will be provided by the Welsh Development Agency. Orion products will continue to be distributed in the UK by L and M Raymond of Watford. Sales are mainly to major retailers – Orion VCRs are sold by Dixons under their Saisho brand name.

TV SYSTEMS TESTED

With the co-operation of Swindon Cable Ltd. IBA engineers recently demonstrated for the first time successful distribution of full-capacity MAC TV signals via a modern, operational cable system. Full-resolution MAC-encoded vision with digital sound at a data rate of 20·25Mbits/sec were inserted at the head end of Swindon Cable's multichannel system, using the EBU's "cut and rotate" scrambling system. A receiver connected to an existing domestic socket outlet produced pictures without any significant degradation.

A demonstration of the MUSE system has been carried out by RAI and NHK at Turin. The Japanese MUSE (multiple subnyquist sample encoding) system has been developed to enable high-definition TV signals to be transmitted using standard satellite TV channel bandwidths. Reception of MUSE-encoded signals via a noisy satellite transmission path is said to have produced pictures virtually identical to the original HDTV ones.

NEW FILM CABLE CHANNEL

British Telecom is to offer cable operators a new film channel, with material sourced from MGM/UA, Paramount and Universal initially. It will compete with Robert Maxwell's Premiere channel, with which MirrorVision was recently amalgamated. Distribution of the new channel to cable operators will be via cassette rather than satellite transmission.

VCR SERVICING VIDEOCASSETTES

Flintdown Ltd. (Mountauban Chambers, 339 Clifton Drive South, Lytham St. Annes FY8 1LP) has produced a series of seven cassettes on servicing domestic VCRs. The series consists of (1) an overview of VCR systems, (2) servo control systems, (3) colour recording systems, (4) frequency modulation, (5) VHS, Betamax, V2000 and Video 8, (6) component video and (7) VCR faults. Each cassette is available in any standard format and costs £35 plus VAT – a discount of 10 per cent is given on a complete set of seven cassettes.

VIDEO EQUIPMENT

JVC has launched a midi-sized hi-fi VCR, Model HRD470, which is expected to retail at around £600. The tape deck has been rotated through 180° to give front-loading of the cassette end first.

Kodak is test marketing some electronic still picture systems in the USA. A disc recorder-player enables 50 TV fields from a TV set or other video source to be recorded on a standard 2in. floppy disc. Recording is triggered by remote control. A companion printer produces prints of any recorded field on instant colour film. There's also a film to disc transfer service which enables 35mm colour film negatives to be recorded on disc for playback via the recorder-player.

Grundig has introduced a combined colour receiver/VCR unit, Model TVR5000, which is expected to sell at around £950. The VCR incorporated is the new VS300 which features auto tape time select, electronic locking and can record two programmes up to a year ahead.

AMSTRAD TAKES OVER SINCLAIR'S COMPUTER INTERESTS

Amstrad has bought the world-wide rights to Sinclair Research's current computer interests. Sinclair is now a research organisation without marketing operations. A computer under development by Sinclair will be offered to Amstrad at a later date.

Amstrad is to continue production of the Spectrum computer in the UK for the present. Sales of the QL will continue while stocks last but this machine will probably be phased out. Interesting that Amstrad decided not to take on Sinclair's pocket monochrome TV set. Amstrad paid £5 million for the right to use the Sinclair brand name and current stocks.

TV/VCR SPARES GUIDE

Some corrections and an addition to the spares guide published with our April issue. Spares for recent NEC products are available from NEC Business Systems (Europe) Ltd., NEC House, 164-166 Drummond Street, London NW1 3HP or from SEME Ltd., Unit 2E, Saxby Road Industrial Estate, Melton Mowbray, Leics. Models include CTVs 12T311, 20T772, 20T773, 14T412, 14T1406, CT1404, FS1901, FS1902, CT1416 and FS1502 and VCRs PVC744E and PVC746E (Beta) and N830EK, N831EK, N833EK, N9013 and N9014 (VHS). Spares for earlier NEC models distributed in the UK by Cap Ten are available from Tech Semco.

The address we gave for Tensai was the last known one. It appears that this company is no longer represented in the UK. Don't use the phone number we gave – it's been transferred to a domestic user.

Spares for three Gold Star monochrome portables, Models VW300, VR317 and VR700, are available from Uni-Com Electronics, Station Road, Edenbridge, Kent TN8 6EW (0732 865 238).

CPC of Preston was mentioned in the Letters column last month as a supplier of spares for Sinclair microcomputers. The full address is CPC Electronic Component Distributors, 194-200 North Road, Preston, Lancs (0772 555 034). CPC are also official spares stockists for Fidelity, Ferguson, Philips, Pye and Sony.

TVRO EQUIPMENT

Megasat's new top-of-the-range satellite TV receiving system is said to be the only totally automatic remote-controlled system on the market with a computer-generated "menu" of programmes presented on the screen for user selection. Any programme can be selected by remote control without the user leaving his chair. The remote control system includes the motorised dish and automatic polarisation. Price is £2,645 including VAT (plus installation). The Megasat system is available from Harrods, Wallace Heaton and Lasky's Tottenham Court Road and Brent Cross stores.

NEC's NESAT satellite TV receiver system is now available with an automatic aerial tracking system. The actuator motor is linked by cable to a microprocessor controlled tracker unit which can be located anywhere in the vicinity of the TV set. An LED display shows the dish position.

Sat-Tel has developed a battery-operated satellite TV signal meter to simplify dish installation. The meter, called the Skyhound, plugs directly into the LNC's output and in addition to the meter display has a variable audio pitch indicator.

A new transistor from Mullard, type BFG195, has a transition frequency of typically 7·5GHz and a unilateral power gain of 12dB at 2GHz. It can handle a power dissipation of 0·5W and is said to have the highest presently available power handling capability for this category of transistor. The four-lead, dual-emitter transistor is intended for applications in high-gain wideband systems up to 2GHz, e.g. in the first i.f. section of a satellite TV receiver.

The Development of Colour Tubes

Part 1 **Eugene Trundle**

The picture tube is the very heart of a colour set or monitor, its characteristics dictating not only the shape and size of the set but the design of every other section of the receiver apart from the tuner, the i.f. amplifier and the control system. Even the sound system is related to the tube in that the loudspeaker usually has to be accommodated alongside and its shape, size and magnetic field must conform, while the audio amplifier is (or should be) tailored to the type of loudspeaker in use.

The Early Days

Colour picture tubes have been with us since late 1949, when Dr. Harold B. Law made the first shadowmask tube at the RCA company's Princeton, New Jersey laboratories. The picture was small, about 11cm in diameter, and the resolution and convergence performance were very poor by today's standards. Most of the ingredients of subsequent tube technology were there however: three guns, one for each primary colour; a tri-colour phosphor screen; and above all the shadowmask. In one form or another the shadowmask has been present behind our screens ever since.

The original RCA design was based on an idea by A. C. Schroeder, patented by him, for a delta-gun/mask/triad-phosphor-dot screen configuration. A much earlier patent for a colour display tube, filed in Germany by Werner Flechsig in 1938, proposed the shadowmask in an aperture-grille form: this uncannily anticipated the Trinitron tube introduced by Sony of Japan some thirty years later.

The first delta-gun tubes had an internal phosphor-dot screen which was flat, as was the shadowmask mounted some 1·2cm behind it: the curved glass faceplate acted merely as a clear window. It wasn't until 1954 that tubes with the phosphors deposited on the rear of the curved faceplate went into production. These had a deflection angle of 70°, a circular 21in. (53cm) screen, a huge 51mm diameter neck and a metal cone. An all-glass version went into production three years later.

Tube Evolution

Gradual improvements in the phosphors, mask and faceplate light transmission characteristics were introduced before the next big step in 1964, the 90° deflection tube with a rectangular 25in. (63cm) screen. This was followed shortly after by a 19in. (49cm) version. The popular 22in. (56cm) 90° tube came in 1967.

1968 was a significant year. In April the Sony Trinitron tube was released, initially in a 33cm (13in.) rectangular format with 90° deflection. With its in-line gun assembly and striped phosphor screen it was the precursor of all the current tube designs: a grille with slots from top to bottom performed the same function as the shadowmask. The rest of the world followed: RCA's PIL (precision in-line) tube with its slotted shadowmask and striped screen was introduced in 1972 and was followed over the next few years by many variants. The great advantage of the PIL tube was the elimination of the need for the convergence circuitry required with delta-gun tubes.

The first 110° shadowmask tube was introduced in 1969 – especially for Europe, as the US market wasn't at that time into wide-angle colour tubes. It was a delta-gun tube with a thick neck (36·5mm). 110° tubes with 29mm neck diameters appeared as early as 1970. The seventies saw a succession of developments: saddle-toroidal yokes in 1973; internal magnetic shields, quick-heat cathodes and the Philips 20AX tube in 1974; "soft flash" in 1977; the Philips 30AX system with no need for setmaker or service technician adjustments in 1978, along with pincushion-distortion free (pin-free) tubes from Japan. In 1979 the mini-neck tube (22·5mm diameter) came from Japan and in 1982 Toshiba introduced the FST (flat square tube) screen. To bring us up to date, the Philips 45AX tube was introduced in 1984 and in 1985 Sanyo demonstrated small, prototype beam-indexing tubes – this type of tube has a single gun with switched RGB inputs and no shadowmask (the idea is not new but its realisation has always proved difficult, mainly because of the problem of switching the video signals at the high frequency required).

The Delta-gun Tube

Since we're going to describe the components and techniques used in colour tubes in some depth it's important that their basic operation and principles are understood. Although delta-gun tubes are now obsolete as far as domestic TV sets are concerned they are still in production for use in monitors and advanced computer displays since they are capable of giving very high definition displays when fitted with a fine-pitch shadowmask. Let's start then with a brief rundown on delta-gun tubes.

The virtue of all types of direct-viewing colour displays (as opposed to multi-tube projection systems) is that the tube used simultaneously produces on its screen light in the three primary colours red, green and blue. This implies the presence on the screen of three different phosphors, and the trick is to ensure that the electron beam from each gun strikes only the appropriate phosphor material. Hence the shadowmask which, for each beam, casts a shadow over the phosphors the beam shouldn't reach. The delta-gun tube has three electron guns arranged in equilateral triangular formation in the tube's neck – see Fig. 1. The guns are each tilted towards the tube's major axis so that their electron beams converge at the shadowmask. Because the beams come from three different "aiming points" their approach angles differ: this is the key to the operation of the mask (see Fig. 2). The beams cross over at the shadowmask and diverge beyond it, each to strike its correct phosphor dot.

Colour Purity

So far as the mask and screen are concerned the origin of the beams is not the delta-gun assembly itself but a point in space in the tube neck, at the centre of the deflection yoke, called the deflection centre. By fitting a lamp at the apparent source of each beam in turn the positions of all the phosphor dots for each colour can be

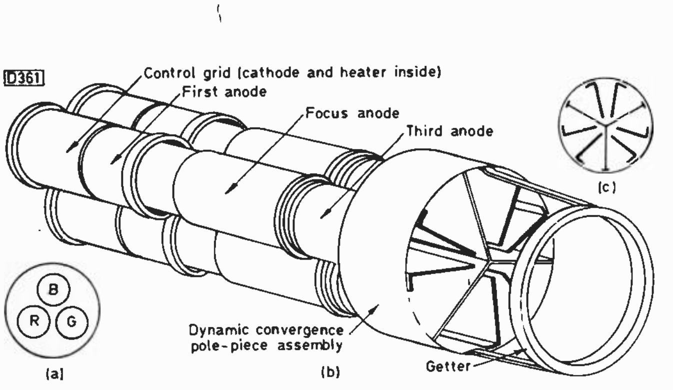


Fig. 1: The thick-neck, delta-gun arrangement. (a) Positions of the three guns in the tube neck. (b) Configuration of the gun electrodes and convergence pole-pieces. (c) Axial view of the pole-pieces mounted at the end of the guns: the pole-pieces guide the magnetic fields from the adjacent radial convergence coils.

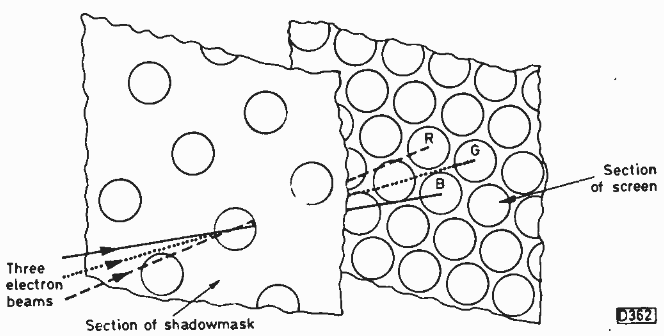


Fig. 2: Trajectories of the beams in a delta-gun tube. In practice each beam is larger than one shadowmask hole.

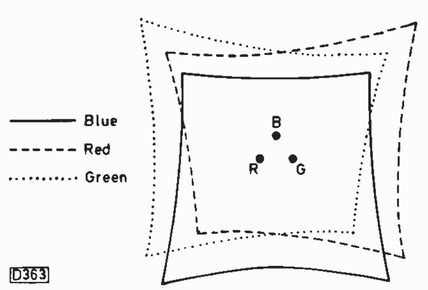


Fig. 3: The inherent raster geometry errors with a delta-gun tube.

fixed photographically with reference to the perforated shadowmask. This is done during manufacture and ensures that provided each beam is correctly aligned at the deflection centre perfect colour purity will be produced in operation, with no overshooting of the electron beams on to phosphor dots of the wrong colour at any point on the screen. Purity setting is easy to adjust: we manipulate a pair of ring magnets to align the beam trajectories through the deflection centre, then adjust the position of the deflection centre itself by sliding the deflection yoke along the tube's axis.

Convergence

The problem with the delta-gun picture tube configuration is its inherent registration errors. The three rasters, red, green and blue, are traced out by separate electron beams coming through the deflection centre at three different angles – each is subject to different aberrations in the scanning process. This results in the complex raster geometry errors shown in Fig. 3. Each colour raster has a different combination of trapezium and pincushion distortion. To pull these odd and divergent rasters into registration, i.e. to overlay them, calls for individual and close control over the positioning of all three beams as they enter the deflection field. A static magnetic field will suffice to pin together the raster centre points (static convergence) but to make the edges of the three individual rasters register each beam must be subjected to a continuously varying magnetic field (dynamic convergence). A parabolic correction waveform is required to iron out the pincushion distortion while a sawtooth correction waveform will cancel trapezium distortion. Hence the "tilted sawtooth" current waveforms in the radial dynamic convergence correction yoke. These are required at both line and field rate, and must be adjustable in amplitude and tilt – and in shape in the case of the blue horizontal correction waveform for 90° tubes and for most functions with 110° tubes.

The difficulties, the compromises necessary, the expense of providing the convergence hardware, the skill needed in aligning the many presets, the power loss in the entire convergence network and its vulnerability to drift prompted the tubemakers to investigate different arrangements for the picture tube. The goal was to produce a tube that has an inherent self-converging characteristic. So long as there are three beams travelling along the tube on different paths this is very difficult! The solution adopted was to mount the guns in line so that the three beams travel abreast and to build correction into the tube and its yoke, something that calls for a very high degree of manufacturing accuracy. Before we come to the self-converging PIL tube however we should look at the first in-line tube to be mass produced, the Sony Trinitron.

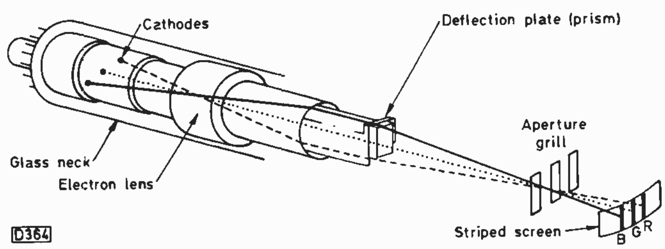


Fig. 4: Principle of the Trinitron tube.

The Trinitron Tube

The principles of the Trinitron tube are shown in Fig. 4. The tube has several advantages over the delta-gun type of tube. These spring from its use of a single in-line electron gun assembly and an aperture-grill form of shadowmask. The electron gun has three separate cathodes arranged side-by-side: all the other electrodes are common to the three beams. This facilitates the use of a single, large-diameter electron lens (see later) in the centre of which the beams cross over, making for minimum aberration and a reduction of the scanning spot size (in comparison with the delta-gun tube) of about 25 per cent. The two diverging outer beams are redirected by an electronic prism (a set of electrostatic deflection plates) so that they converge and cross over at the aperture grille.

The aperture-grille shadowmask consists of a metal sheet with a large number of evenly-spaced vertical slits to provide shadowing for groups of three (RGB) phosphor stripes. This form of construction has little stiffness in the vertical direction and has thus to be kept under considerable tension to prevent sag or buckle. One consequence is that a parabolic faceplate contour cannot be used – Trinitron faceplates have a cylindrical contour with the vertical profile straight. The transparency of the aperture grille was about 33 per cent greater than that of the shadowmasks used in contemporary delta-gun tubes, giving a brighter image for a given beam current. This and the 25 per cent smaller spot diameter gave the Trinitron tube a considerable advantage, which was widely acclaimed.

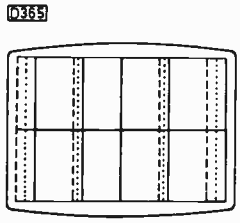
Having the three beams in the same horizontal plane brings two benefits: first the purity is virtually unaffected by horizontal magnetic fields such as the Earth's; secondly the need for vertical convergence correction disappears because the deflected beam trajectories remain in a single horizontal plane. The fact that the three beams are very close together on their journey through the deflection field also minimises horizontal misregistration of the three rasters. Total errors are reduced to those shown in Fig. 5. The standing voltage on the prism electrodes is adjusted to achieve correct static convergence on the vertical centre line, leaving a relatively simple dynamic convergence correction problem which can be solved by applying a parabolic waveform to the prism electrodes, see Fig. 6. Minor trimming is carried out by tilting the deflection yoke and adjusting the line-rate (and, in large-screen versions, field-rate) sawtooth current in a single four-pole convergence coil associated with the deflection yoke. These are purely trimming adjustments to take up tube and yoke manufacturing tolerances, not correction for inherent geometrical errors as in delta-gun tubes.

The PIL Tube

The Trinitron design showed the advantages of the in-line gun configuration. It was not long before the PIL tube came along. The main differences between the two tubes are as follows: in the PIL tube there are staggered crossties in the mask assembly (see Fig. 7) to provide sufficient mechanical rigidity to enable a conventional parabolically curved faceplate to be used, and the elimination of all need for dynamic convergence correction. This is achieved by a very special deflection yoke design in which the density of the magnetic flux in the tube's neck is not homogeneous, as in a monochrome or delta-gun tube, but astigmatic.

The degree of deflection applied to an electron beam is proportional to the deflection field's magnetic flux density. To scan a picture tube horizontally and vertically both deflection field strengths change continuously according to a sawtooth law, but at any given instant the total flux density present is proportional to the distance from screen centre to the point at which the beams strike the screen. If the magnetic field required is carefully distributed in the tube's neck it's possible to achieve good convergence all over the screen area. Fig. 8 shows the effect of a uniform deflection field in a tube cross-section: the three beams converge at the screen centre and since each is affected equally by the deflection field they will converge at a point along a circular line (the image field) whose radius is the deflection centre to screen centre spacing. Beyond this crossover point the beams will diverge, striking the relatively flat tube screen at points a, b and c.

The operating principle of the PIL tube depends on a special deflection yoke design which produces magnetic flux lines distributed in the tube's neck in the manner shown in Fig. 9, which is again a tube cross-section drawn looking from above the tube to show horizontal deflection. In this astigmatic field the deflection force acting on



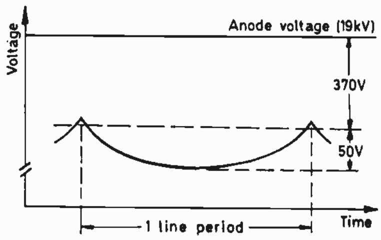
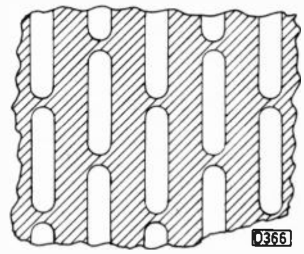
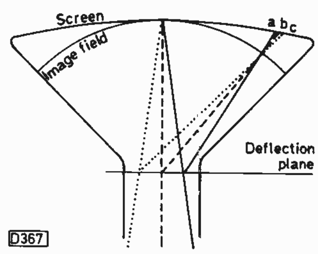


Fig. 5 (left): The Trinitron tube's basic convergence errors. The absence of crossover with the R and B verticals is due to the use of an astigmatic vertical deflection field.

Fig. 6 (right): Voltage and waveform applied to the prism electrodes to correct the misregistration shown in Fig. 5.

Fig. 7: Configuration of the slots in a PIL shadowmask.





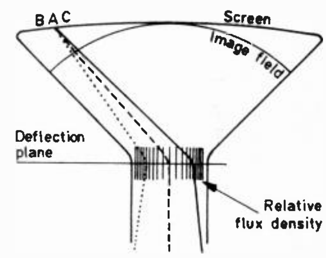
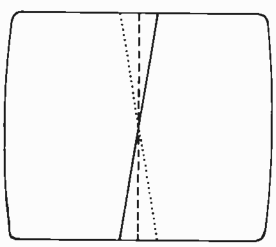


Fig. 8 (left): An in-line gun array projecting three beams through a homogeneous deflection field.

Fig. 9 (right): With careful distribution of the deflection field flux density, convergence is automatically achieved over the entire screen area.



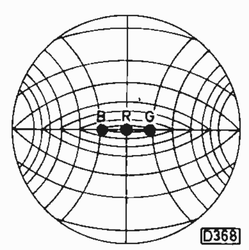


Fig. 10 (left): Errors arising from vertical deflection of in-line beams by a homogeneous magnetic field.

Fig. 11 (right): Opposing astigmatic line and field deflection fields in a fully self-converging yoke/tube system.

a given beam depends on the path taken by the beam through the deflection field. The centre beam, taking this first, passes through the relatively weak field in the middle of the deflection centre and is deflected to point A on the screen. The right-hand beam will start to turn left as it enters the deflection field. It then passes into an area of reduced flux. As a result the deflection force acting on it is reduced and it turns through a lesser angle than the centre beam. If the flux density in the deflection field is tailored to be just right the beam will converge with the centre beam at point A instead of crossing the centre beam's path to strike the screen at some point B. As the left-hand beam starts to turn left it encounters an increasingly strong magnetic field. This bends it farther to the left with the result that it's aimed precisely at point A on the screen

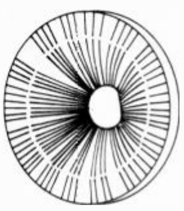


Fig. 12 (left): Earliest form of toroidal deflection yoke for a PIL tube.

Fig. 13 (right): Saddle-wound yoke for a 110° 20AX self-converging tube, showing the horizontal deflection coils.

– if it passed through a homogeneous field it would strike the screen at some point C. The same principle applies when the three beams are deflected to the right instead of to the left.

Now for vertical deflection. As the beams are deflected upwards or downwards from screen centre the yoke-to-screen beam path becomes progressively longer, which would lead to horizontal displacement of the three images due to crossover of the beams before they reach the screen, see Fig. 10. To counter this the horizontal lines of magnetic flux, which produce the vertical deflection, are given an increasing vertical component away from the tube's axis – the field is increasingly barrel shaped.

The horizontal and vertical field patterns required are shown in Fig. 11. These astigmatic fields are achieved by the deflection yoke's winding pattern: the configuration of the toroidally-wound yoke is shown in Fig. 12. The effective field pattern (and hence dynamic convergence trimming) can be adjusted by tilting the front (screen) end of the deflection yoke to achieve optimum registration of the three rasters. In the original PIL tube design this was carried out at the tube factory, using a yamming jig (YAM = Yoke Alignment Machine), after which the yoke was wedged and sealed to the tube with a thermosetting adhesive. The tube and yoke thus became effectively a single assembly and replacement tubes came with sealed on yokes. In subsequent designs the yoke and tube were treated as separate components, with alignment left to the setmaker or TV technician.

Purity (initial alignment of all three beam paths) and static convergence (individual control of the effective point of origin of the two outer beams) is provided by a combination of two-, four- and six-pole magnets mounted on the tube's neck behind the deflection yoke. These were sealed in the original type of PIL tube but can be adjusted in later in-line tube designs.

To summarise, the PIL type tube trades the complications of delta-gun tube convergence for very tight manufacturing tolerances in both the tube and yoke design. We'll return to both of these later, but before doing so we must examine the approach taken by Philips/Mullard in their 20AX in-line tube design.

20AX System

This was the first European successor to the delta-gun tube. It has three separate guns mounted in-line in a thick tube neck (36·5mm diameter). The deflection angle is 110° (the deflection angle with the original, smaller screen size PIL tubes was 90°: the later larger screen tubes have 110° deflection). With the 20AX tube the manufacturing tolerances are sufficiently tight not to require any tilting of the yoke assembly. Instead, manufacturing tolerances are taken up by introducing adjustable sawtooth currents at line and field rate in a four-pole convergence correction coil built on to the deflection yoke and by differential adjustment of the sawtooth scanning currents flowing in the separate halves of each deflection coil pair. These current controls are provided by half a dozen preset potentiometers or links. Static convergence and purity are catered for by a cluster of two-, four- and six-pole ring magnets of similar design and working on the same principles as those used with the PIL tube.

The 30AX Design

All the adjustments required with the 20AX tube were eliminated when the next Philips design, the 30AX, came along some four years later. This is similar in principle to its predecessor but with such close yoke design tolerances that dynamic convergence trimming adjustments are no longer necessary. The cluster of ring magnets on the tube neck was replaced by a special magnetic ring mounted inside the tube, on the top of the triple-gun assembly. This has a combination of two-, four- and six-pole fields printed into it during manufacture, using a computer-controlled external magnetising jig. These fields are "customised" for each tube, which is thus brought to design centre tolerance in respect to picture geometry, purity and static convergence: the magnetic characteristics of the ring do not drift during the tube's life. With the 30AX system any tube will work with any yoke (for a given tube size) without need for setting-up adjustment – the yoke is precision located by three bosses moulded into the tube's glass flare.

20AX and 30AX tubes use saddle-wound yokes with the distribution of the wires controlled by the precision mandrel on which they are wound. Fig. 13 shows the winding pattern for the 20AX tube: it's the "bunching" of the individual wires that provides the astigmatic deflection field required.

FS Tubes

The next significant change in tube design came in 1982 with the FST glass envelope. This was pioneered by Toshiba of Japan and involved increasing the radius of the faceplate to make it flatter while squaring off the corners in order to approach the rectangular shape of the transmitted picture more closely. The reduced bracing effect of the flatter faceplate necessitated an increase of around 30 per cent in the thickness of the front glass and a corresponding increase in tube weight. Benefits of the new design include reduced reflections from the tube screen, a greater angle of legibility and less pattern distortion in the picture. The characteristics of the FS tube were described in an article in the June 1985 issue of *Television*.

The 45AX

The latest example of an FS type tube is the Philips/Mullard 45AX design, in which the triple-gun assembly and thick neck have finally been abandoned in favour of single-gun, narrow-neck technology.

This article has briefly set the scene in outlining the main developments in colour tube technology over the years. Next month we will start to look in greater detail at the individual components that go to make up a picture tube and its deflection system. This will give greater insight into design philosophy and the continuing quest for better performance with lower power consumption.

Servicing Teletext Decoders

Part 5: Fault Finding

Mike Phelan

In this concluding article in the present series we'll examine methods of tackling faults that affect teletext reception. By now many readers will be well versed in servicing digital circuitry since this is becoming more and more common in consumer electronics equipment. An in-depth knowledge of this is not essential for teletext servicing however. There are two main reasons for this. First the use of LSI chips means that we cannot go down to gate-level fault-finding: most decoder faults are caused by failure of one of the LSI or memory chips. Secondly there's the advantage that since teletext is basically a display function the screen usually tells us what's happening. Thus many faults can be diagnosed without even removing the set's back cover.

It must be said at the outset that many of the faults that affect teletext reception are not caused by a decoder malfunction. Ignoring for the moment faults with the power supplies, earths etc. we should emphasise that the digital signal obtained from the vision detector must be of good quality with few errors: thus everything from the transmitter to this point must be working reasonably well.

Faults in the early stages of the set show up as text display errors, such as wrong characters or graphic blocks, possibly not on all channels and possibly very intermittent. Incorrect characters can be caused by a decoder fault but in his case the errors repeat themselves, i.e. either the fault occurs at the same screen position, the same character or group of characters are wrongly displayed or maybe rows or columns are repeated. More on this later.

Starting at the front, the aerial must provide a ghost-free signal. It's difficult laying down any hard and fast rules here: various things affect reception and the type of set is also relevant. It's true to say however that signal strength is not the most important thing: excessive patterning due to beats with other transmissions, i.e. cross-modulation, and ghosts – especially those close to the original signal – can wreak havoc with teletext reception.

The tuner and i.f. strip must have good h.f. performance. In general this means that if we were to look at the reproduction of a perfect staircase signal, using a perfect oscilloscope, there would be slight overshoot on each step but it would be possible to tune the vision detector to obtain square corners. Every stage from the aerial socket to the vision detector has a bearing on this. To return to teletext versions of the Philips G11 chassis, which we took as our basic example of a teletext receiver, in these the i.f. panels (incorporating the tuner) were selected for teletext performance and so labelled. This doesn't mean that an i.f. strip not so labelled won't work – it probably hasn't been tested for text performance.

G11 Teletext Conversion

We'll digress here for a moment to mention, for the benefit of anyone wishing to make up a teletext G11, that the other differences lie in the colour decoder, the text power supplies and the additional remote control circuitry. The colour decoder has the RGB interfacing panel described in Part 1 added – this can be done on a non-teletext panel by removing the links to the bases of the RGB output transistors.

Power Supply Arrangements

In early models with ultrasonic remote control there's a separate power supply panel that lives in the bottom of

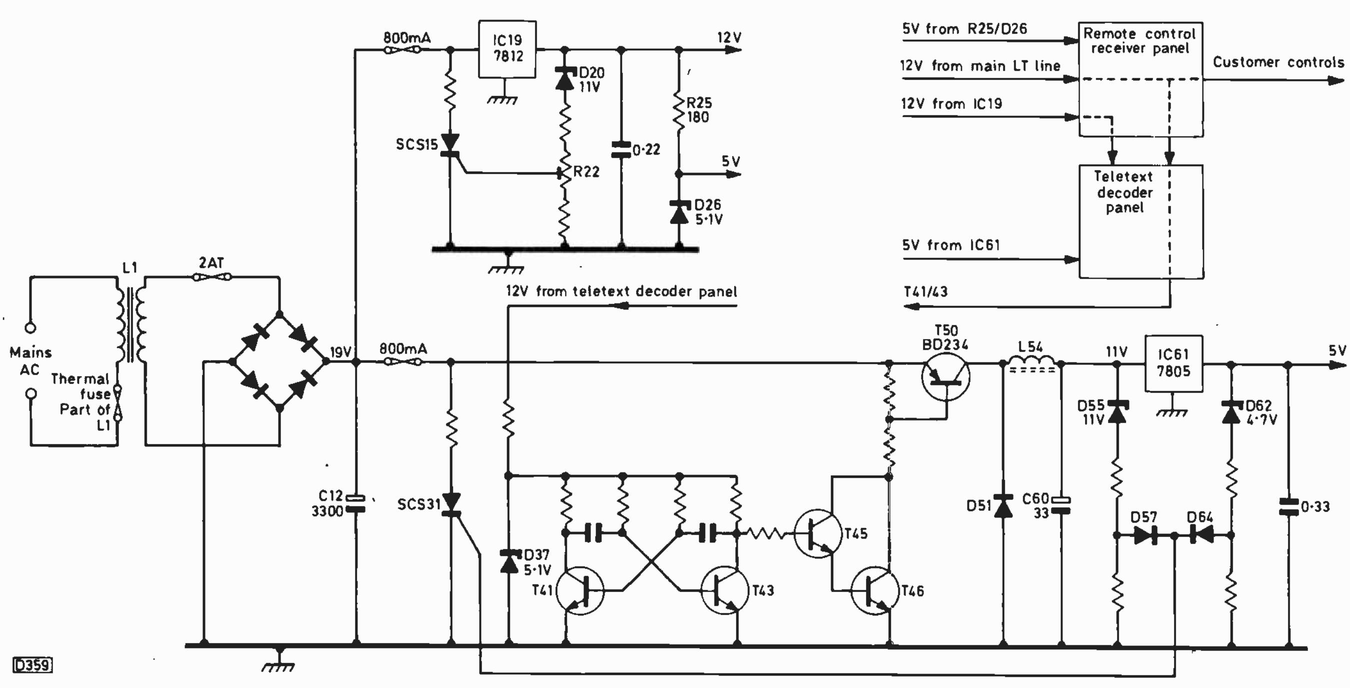


Fig. 1: The teletext decoder/remote control power supply arrangement used in early teletext versions of the Philips G11 chassis. The circuit is shown in basic outline only.

the cabinet – a simplified circuit is shown in Fig. 1. The mains transformer feeds a bridge rectifier which produces 19V across C12. IC19 provides a regulated 12V supply from the 19V supply: this voltage is used to power the remote control receiver and is also passed to the VIP chip in the decoder. R25 drops this supply to 5V for the M911 remote control decoder chip. The 19V supply is also fed to the emitter of the chopper transistor T50. This is part of a series chopper circuit with L54 the reservoir inductor and D51 the "efficiency diode". The 11V output developed by the chopper is applied to the 5V regulator IC61 whose output powers the rest of the teletext decoder. At least it does once the line timebase has started up. The delay is necessary to allow C12 to become fully charged before the chopper starts. Note that the supply for the 18kHz astable multivibrator T41/43 comes from the set's main 12V line, which is derived from the line output transformer. So T50 is without drive until the line output stage is operative. There's elaborate over-voltage protection – teletext decoders were worth a fortune at that time!

Later models with infra-red remote control have a simpler arrangement – the decoder's 5V supply is derived from an extra winding on the line output transformer, making the line output panels non-compatible. The pulses from the line output transformer are fed to a small panel at the bottom of the cabinet. This panel contains a large diode, a 5V regulator and a few other bits. The teletext decoder's 12V supply comes from the set's main 12V line via the remote control receiver.

Servicing either of these power supplies should pose no problems, but we'll mention the effect of either teletext decoder supply being absent: no 5V rail produces a bright blank raster, no 12V supply gives absence of text only. Needless to say any voltage change or defective decoupling can cause some very strange faults indeed! The moral is to check both lines, preferrably with a scope, when presented with an inexplicable fault symptom.

Misadjusted Clock Coil

An odd effect occurs when the 6·93MHz clock coil is incorrectly adjusted: the errors increase towards the right-hand side of the screen. This shows up clearly when the clockcracker page is selected. Don't forget that adjustment will have no visible effect until the page is reselected. Leave any adjustments on the decoder alone unless absolutely necessary.

Memory Faults

Most of the faults on the G11's teletext decoder panel are due to the 2102 memory chips. If wrong characters are persistently displayed at a particular row/column position one of the memory cells is stuck at one or zero. Many characters wrong but always the same errors means that one of the data bits is stuck. This may occur during read or write but this makes no practical difference. If row or column address pins are shorted to either rail groups of text will be repeated.

A "hard" RAM failure means the device is permanently damaged. This sort of thing usually occurs during the initial test period – the so-called burn-in. There are on the other hand "soft" failures that recover or occur only once. Soft failures can be caused by mains noise, static, c.r.t. flashovers or cosmic particles. No, we're not entering the realms of science fiction: it's a fact that our seven

Table 1: ASCII code for the SAA5050.

Dec.	Binary	Means	Dec.	Binary	Means	Dec.	Binary	Means	Dec.	Binary	Means
0	0000000		32	0100000	Space	64	1000000	@	96	1100000	—
1	0000001	Red*	33	0100001	!	65	1000001	A	97	1100001	a
2	0000010	Green*	34	0100010	"	66	1000010	B	98	1100010	b
3	0000011	Yellow*	35	0100011	£	67	1000011	C	99	1100011	c
4	0000100	Blue*	36	0100100	$	68	1000100	D	100	1100100	d
5	0000101	Magenta*	37	0100101	%	69	1000101	E	101	1100101	e
6	0000110	Cyan*	38	0100110	&	70	1000110	F	102	1100110	f
7	0000111	White*	39	0100111	'	71	1000111	G	103	1100111	g
8	0001000	Flash	40	0101000	(	72	1001000	H	104	1101000	h
9	0001001	Steady	41	0101001	)	73	1001001	I	105	1101001	i
10	0001010	End box	42	0101010	*	74	1001010	J	106	1101010	j
11	0001011	Start box	43	0101011	+	75	1001011	K	107	1101011	k
12	0001100	Normal height	44	0101100	,	76	1001100	L	108	1101100	l
13	0001101	Double height	45	0101101	–	77	1001101	M	109	1101101	m
14	0001110		46	0101110	.	78	1001110	N	110	1101110	n
15	0001111		47	0101111	/	79	1001111	O	111	1101111	o
16	0010000		48	0110000	0	80	1010000	P	112	1110000	p
17	0010001	Red†	49	0110001	1	81	1010001	Q	113	1110001	q
18	0010010	Green†	50	0110010	2	82	1010010	R	114	1110010	r
19	0010011	Yellow†	51	0110011	3	83	1010011	S	115	1110011	s
20	0010100	Blue†	52	0110100	4	84	1010100	T	116	1110100	t
21	0010101	Magenta†	53	0110101	5	85	1010101	U	117	1110101	u
22	0010110	Cyan†	54	0110110	6	86	1010110	V	118	1110110	v
23	0010111	White†	55	0110111	7	87	1010111	W	119	1110111	w
24	0011000	Conceal	56	0111000	8	88	1011000	X	120	1111000	x
25	0011001	Norm. graphics	57	0111001	9	89	1011001	Y	121	1111001	y
26	0011010	Sep. graphics	58	0111010	:	90	1011010	Z	122	1111010	z
27	0011011		59	0111011	;	91	1011011	←	123	1111011	¼
28	0011100	Black backg'd	60	0111100	<	92	1011100	½	124	1111100	‖
29	0011101	New backg'd	61	0111101	=	93	1011101	→	125	1111101	¾
30	0011110	Hold graphics	62	0111110	>	94	1011110	↑	126	1111110	÷
31	0011111	Release graphics	63	0111111	?	95	1011111	#	127	1111111	■

* Alphanumerals. † Graphics.
Notes: Graphics see Fig. 2. ASCII = American Standard Code for Information Interchange.

2102s, innocently sitting there, are occasionally hit by charged particles from space or from other sources – even i.c.s emit them! The result can simply be that one of the cells is flipped over without damage. More often however one of the gate layers is punctured: this is not always permanent.

Equipment for fault-finding can consist of just a meter (or logic probe) and, most importantly, an ASCII table (see Table 1 and Fig. 2). It's important to know which memory chip deals with which bit. We refer to the bits of a byte by number, starting with the left-most bit which is also referred to as the most significant bit (MSB) as it represents 64. This is bit number one. The least significant bit (LSB), the right-most one, is equal to one. This is bit seven (our character set is a seven-bit one so we don't use a full-sized byte, i.e. one with eight bits). The RAM chips in this decoder are numbered IC6671-IC6677: IC6671 is for bit seven, IC6672 for bit six, etc.

In the event of wrong characters note at least two wrong characters and decide what they should have been. Then see what the difference is in the binary ASCII code. You should find that only one bit differs between the correct and incorrect versions, and that this applies to all the wrongly displayed characters. Note that some characters will be correct despite the presence of the fault: these correspond to the ones in which the stuck cell or data line is stuck at the correct level. For example, bit seven stuck at one means that the even numbered codes can't be displayed. The displayed alphabet will consist of AACCEE etc. At the other end, bit one stuck at zero will make it impossible to count above 63, so that codes from 64 to 127 will be displayed as zero to 63. This means that the alphabet cannot appear. All you'll get is numerics, attributes and some punctuation marks. Clearly the possibilities are legion. For example, bit two stuck causes all letters to be in upper or lower case: bit two stuck at zero makes an attribute of anything with bit one low – this gives a very strange display, with psychedelic colours everywhere – whereas if bit two is stuck high the display is in monochrome with everything in lower case and no graphics.

The way in which the errors are displayed depends on whether a memory cell or data line is stuck. If a memory cell is stuck, one location only will show errors. A stuck data line will affect the whole screen. Returning to our earlier example of bit seven stuck high, if say row six column two shows D when it should show C one memory cell is defective and will produce display errors only when

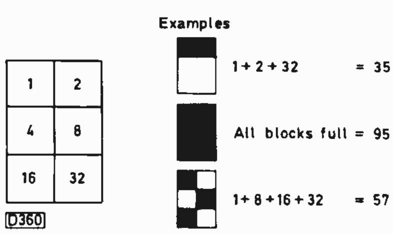


Fig. 2: Graphics characters are from 33 to 127 (ASCII code) and are built of six blocks. To ascertain the ASCII value of a graphic, add together the blocks and add 32 to the total. These are displayed if preceded by attribute 30 (hold graphics).

it should contain an even code. If the bit seven data line is high however no even codes will be displayed anywhere on the screen.

When row or column address lines are stuck the effect is that groups of rows or columns are repeated depending on which bit is stuck or missing. The addresses can count only in steps of 2, 4, 8, 16 or 32, remembering the bit of wizardry carried out in this decoder to make the RAMs compatible with the screen format. Problems here are usually due to faults in either one of the three 74LS chips in the row/column address decoder or because one of the five little white chokes in the column address lines is open-circuit. A logic probe with a pulse indication is useful here. The chokes can safely be shorted out.

There are many other fault possibilities. When two pins of one of the 2102 memory chips short together internally there will be all sorts of weird effects, the usual one being an almost blank screen with just one character repeatedly displayed at random. Check by removing each RAM i.c. in turn, followed by reselecting a page: when the faulty i.c. has been removed the display will return to the one byte missing condition, as when a data line is stuck low.

So this part of the decoder is not too bad after all – a little thought and detective work will sort out any problems.

LSI Chip Faults

The various LSI chips can fail. The VIP and TIC chips usually give a blank screen with no text and the TAC chip inability to select text or pages. An interesting variation occurs when an SAA5040 is fitted instead of an SAA5040A. The only difference is that the status displays for channels two and three (BBC-2/ITV) are transposed – the converse is also true of course.

The TROM chip is first in the firing line in the event of any c.r.t. flashovers, so the output pins are prone to getting stuck. The funny one is when pin 16 (TLC – transmitted large characters) which is connected to the TIC chip gets stuck, either due to a duff TIC or TROM chip: the RACK stops and the header row is repeated all down the screen. Remember that the outputs can be high, low or open-circuit. No luminance output affects only the mix mode: the result is not too obvious – the picture can be seen through the text. No blanking output (pin 25) gives mix mode instead of text; if this pin is stuck high there's text only, with no picture; if stuck low the text in the mix mode is faint. The results of the RGB outputs packing up should be fairly obvious.

TEL 0902 712083 TELEX 338490

HA1374	4.80
HA1377	3.96
HA1389R	2.05
HA1389	2.39
HA1392	3.90
HA1394	3.95
HA1397	3.76
HA1398	3.98
HA1406	2.07
HA1452	1.63
HBF4030AF	2.48
HD14538	2.07
HD38702-A2	7.45
HD38750A53	8.71
HD38750A-7	7.25
HD38800A50	14.09
HD44801A05	17.49
HEF4001BP	0.67
HISH1010	8.59
HISH1004	6.00
HISH1002	9.50
HM6231	9.81
HM6232	8.89
HM6251	5.70
HM7103	2.46
HM9032	3.22
HM9012	3.22
HM9015	3.24
HT4207	17.16
HT4208	18.25
IN5401	0.11
IR2403	4.25
IR2C05	4.25
IR3P06	2.25
IR3P08	4.95
IR94558	6.25
IS751	2.85
ITT425	0.18
IZ0003GE	5.37
IZ0020GE	5.93
K174YP	3.46
KA2101	2.92
KC581C	6.32
KC582C	3.97
KC583C	5.54
L200CV	1.69
LA1201	1.02
LA1210	1.56
LA1230	2.87
LA1320	2.87
LA1352	1.75
LA1357N	11.07
LA1363	7.25
LA1364	3.02
LA1365J	3.44
LA1385	1.94
LA1387	7.60
LA3155	1.25
LA3301	1.41
LA3350	1.43
LA3361	1.23
LA3365	3.98
LA3390	4.25
LA4030P	4.20
LA4031P	3.20
LA4032P	2.35
LA4100	1.25
LA4101	1.30
LA4102	2.81
LA4112	4.83
LA4125	2.25
LA4138	3.38
LA4140	1.15
LA4192	3.65
LA4220	1.62
LA4250	6.75
LA4400	2.25
LA4420	1.72
LA4422	1.72
LA4430	1.47
LA4440	4.95
LA4445	7.25
LA4460	2.32
LA4461	2.95
LA4505	5.94
LA5112N	2.65
LA7020	7.33
LA7025	8.05
LA7027	9.35
LA7040	9.20
LA7042	4.25
LA7800	2.65
LA7801	4.15
LB1274	3.08
LC7800	9.20
LD3120	1.13
LD3150	2.25
LM1017N	4.29
LM1877	10.92
LM224	1.75
LM2808	5.94
LM2877	4.93
LM317CKC	1.38
LM324N	0.75
LM339N	0.80
LM340K	11.85
LM342P	1.62
LM342P	1.62
LM342P	1.62
LM348N	2.15
LM380N	2.80
LM384N01	3.25
LM567CN	1.71
LM6402/011	10.23
LM6402A093	10.15
LM748	1.82
LM8360	3.87
LM8361	3.57
LR2612	11.95

LR3419	9.37
LR3471	9.37
LU1141	7.27
LU52012	5.95
LU52011	4.95
LU03112	12.37
M193	12.75
M21C	1.00
M23C	0.83
M293	9.15
M51102L	6.35
M5115P	5.24
M51203L	3.15
M51231P	3.04
M5134-9341	4.13
M51353P	5.25
M51381P	4.50
M51393AP	7.78
M51394P	11.97
M5142P	5.49
M5144P	4.25
M51513L	2.55
M51515BL	3.23
M51517L	3.71
M5192	2.20
M5194AP	5.74
M5231L	1.95
M53274P	1.33
M54532P	2.15
M54544L	4.75
M58478P	6.75
M58485P	10.74
MA06	1.07
MA8001	0.82
MA8003	1.16
MB3705	1.98
MB3712	1.85
MB3713	1.69
MB3730	3.25
MC13002	3.55
MC1310P	2.25
MC1327P	1.33
MC1330P	1.69
MC1350P	1.61
MC1351P	3.96
MC1352P	2.50
MC1357P	2.15
MC1358P	1.30
MC14001	2.40
MC14013	0.41
MC14493P	3.44
MC14494P	2.15
MC14497	3.65
MC14510BAL	3.75
MC14511BCP	1.10
MC14528BCP	2.70
MC1712	3.88
MC5192	13.50
MC7724CP	3.49
MC7818C	2.18
MCR100/7	1.65
MCR106-5/6	0.85
MCR220/7	2.28
ME0402	0.17
ME0404/2	0.47
ME0411	0.28
ME6002	0.26
ME6102	0.28
ME8001	0.34
ME0411	0.75
MJ2501	1.69
MJ3001	1.69
MJ481	1.53
MJ802	5.45
MJE2955	1.89
MJE3055	1.65
MJE340	0.49
MJE520	0.49
ML231	3.33
ML232B	2.15
ML237B	2.51
ML238	5.77
ML923	3.30
ML926	3.58
MM5314N	4.02
MM5316N	4.25
MM5318N	3.11
MM5369N	2.01
MM5387AA/N	6.20
MM5841N	6.49
MN1400VL	9.96
MN1405	9.52
MN1435VX	11.48
MN6016A	20.56
MP1192	5.07
MP2794	4.00
MP2812	5.07
MP8512	1.57
MPC596	2.13
MPF256C	0.60
MPS6570	0.48
MPSA42	0.65
MPSA56	0.27
MPSA92	0.45
MPSU05	0.86
MPSU10	1.56
MPSU56	0.60
MPSU60	1.33
MR818	0.33
MR854	0.72
MR914	1.20
MSM5816RS	17.35
MSM5840H	9.15
MVS460-02	0.61
NE542	2.50
NE545B	3.94
NE555	0.38
NE556	0.95

NE565N	1.33
NE645BN	3.35
NP1106	5.61
OA202	0.11
OA47	0.14
OA91	0.09
OA95	0.09
OC28	2.95
OC29	2.15
OC36	1.28
OC44	0.35
OC45	0.18
OC72	0.44
OC75	0.44
ON236	1.06
ON782	1.98
OT121	1.45
PT6042	2.45
PT8504	4.98
R1038	2.19
R1039	2.19
R2008B	1.33
R2009	1.98
R2010B	1.33
R2029	1.33
R2030	1.33
R2257	2.38
R2265	1.49
R2305	1.18
R2322	0.59
R2323	0.76
R2354A	2.01
R2354B	2.01
R2443	0.88
R2461	1.50
R2540	2.31
R2540X	3.30
R2615	0.67
RCA16029	2.01
RCA16600	1.38
RCA16802	1.08
RCA17074	6.60
RCA17376	1.58
RCA17524	0.83
RCA17523	0.83
RCA2060	2.00
RGP01-15	0.70
RGP10	0.50
RGP30M	0.59
RT402	1.58
RT905A	2.38
S1299	5.74
S175	31.48
S2062D	2.07
S2800D	5.54
S2802	3.47
S2818	4.05
S3702S	6.15
S40W	10.89
S6080B	8.80
SA8063	5.17
SAA1006	1.75
SAA1020	4.76
SAA1025	4.40
SAA1024	2.81
SAA1075	6.25
SAA1121	5.14
SAA1124	3.25
SAA1130	4.99
SAA1174	7.77
SAA1250	3.96
SAA1251	9.85
SAA11351	4.95
SAA3027P	10.03
SAA5000	2.95
SAA5010	5.39
SAA5012	5.20
SAA5020	5.78
SAA5030	8.25
SAA5050	7.74
SAB1009B	6.81
SAB3011	7.34
SAB3013	5.61
SAB3021	7.90
SAB3024	6.36
SAB3209	5.82
SAB3210	3.49
SAF1032P	6.50
SAF1039	3.35
SAS5010	8.39
SAS560S	2.26
SAS560T	5.42
SAS570T	5.42
SAS570S	2.61
SAS580	2.85
SAS6600	1.33
SAS660	2.97
SAS6700	1.33
SAS670	3.96
SAS6710	1.33
SBA750	1.61
SC84203	18.98
SC9504P	1.95
SDA2006	18.95
SDA2112/2	12.85
SG264A	5.26
SG613	8.75
SG629	8.27
SG6533	10.31
SI-1020H	10.89
SI-1125HD	17.63
SI1125H	7.50
SI1225HD	17.73
SI1630HD	17.85
SI6900	12.00
SKE1/02	1.85
SKE2F1/04	1.39
SKE2G3/04	1.05
SKE4F1/06	0.73

SKE4F2/08	1.24
SKE4F2/06	0.85
SKE4F2/10	1.24
SKE4G2/02	0.96
SKE5F3/10	1.60
SKS1/10	2.15
SL1310	3.14
SL1430T	2.31
SL414	3.69
SL432A	3.44
SL439	2.48
SL471	3.28
SL480	3.14
SL490	2.37
SL901B	8.32
SL918A	9.07
SN16861ANO	4.95
SN16862AN	2.98
SN16966N	10.25
SN29717N	7.19
SN29716N	3.66
SN29715N	6.04
SN29722	11.95
SN29723AN	7.65
SN29764AN	1.38
SN29767	4.98
SN29770BN	4.24
SN29772BN	4.91
SN29771BN	4.93
SN29791	1.67
SN29798N	5.56
SN2709	0.44
SN7400N	0.34
SN7401N	0.36
SN7402N	0.65
SN7404N	0.24
SN7408N	0.27
SN7410N	0.27
SN74121	1.60
SN7413N	0.37
SN74141N	2.65
SN74151AN	1.51
SN74154N	1.27
SN74190	2.00
SN7420N	0.34
SN7430	0.49
SN7440N	0.27
SN7472	1.54
SN7474N	0.44
SN7490AN	0.93
SN74LS26N	0.53
SN76001N	1.65
SN76013ND	2.48
SN76023N	5.15
SN76023ND	3.96
SN76033N	4.15
SN76110N	0.90
SN76115AN	1.61
SN76131	1.92
SN76227N	1.33
SN76226DN	1.98
SN76228N	3.27
SN76242	8.95
SN76243	5.23
SN76396	2.90
SN76533N	2.47
SN76532N	2.95
SN76545	4.87
SN76546N	3.47
SN76549	2.59
SN76570	3.08
SN76611	2.59
SN76620	2.59
SN76660N	2.48
SN76666N	1.41
SN76708	4.86
SN76709	5.12
SN76709N	5.45
SN76707N	4.39
SN76705N	1.34
SN76730	5.36
SN76810N	0.60
SN76832N	3.25
SN94041	5.54
SN94042	4.35
SP8385	0.55
SPS5384	1.98
ST1702L	0.99
STA401	6.76
STA441C	2.75
STA471C	6.76
STK0029	5.54
STK0039	5.35
STK0040	12.00
STK0050	7.67
STK0080	9.16
STK011	3.96
STK013	9.25
STK014	9.80
STK015	7.75
STK016	6.94
STK022	5.25
STK025	12.50
STK031	12.95
STK040	8.70
STK043	13.44
STK054	7.13
STK058	18.25
STK077	7.67
STK078	8.52
STK080	16.50
STK082	11.86
STK086	13.59
STK1039	5.75
STK2110	7.33
STK2145	16.25
STK2230	7.70
STK2240	14.40
STK2250	18.95

STK3042	11.05
STK3044	5.75
STK4019	4.50
STK430	11.75
STK433	5.45
STK4332	8.25
STK435	5.94
STK4352	12.25
STK436	7.21
STK437	7.80
STK4372	3.85
STK439	8.31
STK441	11.28
STK443	10.29
STK457	13.45
STK460	14.83
STK461	9.68
STK463	11.53
STK466	11.77
STK4833	16.95
STK501	6.32
STK502	5.74
STK5314	9.48
STK5730	3.95
STK7216	12.67
STK772	6.95
STR1096	4.50
STR4090	11.75
STR440	7.85
STR441	9.45
STR451	4.95
STR453	8.16
STR454	7.50
STR6020	8.31
T6029V	5.75
T6035V	0.73
T6036	0.67
T6037	2.11
T6044V	0.95
T6045	1.20
T6049	1.45
T6052V	0.87
T6058	0.59
T6059	0.65
T9003V	1.25
T9005V	2.38
T9011V	0.49
T9013V	7.96
T9014V	2.60
T9016	1.02
T9019W	1.98
T9034V	1.38
T9035V	1.39
T9051	7.45
T9054V	1.15
T9057V	0.70
T9062V	0.49
T9064	1.51
TA6002	4.35
TA7027	4.80
TA7050	1.74
TA7051	1.74
TA7054	2.55
TA7060AP	0.71
TA7061AP	1.27
TA7069	3.13
TA7070P	1.83
TA7072P	2.57
TA7073P	5.86
TA7074P	1.98
TA7076P	7.50
TA7089P	1.50
TA7092P	7.50
TA7093P	3.99
TA7102P	5.88
TA7108P	1.61
TA7109	4.90
TA7122B/P	0.92
TA7124P	2.34
TA7129P	1.50
TA7130P	1.27
TA7136AP	1.27
TA7137P	0.98
TA7141AP	3.87
TA7146	2.50
TA7146P	4.23
TA7148P	1.67
TA7149P	3.26
TA7152P	1.72
TA7153P	7.47
TA7161P	5.45
TA7162P	2.98
TA7169	9.54
TA7172P	1.41
TA7176P	2.48
TA7193AP	6.67
TA7193P	5.50
TA7201P	2.71
TA7203P	2.18
TA7204P	2.16
TA7205P	1.38
TA7206P	6.35
TA7207P	3.34
TA7208P	2.15
TA7210P	3.58
TA7214P	3.63
TA7215P	2.58
TA7217AP	1.45
TA7222	1.95
TA7226	10.25
TA7227P	2.81
TA7229P	4.45
TA7230P	4.98
TA7232P	6.60
TA7233P	5.32
TA7240AP	7.83
TA7245P	7.50
TA7270	6.75
TA7310P	2.15

TA7312P	2.45
TA7313AP	1.50
TA7314	5.94
TA7323P	3.15
TA7325P	1.15
TA7339P	1.35
TA7340P	5.06
TA7607AP	13.90
TA7609	3.28
TA7611AP	4.80
TA7616P	5.25
TA7622AP	8.94
TA7628P	5.62
TA7629P	7.50
TA7630P	2.98
TA7640AP	1.19
TA7672P	1.75
TA7676P	2.81
TA7726P	10.25
TAA320A	1.27
TAA350A	0.80
TAA570	1.74
TAA621AX1	2.48
TAA621A12	2.14
TAA661B	1.00
TAA691	8.58
TAA700	3.75
TAA930	4.87
TAA970	2.83
TAA110	2.52
TAG232-600	0.73
TAG626-600	1.06
TBA120AS	1.24
TBA120SB	1.05
TBA120T	0.95
TBA120U	2.50
TBA120A	1.05
TBA1440	2.03
TBA1441	1.62
TBA1440G	5.20
TBA1441	1.75
TBA240A	3.99
TBA395	1.10
TBA395Q	1.10
TBA396	0.80
TBA400	2.39
TBA440P	2.45
TBA480Q	1.30
TBA500P	6.58
TBA510	1.37
TBA520	1.84
TBA520Q	1.68
TBA530	1.30
TBA530	1.30
TBA540	1.15
TBA540Q	1.15
TBA560C	1.40
TBA560CQ	1.60
TBA570Q	1.60
TBA570A	1.71
TBA641A12	4.13
TBA641B72	3.03
TBA651	1.76
TBA673	2.60
TBA700	1.85
TBA720	1.55
TBA730	3.55
TBA750Q	2.90
TBA760	1.71
TBA800	1.08
TBA810S	1.61
TBA810T	1.50
TBA810AS	1.00
TBA820	1.52
TBA820M	0.82
TBA890	2.50
TBA920	1.89
TBA920Q	2.31
TBA940	1.87
TBA950	1.55
TBA970	1.79
TBA990	1.82
TBA990Q	1.68
TC4001BP	3.25
TC4011BP	3.50
TC4013BP	3.75
TC4016BP	3.15
TC4053BP	4.34
TC4069	1.52
TC4071BP	2.76
TC4081BP	3.25
TC40H000	1.98
TC4514BP	4.15
TC9002BP	11.95
TCA270Q	1.71
TCA270S	2.15
TCA270SQ	1.65
TCA290A	2.39
TCA420A	2.16
TCA440	1.93
TCA530	2.16
TCA640	10.26
TCA650	2.04
TCA660B	3.30
TCA730	3.81
TCA750	2.25
TCA800Q	6.95
TCA830S	2.38
TCA890	5.44
TCA900	2.04
TCA910	1.65
TCA940	1.80
TCA940E	2.93
TCE330	3.89
TCEP100Q	10.25
TCEP100	9.61
TD3406AP	3.98
TD3F800R	3.92
TD3F900H	4.16

TD62105P	2.50
TD62104P	2.50
TD62706P	4.50
TDA1001B	2.31
TDA1003A	2.25
TDA1005A	2.22
TDA1006A	2.11
TDA1010AF	4.25
TDA1011	2.40
TDA1010	1.15
TDA1011A	5.25
TDA1028	2.45
TDA1034B	2.42
TDA1035S	2.95
TDA1035T	2.55
TDA1037	1.98
TDA1037D	3.25
TDA1044	2.62
TDA1047	4.10
TDA1059B	0.80
TDA1054M	1.21
TDA1060	2.60
TDA1082	3.25
TDA1151	1.22
TDA1170S	2.25
TDA1190	2.11
TDA1190Z	3.96
TDA1200	1.50
TDA1235	3.88
TDA1236	4.30
TDA1270	3.76
TDA1327A	1.33
TDA1412	1.05
TDA1420	1.55
TDA1440	3.45
TDA1470	3.16
TDA1470P	4.25
TDA1506	7.45
TDA1510	5.90
TDA1512	2.89
TDA1515	16.60
TDA1559	3.15
TDA1670	4.48
TDA1770	6.85
TDA1905	1.76
TDA1908	2.52
TDA1940	1.95
TDA1950	4.75
TDA2005	5.08
TDA2006	1.55
TDA2004	2.27
TDA2002	0.90
TDA2003	1.75
TDA2010	1.85
TDA2020	2.77
TDA2030	1.99
TDA2140	1.59
TDA2150	6.20
TDA2151	1.93
TDA2160	4.01
TDA2161	1.85
TDA2170	2.98
TDA2190	4.95
TDA2270	4.65
TDA2510	7.85
TDA2520	2.37
TDA2522	3.46
TDA2524	4.50
TDA2521	3.71
TDA2525	3.90
TDA2532	2.50
TDA2530	2.70
TDA2541	2.48
TDA2540	2.15
TDA2545Q	5.94
TDA2560	2.17
TDA2575A	0.50
TDA2571AQ	3.60
TDA2576A	2.85
TDA2571A	3.66
TDA2578A	4.95
TDA2576A+K	11.98
TDA2581	2.25
TDA2582	2.18
TDA2591	2.50
TDA2594	3.26
TDA2593	2.47
TDA2591Q	0.83
TDA2595	5.26
TDA2600	5.50
TDA2611AQ	2.98
TDA2612Q	4.68
TDA2611A	1.25
TDA2610	2.79
TDA2620	2.15
TDA263C	1.96
TDA2631	2.73
TDA2640	2.59
TDA2652	6.95
TDA2653	5.65
TDA2654	6.18
TDA2670	2.48
TDA2680	3.20
TDA2690A	2.65
TDA2740	6.00
TDA2780AQ	5.14
TDA2795	2.78
TDA2791	2.5
TDA2910	13.25
TDA3000T	2.55
TDA3300B	9.00
TDA3330	3.30
TDA3506	7.98
TDA3501	7.25
TDA3500	4.25
TDA3510	6.55
TDA3520	9.71
TDA3540	2.98
TDA3541	3.80

TDA3560	5.00
TDA3571Q	2.83
TDA3576	7.09
TDA3590	5.79
TDA3591	6.45
TDA3650	7.50
TDA3652	5.44
TDA3651AQ	2.96
TDA3651	3.30
TDA3651A	2.65
TDA3950	3.25
TDA4050B	3.95
TDA4280	7.20
TDA4290	4.47
TDA4400	2.27
TDA4420	5.01
TDA4422	8.32
TDA4427S	9.00
TDA4431	2.27
TDA4440	2.87
TDA4442	4.85
TDA4500	7.30
TDA4600	2.84
TDA4610	4.80
TDA4620	4.46
TDA5500	4.78
TDA5700	2.60
TDA7270S	2.25
TDA8190	3.47
TDA9403	3.15
TDA9503	2.92
TDA9513	5.44
TDB1033	2.08
TDE1081	6.61
TE626	1.49
TEA1002	3.47
TEA1009	1.86
TEA1014	3.15
TEA1020SP	8.21
TIC106C	0.61
TIC106M	0.77
TIC116Y100	2.07
TIC44	0.72
TIC45	0.77
TIC47	0.35
TIP120	1.06
TIP110	0.53
TIP112E	0.85
TIP112	0.88
TIP117	0.95
TIP121	0.87
TIP126	0.73
TIP132	1.40
TIP137	1.50
TIP29	0.66
TIP2955	0.95
TIP29A	0.46
TIP29B	0.63
TIP29C	0.40
TIP29D	0.75
TIP3055	0.75
TIP30A	0.41
TIP30C	0.16
TIP31A	0.34
TIP31B	0.38
TIP31C	0.50
TIP32A	0.53
TIP32B	0.69
TIP32C	0.40
TIP33	0.85
TIP33A	1.05
TIP33C	0.80
TIP34	3.54
TIP41A	0.49
TIP41B	0.65
TIP41C	0.49
TIP42A	0.49
TIP42B	0.53
TIP42C	0.53
TIP47	0.65
TIP48	0.92
TIP49	3.61
TIP55A	3.65
TIS43	1.43
TIS90	0.28
TL011CP	1.55
TL072	2.85
TL494CN	6.74
TL072CP	2.55
TMP4320	15.00
TMS1024NLL	6.86
TMS1025N	6.25
TMS3720ANS	19.50
TMS3748NS	14.95
TMS3755	13.65
TMS3894NL	19.25
MS5102NLL	6.25

TUA2000	6.98
TV106	1.76
TY6010B	2.97
U05G	1.14
ULN2204	11.45
UPA53C	4.94
UPC1003	4.95
UPC1009C	6.32
UPC1025H	2.90
UPC1026C	1.24
UPC1028H	2.00
UPC1020H	2.77
UPC1032H	0.62
UPC1042C	8.95
UPC1156H	2.96
UPC1158	5.84
UPC1161C	4.50
UPC1182H	1.82
UPC1186H	1.05
UPC1181H	1.25
UPC1185H	2.94
UPC1188	6.95
UPC1213C	0.99
UPC1212C	1.72
UPC1225H	3.25
UPC1230	7.24
UPC1238	2.98
UPC1263	3.45
UPC1277H	5.85
UPC1278H	4.85
UPC1351C	1.81
UPC1350C	1.40
UPC1353	7.85
UPC1355C	2.13
UPC1363	4.20
UPC1362	7.75
UPC1365C	6.98
UPC1366	7.14
UPC1360C	4.51
UPC1378H	4.25
UPC141C	3.75
UPC1458	8.66
UPC151C	2.95
UPC2002	1.48
UPC30C	2.51
UPC324C	4.70
UPC32C	4.94
UPC339C	4.90
UPC41C	4.10
UPC4558C	2.15
UPC474	5.11
UPC554C	1.85
UPC566H	2.95
UPC574	3.25
UPC575C2	2.40
UPC576H	2.58
UPC577H	1.25
UPC578C	7.35
UPC580C	4.13
UPC587C2	1.34
UPC592H	2.15
UPC595	2.95
UPC596	1.98
UPD1514C	8.95
UPD2819C	4.98
UPD4013B	4.00
UPD4066B	4.95
UPD553-164	19.25
UPD8049C-1	10.14
X0007TA	4.68
X0022CE	5.75
X0029CE	4.95
X0031CE	4.95
X0035TA	5.11
X0040TA	4.50
X0042CE	4.35
X0043CE	2.75
X0056CE	5.11
X0057GE	6.00
X0062CE	6.52
X0065CE	5.75
X0074GE	10.00
X0077GE	12.95
X0079CE	4.95
X0092CE	4.95
X0096CE	4.29
X0109CE	10.90
X0113CE	2.07
X0195CE	4.00
X0204CE	8.74
X0261CE	8.75
X1222AF	3.63
IX0111CE	2.95
Y969	0.82
TDA3310	2.15
ZPY120	0.95
ZTK33	0.43

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VCR Clinic

Reports from Christopher Holland, Les Harris, Philip Blundell, Eng. Tech., Steve Illidge and Mick Dutton

JVC HRD140 – Ferguson 3V44/45

The latest generation of JVC VCRs have been around for about a year. Though proving to be reliable a fair number have appeared in our workshops in recent months. I'd hesitate to describe the following as stock faults: we've nevertheless encountered most of them more than once.

First a note about the circuit protectors used in the power supply. These look like two-legged transistors and appear to go open-circuit for little or no reason. Different sets of symptoms occur when the various d.c. lines produced by the power supply panel are absent. With any VCR that appears to be non-functional or has all the motors spinning at switch on, first check the unswitched 12V line and the switched 5V and 12V lines. Replacement of the appropriate circuit protector will normally provide a complete cure. Note that it's also easy to cause them to fail while you're working on a machine. The unswitched 12V line remains throughout the machine even when the front operate switch is at off, and there's no on-off switch at the back. Don't let the meter's probe slip while checking the output at plug CN3 of the power supply. Absence of the switched 5V line with the relevant circuit protector intact can be caused by Q10 and D3 on the power supply panel.

The use of resistors in place of circuit protectors is not recommended. Even very small value resistors will produce a voltage change that can interfere with normal working. Here's an example. The problem with the machine was that the drum motor would not spin when the tape loaded to the heads. This was eventually traced to someone having used a 4·7Ω resistor in place of a circuit protector in the switched 12V line.

Some other problems. The tape loading half way to the heads then returning to the cassette is due to the absence of drum pickup head pulses. I've had the lead open-circuit at the head, also a defective head where the pin fell out of the head body. If the machine plays for a few seconds then unloads, with fast forward or rewind for only a few seconds, the take-up pulses are missing: I've twice had Q1 on the deck terminal faulty – on both occasions the transistor checked o.k. on an ohmmeter.

The symptoms associated with absence of the switched 12V line are that the operate indicator comes on as soon as the machine is plugged in, the drum and capstan motors turn, the machine switching itself off after a few seconds. Should these symptoms continue after replacing the appropriate circuit protector, or if the protector is intact, check the outputs from the two loading sensors. These should give d.c. levels of 0V and 12V at pins 34 and 35 of the main microcomputer chip. If either level is wrong yet both loading arms are back in the cassette housing the timing of the gear train from the loading motor has slipped. Ideally you'll need a second open VCR to see how to put it all back together again. Why does the timing slip? Check that the back-tension arm is not fouling the left-hand loading arm during the unloading procedure.

Two problem areas with the previous generation of JVC machines were the cassette housing and a tendency for the video heads to clog with dirt very easily. The latest machines do not suffer from these problems to the same extent. If you have to remove the screening plate over the heads for any reason, take care when replacing it – it's very easy to dry-joint Q1 on the head motor driver amplifier panel but very difficult to resolder this properly. There speaks the voice of experience!

On one occasion when I thought I had an instance of dirty heads the culprit turned out to be IC102, which is really a luminance subassembly soldered in at right-angles to the main PCB. Each to his own way of removing it. I've also had this assembly cause picture overloading after a few seconds of play, a squirt of freezer putting things right again for a further few seconds.

A case of failure to record was caused by the 9V line to pin 2 of IC101 being absent: Q111 had gone open-circuit.

An unusual problem was a VCR with no tuner channel change, being stuck on number one. A few preliminary checks failed to bring anything to light so as I'd a similar machine already on the bench I swapped the front panels. This didn't cure the fault. Back went the original front, whereupon I inadvertently discovered that the timer indicator wasn't responding to the timer switch. Deciding to follow this lead instead took me to pin 51 of the main microcomputer chip. Due to some form of corrosion there was a leak to pin 52, the 5V supply line. Cleaning the print provided a cure. A few weeks later another machine came in with the same fault symptoms and the same cause as well.

Another unusual problem was poor playback pictures with the machine's own recordings. The f.m. waveform at TP106 was continually varying in amplitude, with the output from one head occasionally disappearing altogether. The effect on the screen was that the pictures would fade into noise maybe twice or three times a minute. Examination of the record f.m. signal showed that nothing was amiss and the odd thing was that the noise appeared at different points when the same recording was played again. The answer was that no control pulses were being recorded. The cause: R438 was missing – it had never been fitted. This would have been easy to miss during a quick visual check as the picture was stable for up to twenty seconds at a time. Very good these digital servos!

There we have it then. All in all the best machine developed by JVC to date, and by quite a margin. The only design problems from a servicing point of view appear to be the bottom cover retaining screws, which can be awkward to remove, and the relatively inaccessible motor driver amplifier panel. There's also a knack to removing the bracket which holds the combined aerial amplifier/r.f. modulator unit. A weak point here appears to be the external aerial connection centre pins. We've found them to be broken on a greater number of machines than we would expect – potentially a very expensive repair. Otherwise these machines will in years to come greatly lighten the workload of harassed video engineers. **C.H.**

Ferguson 3V29/30 – JVC HR7200/7300

There have been various comments in these pages in recent months concerning the problem of loading motor belt slippage in these very popular machines. Perhaps the following notes will help. We've had a large number of these machines through our workshops over the years and have found that a contributory factor seems to be dust on the motor and worm pulleys – the fault often occurs with VCRs that have a dusty interior, though not exclusively so. Before replacing the belt clean both pulleys and examine the two cogs that protrude into the upper part of the chassis and engage the loading rings – clean out any grit that's become embedded in hardened grease. Take care not to get any of the grease from the worm drive on the replacement belt.

Another point I've noticed is that belt slippage can occur as the machine warms up: on many occasions I've left a VCR on soak test while trying to trace a servo fault or whatever and after playing a three hour tape once or twice have found that the machine refuses to load. Most customers don't put their machines to this sort of extended use, but a case could perhaps be made for belt changing whenever one of these VCRs is brought in for service. Don't ask me how a belt stretches as a VCR warms up. Maybe the motor would be a more likely candidate for suspicion. Changing the belt however has always in my experience provided a complete cure.

Finally, I see a lot of VCRs that have been "looked at" elsewhere. A few intriguing solutions to this problem have been noted. I cannot comment on belt boiling as it's difficult to tell when a belt has been boiled, but bending the contacts of the after-loading switch is very popular: it doesn't work. Neither does replacing D3, an 11V zener diode on the mechacon panel, with a higher voltage type – the loading arms will come out of the cassette housing like greyhounds out of their traps but the belt will still slip. What will work is removing the loading motor from its bracket and elongating the bracket mounting holes using a needle file. I did this once with a local customer's machine when we'd no spare belts and told him to come back when the problem recurred: that was over a year ago, and I've not seen him since. Maybe he just didn't want to return to someone who confessed to carrying out a temporary repair. It's quicker of course to replace the belt. **C.H.**

Sharp VC581

This was a good one! At stop the capstan rotated backwards and when play was selected the capstan stopped . . . Investigation started at the capstan forward/reverse switching i.c. (IC701) where the reverse select pin 2 was found to be high all the time. The track was traced back to D7018 via wire link J20 which was shorting to link J25. These links are at the right-hand side of the mother board. **P.B.**

Panasonic NV7000

The fault with this machine was no sound in the E-E mode. Checks in the sound section revealed that the audio mute circuitry was operating: pin 1 of connector P4009 was high at approximately 5V. The cause of the trouble was the quad, two-input nand gate chip IC6010. Replacing this provided a complete cure. **S.I.**

Panasonic NV333

The capstan wouldn't lock in the playback mode. Both the reference and capstan FG signals were present and on checking the d.c. voltages around the capstan servo chip IC2003 the voltage at pin 16 was found to be low at about half the correct level. Tracing this voltage back to its source we found that the 9V supply to connection E on the system control board was missing. The cause was Q6003 being open-circuit: this transistor acts as a switch, supplying 9V except when the machine is in the record mode. **S.I.**

Hitachi VT8000

On pressing the play button the drum motor would creep up to speed slowly, in an irregular manner. The capstan motor would then start, again in a very erratic manner. The 9V supply at PG502/6 and the 12V supply at PG502/7 were both low. The cause was traced to R054 on the system control board being high in value. **S.I.**

Sharp VC8300

We had two of these in during the same day. The first wouldn't switch off, with the operate light always on. Q902 was found to be short-circuit. The second machine would lose the playback picture – the screen intermittently became a blank white raster. This was traced to dry-joints on plug/socket connector CD on board PWB-C. **M.D.**

Sharp VC7700

The complaint was no play. The machine would lace up then unlace after about three seconds. We checked the inputs to the microcomputer chip and found that the source of the trouble was a false signal from the slack sensor mounted on the pinch roller bracket. Replacing this cured the problem. **M.D.**

Panasonic NV370 with TX5500

We delivered a new Panasonic NV370 VCR and TX5500 colour receiver. This set employs a budget-type search tuning system that's difficult to fine tune exactly. We tuned in the TV channels, but when the VCR was tuned in there was loud intercarrier buzz on the ITV channel (41) in the E-E mode. We tried shifting the modulator frequency but this didn't help. It was possible to cure the problem by fine tuning the set but when the video channel was reselected the buzz returned. The problem remained even when both the TV set and the VCR were exchanged. As Panasonic had no suggestions we resorted to opening the VCR's modulator in the customer's house and adjusting the sound coil and video level potentiometer for no buzz. This cured the problem but means that the VCR is no longer compatible with other TV sets (low sound). **M.D.**

Hitachi VT33

The problem with this machine, which had been faulty from new, was a ringing on playback of its own recordings. I replaced IC201 but the fault remained: this meant I had to think! A check through the recording signal path revealed that R222, which damps L204, was 270kΩ instead of 150Ω. Replacing this resistor produced correct operation. **L.H.**

Philips VHS VCR with Thorn TX9

A Philips VHS machine would work all right with any other set but on playback of some recordings via a set fitted with the Thorn TX9 chassis the top of the picture pulled and there was a white band at the top. The problem was cured by fitting a 10dB attenuator between the TV set and the VCR. **L.H.**

GEC V4004/Hitachi VT33

The problem with this machine was intermittent loss of colour on playback. After a few checks I suspected the colour processing chip IC203 as I've had this fail before, but the fault remained when a new HT4239 was fitted. On making voltage checks at Q217 and Q358 I found that the 9V collector supply was only 5V, due to choke L215 in the supply line being open-circuit – the 5V was coming from pin 27 of IC203 via the base-collector junction of Q217! Normal operation was restored after replacing L215. **L.H.**

LCD TVs from Citizen

Pocket TV sets using liquid-crystal panels to produce the picture have been on sale in Japan and the USA for some time. Late last year Casio released an LCD set in the UK and the 1985-6 Tandy catalogue lists two such sets, one by Casio and another by Citizen. Citizen are now marketing the set themselves in the UK and we have been lent one to see how it performs.

The present model has a 2·7in. (diagonal) screen with just over 18,000 pixels (picture elements). A model with 3·5in. screen, more pixels and incorporating f.m. radio is due for release shortly and a colour set is expected by the end of the year. The current model measures just 7·5 × 135 × 23·6mm (15/16 ×5⅜ × 3in.) and weighs approximately 230g (270g with batteries). It consumes 0·4W and can be operated from four size AAA batteries, an a.c. adaptor, a car battery or an optional NiCd rechargeable battery pack. Battery life is approximately ten hours with continuous use of four AAA alkaline batteries. There's a video input jack, earphone jack, external aerial jack and a.c. adaptor jack.

The LCD panel is illuminated from the rear and produces the picture by either allowing the light through or blocking it to a greater of lesser extent. Natural light (outdoors), a back-lighting attachment or other light source can be used. The panel consists of two sheets of glass with a gap of about 0·3 mil between them: the twisted nematic (TN) liquid crystal material fills the gap between these sheets. Two sheets of polarising material cover the rear and front surfaces of the panel. Inside the panel are 122 horizontal row elements backing one glass sheet and 148 vertical column elements backing the other sheet. The intersections of the row and column elements produce the pixels.

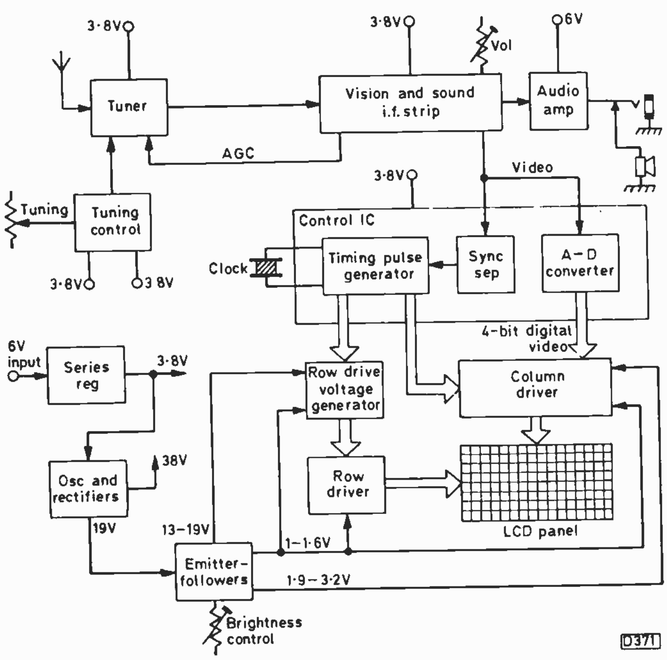


Fig. 1: Block diagram of Citizen's LCD TV receiver.

Light entering the rear of the panel is first polarised, i.e. only light waves polarised in one direction are allowed through by the rear polarising sheet (ordinary light has random polarisation). The effect of the TN liquid crystal material is to change the polarisation of the light by 90°. The second polarising sheet at the front allows this light through. Control of the panel's light transmission is achieved by applying an electric field to each row/column intersection, i.e. pixel, in turn. The fields alter the alignment of the liquid crystal molecules with the result that the light transmission characteristic changes.

A block diagram of the Citizen receiver is shown in Fig. 1. The top part is conventional – a tuner, i.f. strip and audio amplifier – the rest is not. The LCD panel requires row and column drive, and there are 122 rows not 625 lines. The heart of the set is the control i.c. which provides synchronised timing for the display drives and converts the analogue video signal to a four-bit digital signal. This signal is then processed in the column driver i.c., using shift registers, latches and pulse-width modulation. The digital video signal is alternately stored in two shift registers, the switching being at 0·3μsec. When a complete line of video signal has been stored it's read out at a rate that conforms with the row timing. It's then converted to pulse-width modulation to drive the column electrodes. The row drive circuit addresses the row electrodes in sequence: when a row is switched on, the column electrodes apply the pulse-width modulation to the pixels in that row.

The brightness of the display is varied in two ways, by the pulse-width video modulation and by the brightness control which sets the amplitude of the pulses applied to the column electrodes. Note that the brightness control has to vary several voltages so that its operation does not affect the pixel address switching.

It's necessary to generate higher voltages than the 6V input: the varicap tuning system requires 38V while the row address system requires up to 19V. An *LC* oscillator and two rectifier circuits produce these higher voltages.

Some sophisticated electronic technology is used in the set and the construction is a masterpiece of miniaturisation – the PCBs use surface-mounted component technology. We found the set to be sensitive, using its built-in rod aerial, and easy to tune. What of the picture? We feel that any attempt at lengthy viewing would not be easy on the eyes. But then the set is not meant as a main TV picture source, rather as a portable picture source to refer to as and when the user wishes to do so. The limited resolution unfortunately makes most lettering illegible.

TV Fault Finding

Reports from Alan Shaw, Michael Dranfield and Philip Blundell, Eng. Tech.

Thorn TX100 Chassis

This is the best TV chassis produced to date by Thorn-EMI-Ferguson. It's used in sets fitted with various types of tube, certain component values being changed to suit. As with most new TV chassis there's no such thing as a common "stock" fault. Anyone with experience of the later TX9 and the TX10 chassis will be at ease with the TX100. I hope the following notes will be of interest to those who are not too familiar with Ferguson colour sets.

One interesting feature is the automatic grey-scale adjustment. If you reduce the height of the picture you'll see three test lines above the picture area. These test lines (23, 24 and 25) are used to produce a beam current of 10μA to set the c.r.t. cut-off point for each gun. The only variable controls are for the highlights. A start-up delay circuit (TR3 etc.) earths pin 18 of the colour decoder chip when the set is first switched on to prevent the rapid warm-up c.r.t. producing a bright picture that drifts down to black level.

The power supply is built around the popular TDA4600-2 self-oscillating chopper control chip. A replacement must have the suffix -2: the early TDA4600 will not work in the chassis. Start up is via a thyristor (SCR1) which provides a supply to pin 9 of this chip – around 5-6V at this pin is sufficient to get the circuit going. D10 stops SCR1 working once the chopper circuit comes into operation. When the h.t. voltage rises so does the voltage across pins 10-8 of the chopper transformer: this voltage controls the mark-space ratio of the output from the chip. The chopper circuit's normal operating frequency is 20kHz, rising to 60kHz with remote-control versions in standby and dropping to 4kHz when there's a heavy load on the 119V line, e.g. a short-circuit line output transistor.

Important servicing note: the 15V regulator chip IC9, the sound channel chip IC5 and the field output chip IC6 are all temperature conscious – never apply freezer to any of them under fault conditions. IC6 will automatically turn off when the temperature exceeds 175°C. If you apply freezer you'll turn it back on, with possibly alarming results – the i.c. can literally explode, with consequent damage to the board.

Faults we've had to date are as follows. (1) Blown mains fuse due to the chopper transistor TR6 being leaky or short-circuit. Check the TDA4600-2, R121 (27Ω) and R114 (0·47Ω or 0·39Ω depending on chopper transformer), also R115 (330kΩ or 270kΩ depending on chopper transformer) – repeated failure of TR6 is likely if this latter resistor is out of tolerance. (2) Grainy picture due to the r.f. amplifier transistor in the tuner or the SL1432 i.f. preamplifier chip IC1 being faulty. (3) Intermittent field collapse due to C95 (0·01μF) being intermittently leaky. (4) A small picture due to D28 (BY299) being leaky – this diode is present only in 110° models. **A.S.**

Some Quickies

Ferguson TX90 chassis: We've had a couple of these portables in with the mains fuse blown due to one of the c.r.t. fixing screw washers trapping the degaussing coil and shorting it to the earthed c.r.t. rimband.

ITT CVC32 chassis: Blank raster, sound o.k. Check whether R28 (820Ω, ½W) on the mother board is open-circuit.

Amstrad CTV1400/Orion 14PC portable: Intermittent flashing and drifting is usually caused by faulty eight-way channel selection switches but can also be due to a faulty tuning potentiometer bank. Note that while they look the same the potentiometers in non-remote control models are 100kΩ each while those in remote-control versions are 20kΩ each.

Pye 725/737 chassis: For weak field sync check C941 (4·7μF).

Thorn 9000 chassis: Line off speed. C715 (22μF, 275V) open-circuit.

Philips KT4/K40 chassis, remote control versions. Unable to tune any stations, on-screen line not moving and no channel display – the 5V regulator on the VST panel is open-circuit. Remote receive light permanently lit, channel change slow to react – D6103 (BA317) on the VST panel leaky. **A.S.**

Thorn TX90 Chassis

A few of these sets have been in for repair with the same fault – intermittent collapse of the bottom half of the field scan and height variations from the bottom upwards. This is caused by dry-joints around the field output transistors. As there aren't many components in the field output stage we generally resolder the lot. **M.D.**

GEC C2110 Series

Some quickies on these sets.

Field collapse: Check the voltage at the collector of the discharge transistor TR452. If abnormally high (33V) change R455 (470kΩ).

Slight field jitter at the top of the picture: Replace the mid-point voltage preset P454 (470Ω).

Height shrinks as the set warms up: Change the field driver transistor TR453 (AC188).

Picture only ten inches high, with unlocked colour and distorted sound: Replace the 40V supply rectifier D601 on the line timebase panel. A BY210-800 is suitable.

Loss of one primary colour with a dark picture, the relevant first anode voltage being low: Replace the tube base spark gap associated with the missing colour. **M.D.**

Thorn 1790 Chassis

We've had a lot of these sets in for repair lately, all with the no results symptom. In every case the cause has been bad cracking around the mains transformer. One set came in with an intermittent fault: no signals, no video and a jumping picture. When the fault eventually appeared we found that the 90V rail was missing. This was traced to a crack around one of the line output transformer's pins. **M.D.**

Philips G9 Chassis

There was a very odd fault on this set. The top quarter of the field scan was missing: it wasn't compressed or folded

over, and the rest of the picture was normal. The set was left on and after ten minutes the scan had filled more of the screen, leaving a circular patch at the top left. A quick timebase panel swap proved that the fault was in this area and a number of electrolytics in the field timebase were changed: the fault was cleared when C22 (10μF) and C51 (47μF) were replaced. Surprisingly if either one of these capacitors was replaced the fault remained: the two capacitors had to be replaced as a pair and we couldn't find anything wrong with the originals. **M.D.**
(Editorial note: In this chassis changes in the conditions in the field timebase affect the line blanking.)

Philips KT3 Chassis

This set led me a merry dance: there were intermittent black lines at the top of the picture. As usual the fault disappeared as soon as the chassis was disturbed. Over a period of time the decoder panel and the blanking transistor were replaced to no avail. Then one day the test card was on when the fault appeared and I noticed that the top of the picture was bending over to the right. Examination of the soldering on the sync separator and i.f. modules revealed that C2148 at the input to the TDA2540 chip, inside the i.f. can, hadn't been soldered in. **P.B.**

Philips K35 Chassis

This set had no colour till you turned up the brightness. Then along with the colour came flashing horizontal lines. Substitution proved that the fault was in the decoder module. A new TDA3560 decoder chip stopped the flashing lines but a replacement for C66 (100μF) was required to bring back the colour – this electrolytic decouples the 12V supply to the chip. **P.B.**

Long-distance Television

Roger Bunney

March was another relatively quiet month but now that April is here there should be increasing Sporadic E activity – mid-April SpE openings usually indicate a good season ahead. A brief outline of SpE signal propagation is given later in the column for the benefit of new readers.

The repeat performance 27 days after the massive Aurora on February 8th produced little by way of reception here in the south – I noted only heavy patterning from the north on chs. E2/R1 on March 6th. Iain Menzies, well placed in Aberdeen, logged AR signals on the 6th, 7th and 9th, but only NRK (Norway) chs. E2/3 and TSS (USSR) ch. R1, during the later evening periods. NRK/TSS signals were again logged via AR on March 17th, 20th, 22nd, 23rd and 26th. Further information on the February aurora has come to hand. On the 8th a Swedish amateur (SM6PU) heard a US amateur (K1TOL) operating at 50·11MHz (time 0050-0052). SM's aerial was aimed at 279°. During the midnight period K1TOL heard the UK 50MHz beacon on Anglesey (GB3SIX). This shows that transatlantic DX-TV reception must have been possible in Band I, though it would have been of poor quality.

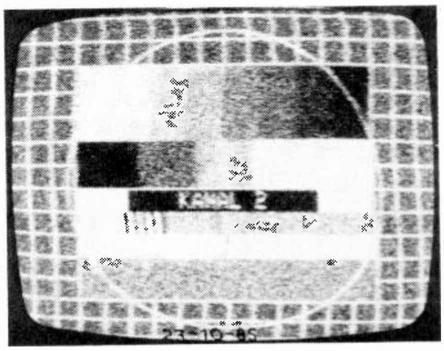
There was minimal SpE propagation during March. The best days were the 18th with TVE (Spain) ch. E3 and TVP (Poland) ch. R1, both at 1220-1230, and the 27th with SR-1 (Sweden) ch. E3.

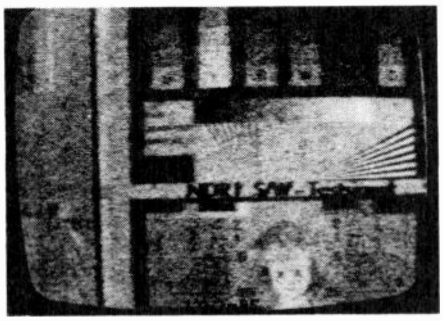
Tropospheric propagation matched the poor weather conditions. There was a slight lift on the 14/15th, giving enhanced reception from France. Dave Shirley at Hastings and Tim Anderson at St. Leonards claim the first reception in the UK of the new French local stations. Dave logged TV5 from Lens on ch. E51 at 0200 on the 15th, with a PM5544 pattern carrying the identifications "TDF" and "RES 5". On the following night he received the Lens TV6 signal on ch. E54, this time on programme with a "TV6" insert at the top right corner, then the PM5544 pattern with similar identifications though "RES 6". The signals were not visible until stronger main network TDF transmitters came on air.

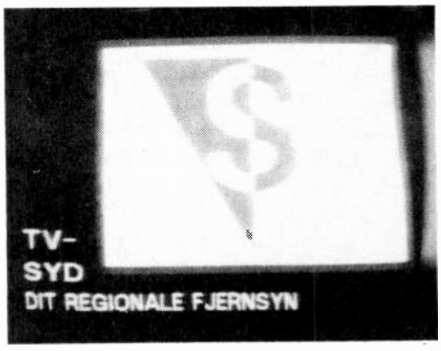
Not an exciting month then, but by the time this is read things should be happening. During the strong gales over the weekend of the 22nd/23rd Cyril Willis's aerial system collapsed: repairs are in hand.

News Items

UK: Gloomy news concerning Band III. It appears that up to five mobile radio networks are to be established in the London area with up to twenty channels each. Regional networks with up to nineteen channels are to be established in Birmingham, Merseyside, Nottingham, Leeds and Central Scotland. National Radiophone should be in operation by the end of the year, covering the London area to the M25 with four transmission sites using twenty channels each.







Left: The FUBK test pattern in use by Copenhagen on ch. E56 at 200W – a French signal transmitted during the October tropospheric opening. Centre: An unusual test card received from Hamburg, ch. E9, in early 1985. Right: A Danish regional identification on ch. E7. Photographs of reception by Ryn Muntjewerff in Holland.

Ireland: The Republic is permitting an experimental amateur radio allocation at 50-51·75MHz, on a limited basis – about twenty operators will be allowed to operate in the first phase, provided there's no interference to cable TV and the RTE-1 outlet at Maghera.
France: A seventh TV network (TV7) is expected to start operations in mid-1987, with programme linking by satellite.
Spain: Full daytime transmissions are planned. We understand that Breakfast TV will be via the TVE-1 transmitters.
In brief: China is to launch a TV/communcations satellite . . . RTM (Morocco) is now testing all day on chs. E25/6, using the PM5544 pattern . . . SBS-TV (Australia) started services from Hobart (Tasmania) and Perth during March, on ch. 28: a new ch. 10 commercial service is planned for Perth.

Satellite TV News

There's been a severe fall off in sales of satellite TV receiving equipment in the USA, mainly because of uncertainty caused by the increased use of scrambling. There have been redundancies in at least two equipment manufacturers – Amplica and Birdview Satellite Communications have announced redundancies approaching forty per cent. The latter company says advances in equipment technology mean that fewer manufacturing personnel are required. There's also a general move to Ku band (11·7-12·2GHz) operation by cable programme originators in the USA in order to avoid their material being received without payment by those with C-band TVROs. Major NBC feeds have recently been transferred to the SBS-3 satellite at 95°W (transponder 1) in preference to adopting scrambling in Band C. Anderson Scientific has produced a "low-cost video stabiliser" which will unscramble VideoCipher 2 and Oak-Orion transmissions – the former has digitally encrypted sound, which is likely to pose a problem.

The AUSSAT satellite is now relaying ABC-TV (Victoria) TV programmes on a full-time basis. Interesting that Tony Dunnett in North Island, New Zealand has received the C-band downlink at his company's NZ location. Tony's company (SAT-TEL – no connection with the UK firm of the same name) makes dishes in sizes up to 3m and LNAs down to 50°K.

Fringe Electronics FM Radio Preamplifier

Fringe Electronics Ltd. (Fringe House, 50 Mansfield Road, Clipstone, Notts NG21 9EQ) has introduced a mains-operated, set-back preamplifier intended for use with f.m. radio equipment: the noise figure quoted is 1·9dB and the claimed gain is typically 20dB. I've recently had one for assessment. Internally the single stage of amplification, using a bipolar transistor, has bandpass input tuning and a tuned collector load circuit. A voltage stabiliser is incorporated and the circuitry is built on a high-quality, low-loss PCB. I've no criticism of the construction. The noise could be checked only subjectively but measurements of gain were made. Over the 88-108MHz band the gain varied from 22dB to 23·5dB, comfortably exceeding the claimed figure. Gain was also checked at various frequencies outside the band to assess the response to known or possible sources of high-level interference. These tests indicate that the unit should minimise if not eliminate all but the strongest local sources of interference. At 41MHz the gain was −25dB, at 50MHz −18dB, at 65MHz −5dB, at 75MHz +7·5dB, at 146MHz −17dB, at 160MHz −28dB and at 170MHz −43dB: 50 and 146MHz were chosen in view of current or pending amateur radio operations while 75, 160 and 170MHz were chosen since they relate to PMR activity.

Checks with weak signals above 100MHz in all instances gave a very clean improvement to a signal that had previously been just above the noise level. In general a weak signal at the noise level was raised to give acceptable, "cleanish" mono reception. I found no evidence of overloading at the bottom end of the band despite the presence of very strong signals locally – this was when listening to weak commercial/BBC stations between strong local ones. It's possible however that the gain could be too great for use with inferior tuners/receivers with bipolar front ends (and thus more susceptible to overloading). My own receiver, a mid-range Sanyo with MOSFET front end, gave no problems. I tested the amplifier thoroughly with a view to DX-FM use and the results were excellent.

The unit comes blisterpacked and sells for £15·75 plus VAT. With appropriate splitters it could also be used in a distribution network.

Old Sets for Disposal

Two elderly sets have recently been passed on to me – they'll be dumped if no one wants them! The first is a mid-fifties Ekco mains/battery portable, Model TMB272. It was working when put into store many years ago. The other is a set I know better – a Bush TV62 in a Bakelite cabinet. I used this type of receiver for many years and can recommend it despite it being made back in 1957: it works, the screen lights up and the cabinet is uncracked –

it'll be a collector's item in years to come! These sets are free but must be collected (Southampton area). If interested, drop us a line with s.a.e. The TV62 can be converted to 625-line operation but it would be nice to see it left as a memorial to 405 lines.

New Book

The latest publication from the BATC (available from 14 Lilac Avenue, Leicester LE5 1FN) is "The Best of CQ-TV". It contains the more important and innovative articles that have appeared over the last five years in the BATC journal *CQ-TV* – interest in amateur TV has increased greatly in recent years and back copies of the magazine are now generally unavailable. The articles cover operation at both 70cm (435MHz) and 23cm (1·3GHz), f.m. and a.m. video, test equipment and even a vision mixer, with full circuit diagrams and with some PCBs offered to members. I truly recommend this 100-page (A5 format) book: it's well worth the £3·50 (including UK postage) price, being packed with information. Overseas readers should send a London based bank draft and include sufficient extra postage.

Australian Channel Allocations

Robert Copeman (Melbourne) has sent us an up-to-date listing (May 1986) of the Australian v.h.f. and u.h.f. TV channel allocations (see Table 1). The B/G system applies, i.e. with 5·5MHz sound-vision spacing and also PAL colour. Note that the use of Band II for TV is being gradually phased out as the number of f.m. radio stations using the band increases.

From our Correspondents . . .

First a couple of corrections. In the December 1985 column we showed a Tele Malta Corporation test pattern received by Mel Thurlbourn whilst he was in the area and suggested that the power of the ch. E10 transmitter was 10kW. Edmond Friggiere tells us that the power is less than 2kW. In the April issue we showed a slide received by Marios Colocassides in Cyprus and captioned it as being from Tunisia. We got the channel right (ch. E33) but the transmission was from Beirut.

In the April column we mentioned a query about reception of an AFRTS signal in Rastanura, Saudi Arabia, on ch. E27. A London-based reader has solved this mystery for us. The source of the signal is a 100W transmitter owned/operated by the Omani Prime Minister. It's of Acrodyne manufacture and is fed with signals from an 11m Scientific Atlanta Intelstat (B standard) earth station. Apparently there are several such receive-only stations dotted around the Gulf area, privately owned by prominent people. The Omani transmitter broadcasts the AFRTS-Southern Europe service for the benefit of local residents, taking the feed (without censorship) from transponder 9 on Intelstat V F-02. There were plans at one stage for a similar service in Abu Dhabi. Interesting that in Turkey the AFRTS relay is delayed for 24 hours for censorship purposes – even for US Forces!

Table 1: Australian TV channel allocations.

Ch.	Freq. (MHz)	Ch.	Freq. (MHz)	Ch.	Freq. (MHz)
0	45-52	33	561-568	53	701-708
1	56-63	34	568-575	54	708-715
2	63-70	35	575-582	55	715-722
3	82-92	39	603-610	56	722-729
4	94-101	40	610-617	57	729-736
5	101-108	41	617-624	58	736-743
5A	137-144	42	624-631	59	743-750
6	174-181	43	631-638	60	750-757
7	181-188	44	638-645	61	757-764
8	188-195	45	645-652	62	764-771
9	195-202	46	652-659	63	771-778
10	208-215	47	659-666	64	778-785
11	215-222	48	666-673	65	785-792
28	526-533	49	673-680	66	792-799
29	533-540	50	680-687	67	799-806
30	540-547	51	687-694	68	806-813
31	547-554	52	694-701	69	813-820
32	554-561				

Sporadic E Propagation

The "season" for Sporadic E propagation normally extends from about the second week in May to mid-August, with sometimes a minor spell of activity in mid-April and another period in mid-December. The ionosphere's E layer is some 70 miles above the Earth during the day and though reflective to short-wave signals is generally transparent to v.h.f. signals. M.W. signals are normally absorbed by the D layer during the day, though reflection from the E layer occurs after dark when the D layer disperses. Reflection of v.h.f. signals from the E layer occurs when ionised clouds are present. These occur at random and cannot be forecast. Incident Band I signals can be reflected over great distances, typically 500-1,500 miles in a single hop. The higher the intensity of the ionisation the higher the signal frequency that can be reflected. Reflection of Band III signals occurs only rarely: reflection of Band II radio signals is rather more common.

During an opening the reflective clouds vary in number and may be stationary or move at some speed. As a result the signal reflections will vary: the skip conditions change and alternative signals may appear on a channel. With widespread reflection the result is severe interference. Reflective conditions can last for minutes or hours. There's a greater chance of SpE activity when the weather is humid and thundery.

Since SpE signals can be very strong a simple wideband dipole will often suffice for reception: two fixed dipoles mounted at right angles will allow switched coverage of all directions. Alternatively a two-element wideband system with a rotator can be used. Aerial height need not be high – the signals tend to arrive at an angle relative to horizontal – but it's best to have the aerial at 20ft or so to clear nearby objects. Most signals start off horizontally polarised, but a propagation shift tends to occur. The general rule however is to mount the aerials horizontally. We hope to feature shortly a wideband Band I/III design as a DIY project.

Double-hop reflection will bring in signals from 2,000 miles or beyond, signals from the Middle East often being seen in the UK. Use of an indoor preamplifier will often help with weaker signals. Local interference tends to occur in Band I and is best filtered out before amplification: provided premium quality coaxial cable is used there will be little loss and the optimum signal/noise ratio will be maintained.

A 625-line receiver with v.h.f. coverage can be used or alternatively a u.h.f. receiver, preferably with single-knob, slow-motion tuning, can be used in conjunction with an upconverter. Improved results will be obtained by using a narrow i.f. bandwidth to reduce adjacent channel interference. Finally a commercial: my DX-TV book, published by Babani publications, is at present out of print – a new edition is expected shortly.

Other things and other places

Les Lawry-Johns

There's more to life than TV sets, though there are times when this is none too obvious. Anyway, I thought you wouldn't mind if for a change I told you about some other things and places.

The Coat

One of these things is my overcoat. It was made to measure in 1938 by M. Burton and cost 37/6d. For those of you who want that in present day money it comes to one pound thirty seven and a half pence (I think). That coat is as good as new and still fits. It's double breasted and waisted. I've worn it twice during the last thirty years, which all goes to show how many funerals I've attended. Not quite true that, because an overcoat isn't needed in summer. Jealousy will get you nowhere. Oh yes, black melton.

The Journey

Next places. A couple of weeks ago the phone rang during the evening. HB answered it. She sounded a bit excited and I heard her say "We'll come up and get it". Since her daughter Colleen was with us at the time she didn't say anything more about the conversation. After Colleen had left I was told all about it. Colleen had always wanted a small Dachsund and we'd sent out signals a month or two back in the hope of getting one for her birthday. One of the signals had now been answered: there were three puppies ready to leave their mother and we could have our pick. All we had to do was to hang up the Closed sign and pop up to Dersingham. Lovely, but where's that?

I consulted my AA New Book of the Road. It's just up from Kings Lynn, near the Wash. My eye wandered down the A10 to Ely, thence to Cambridge and Theydon Bois to pick up the M25 to Dartford Tunnel. Not far. Any idiot could do it with a full tank of petrol.

On the following Tuesday the tank was full, the oil was checked and we were ready to go. Colleen arrived at nine thirty and we were off. First to the Dartford Tunnel which is practically on our doorstep. I missed it. We circled round and after a slight detour through Bexley we got there. Never mind, we were on our way in my safe and strong hands. Straight up the M25 towards Theydon Bois, steer to the right and up the M11 and on our way to Cambridge. On and on like the brave six hundred my Grandad used to sing about. Harlow came and went, then Bishop's Stortford. Flashing along the motorway while other cars flashed past as though we were standing still.

Undeterred we fought our way up past Cambridge and on to Ely, my eyes like diamonds behind my new specs (first time wearing them for two years), though I must admit they were getting tired. King's Lynn loomed up and we went round a roundabout and took the A149 past Castle Rising on the left and finally hit Dersingham. By now the Ouse was ousing all over the place and had been for some time: waterways to the right of us, waterways to the left. On we went, past the fish and chip shop, slowly now, looking for the flags. At last we found them and turned into our destination. A man was waiting at the gate. He'd been waiting for a long time.

HB jumped out and greeted him profusely. I was amazed. Then Colleen did the same. I got out and we shook hands like gentlemen.

"This is my Uncle Roy" said HB.

"Well I'm buggered" said I.

"This is my husband."

"Well I'm buggered" said Roy.

HB hadn't even said we were going to relatives.

Into the house where Roy's wife greeted us warmly. Colleen looked at the large box on the floor from which some wimpering issued. "Goodness, aren't they beautiful!" she cried. One had a black patch on its back. She leaned over and picked him up, then realisation dawned. "He's yours" we told her.

We had lunch and gossiped. I finished off my whisky and started on some wine. They'd a lovely garden where the birds were well catered for. While we were admiring its features we saw a bag containing a marrow and some beans being passed over the wall on a rope. Roy took the bag in and came out with a bottle of home-made wine. It was tied to the rope and and pulled over the wall. Nary a word was said.

"Does that happen often?" I queried.

"Several times a week – the wife makes good wine."

"So I'd noticed."

By now it was almost two and I was beginning to wonder how long it would take to get back. So with Dacksy in a box and plenty of food for him we took our leave and departed, heading for King's Lynn. Somehow I took the wrong road and we went through miles and miles of country. There wasn't much sun but what there was I kept to the right of me so I knew we were going south. Eventually we arrived at Ely. HB glanced at the petrol gauge. "We're half empty."

I'd also been looking at it. "We're half full" I said.

We were well on the way to Cambridge now, but instead of bypassing it I found myself in the town centre. So many bikes, I've never seen so many. We went round the market square just for fun and headed out of town, eventually finding the M11. Down we hurtled while cars flashed by in the outer lane. The petrol gauge by now read very low. It suddenly occurred to me that there are no filling stations on these motorways. I didn't want to go off and get lost again; I also knew that an empty reading meant that there were still two gallons on board. But at the speed we were going they wouldn't last very long. So I gritted what teeth I had and slowed down. We crept along the M25 and under the Dartford Tunnel. Then along the A3 till we were able to fill up just three miles from home. We were glad to be back. Dacksy had slept all the way and even Douggie (Colleen's husband) likes him.

So much for the trip and its confusions. I don't know how ET manages it: from one end of England to the other about twice a week. But I'm not that bad at navigation. JAR gets lost trying to find his way from one side of London to the other (almost) on a good day with the light behind him . . .

Oven Problem (Microwave)

You remember HB's sister Dot – her with the brown eyes? Well Dot has a microwave oven with two bulbs in it.

These are in series which means they are rated at 125V (20W). One went so they both went out. HB brought the good one down so that we could match it. We couldn't. Not only becuase we don't have any 125V bulbs but also because the base is slightly larger than the normal SES.

So HB trudged around the town, getting the same response. One shop assistant gave her detailed instructions on how to get to our own shop, which pleased her no end. Our wholesalers don't seem to have them either, so Dot's going to have to make do with a one lamp (240V) oven with the other lamp shorted out. If we can find a 240V lamp with that unusual base.

Servicing Sinclair Microcomputers

Part 2

Ken Taylor

Last month we considered some of the i.c.s used in microcomputers and ended with a block diagram of the simplest computer possible. It had just a Central Processing Unit (CPU – the microprocessor), a Read Only Memory (ROM) that contained the operating instructions, a Random Access Memory (RAM) for storing the program and data and an Uncommited Logic Array (ULA) for doing all the hardware jobs, including interfacing with the TV modulator and the tape input/output ports. Fig. 5 last month was in fact a block diagram of the Sinclair ZX81 microcomputer which is probably the simplest possible home computer design. We'll now examine this model as an introduction to computer servicing.

In producing such a simple computer Sinclair Research introduced several features which make both the circuitry and operation rather different from that of the more usual type of microcomputer. For instance, where have all the other chips one might expect to find gone? The ones that generate the TV display signals and the decoder chips that decide whether it's the ROM or RAM you want? Or the special that looks after the keyboard? They all seemed to be essential in the Amstrad machine described in this magazine last year. In the ZX81 these jobs are all shared between the CPU and the specialised circuitry in the ULA, the timing and decision making being carried out by the former. There's a penalty to be paid for doing things in this simplified way however: the time the CPU has available for processing the program is severely limited. In fact whenever there's a display present the CPU is free only for the period of the field flyback – for the rest of the time it's producing the line sync and display details!

Sinclair ZX81 Circuit

So when you study the ZX81's circuit details (Fig. 1) remember that this is a very specialised machine with a component count unlike most other microcomputers, though it does have a standard CPU and a system that functions in the same way despite looking so different.

Further examination of Fig. 1 will help to explain some of the differences and clear up many of the problems described above. You'll see that the ULA chip is connected to the TV and tape circuits directly at pins 16 and 20. It can decode the address lines and then enable either the RAM or the ROM via one of the Chip Select (CS) lines at pins 12 and 13. It also assists the CPU in reading the keyboard, via the KBD0-KBD4 lines. These link the ULA to the keyboard via a five-pin socket (KB1) that's not shown in the diagram. This PCB-mounted socket connects the keyboard "tails" to these lines while an eight-pin socket (KB2), also not shown, connects the other keyboard tails to diodes D1-8. The ULA also produces the 3·25MHz clock signal from the 6·5MHz ceramic filter (X1) connected to pin 35.

The machine has only 1Kbyte of RAM fitted to the board. Provision is made for this to consist of either one 4118 memory chip or two 2114 chips. There's also provision for fitting a 2Kbyte RAM for the export model. The usual memory extension consists of a 16K unit which plugs into the edge connector at the back of the machine. Fitting an extension memory disables the internal 1K memory however – the following test procedure assumes that only the internal memory is in use.

The data lines to the ROM and RAM and some of the ROM address lines incorporate buffer resistors. These enable the lines to be used by more than one device without conflict. They are very useful in a fault situation for determining which device is still functioning satisfactorily. Lines downstream of these resistors are given an identifying accent, e.g. A1'. The edge connector also has these identifications on some of the contacts to show which side of the resistors link up with them.

There have been at least three versions of the PCB. Fig. 1 represents the issue one board but I've experienced no difficulty in identifying the circuitry on later boards. They vary a little in layout but the component numbers on the boards seem to be the same. One of the only differences on the issue three board is the use of individual resistors in place of packs RP1 and RP3 – R35-42 and R43-47 respectively. There's a photograph of an early version of the issue one board, without component numbers, on page 162 of the ZX81 BASIC Programming Book that was supplied with every machine. This photograph shows all the i.c.s mounted in sockets, which certainly isn't the case with later boards. Note also that the ULA is called the "Sinclair Computer Logic" which is a less standard but perhaps more sensible name.

The power supply unit is separate from the computer and connects to it via a 3·5mm jack plug. It's not shown in Fig. 1 but is a simple d.c. unit that gives very little trouble – except for the moulded jack. If you have one that's been changed, make sure that the tip is positive.

Initial Checks

When the computer is first switched on the display should consist of a white-on-black K (inverse K) cursor at the bottom left of the screen.

If it doesn't, carry out the following simple checks. Remove any extension memory plugged into the rear connector. Check the power supply – the plug should provide an open-circuit voltage of about 14V, tip positive. If the plug has been changed for a solder-on type it's easy to check the on-load voltage which should be about 11V. This will show whether an overload or open-circuit con-

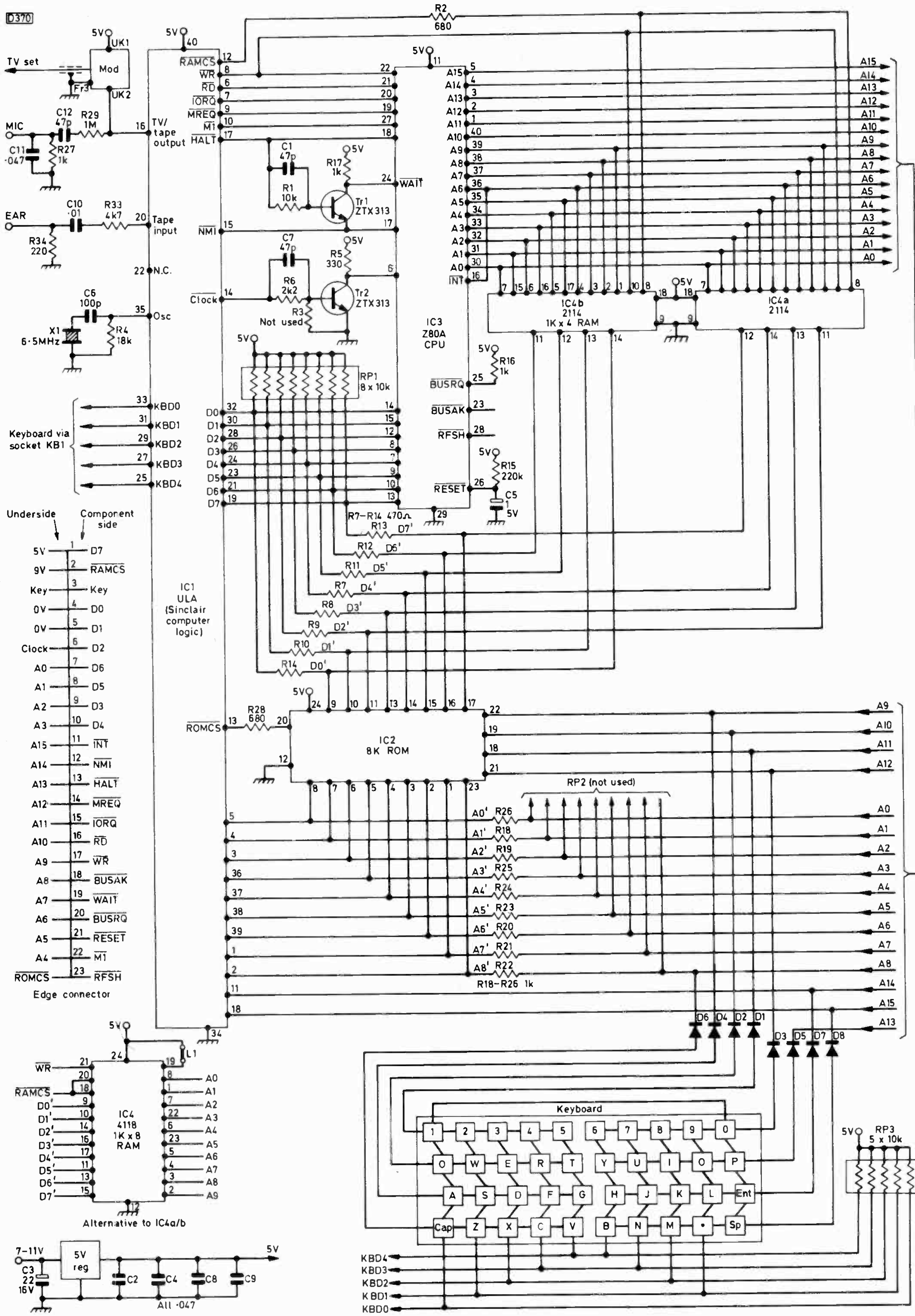


Fig. 1: Basic circuit diagram for the Sinclair ZX81 microcomputer.

dition is present in the machine. In the latter case suspect that the plug has at some time been connected with reversed polarity – this often blows the 5V regulator and saves the rest of the circuitry.

Check the tuning. The modulator is usually set to channel 36 quite accurately, but sweep the band in case the tuning has moved or been altered. If there's no output signal from the ULA the modulator's output will consist of carrier only, devoid of even sync signals. In this case the indication on the TV screen will be negligible.

Dismantling the ZX81

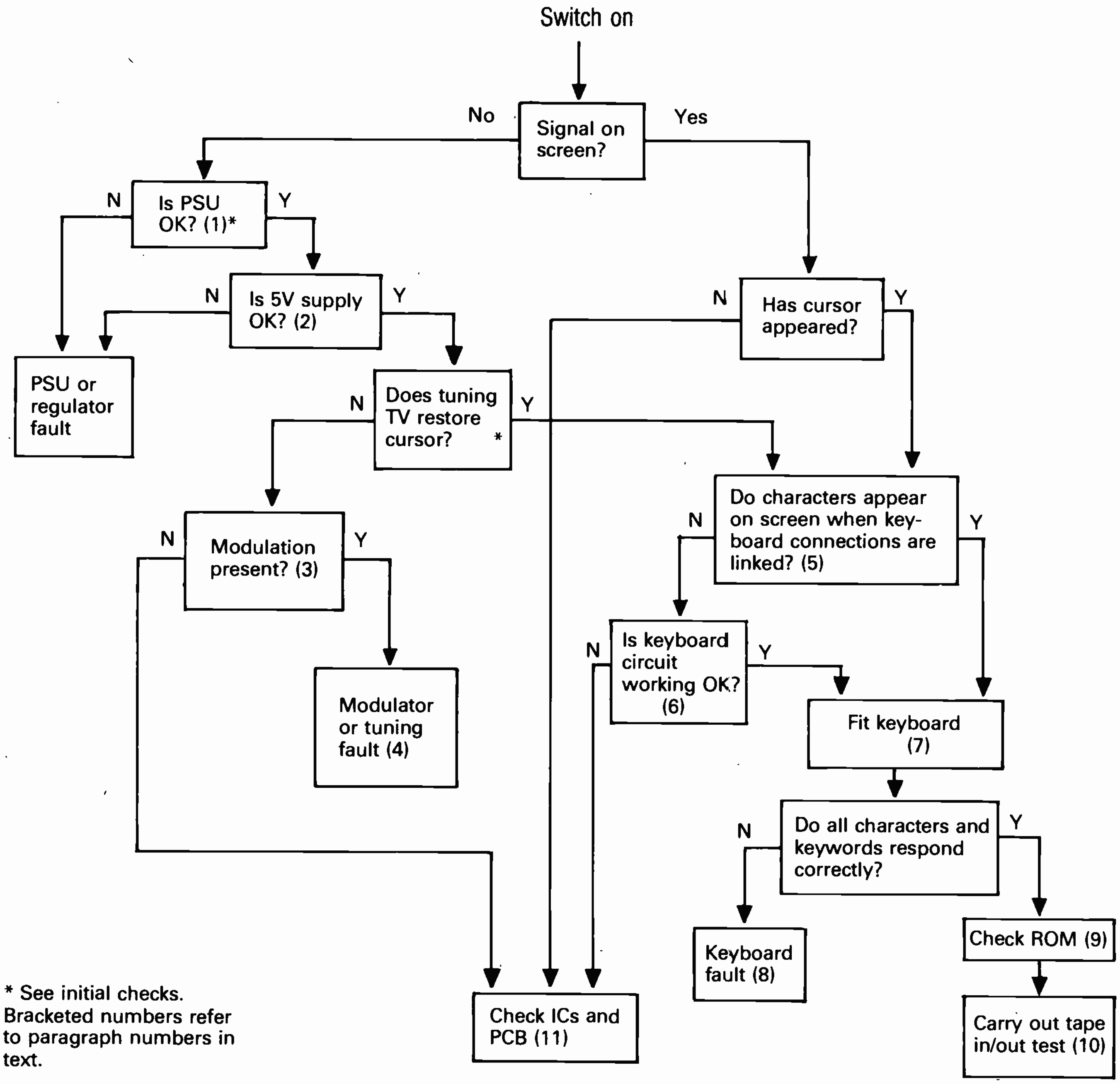
If you haven't found the fault by now you'll have to make internal tests. This means dismantling the unit. First remove the four screws from the base. Three of these should be hidden under rubber feet – if these are still there (the two at the front and the one at back left). Lift off the base and remove the two screws securing the PCB. If you turn the board over towards the front the keyboard tails can be removed from the two sockets. Treat these plastic strips with the utmost care – they are very easily damaged (more about this later).

With the board completely removed the TV and power supply leads can be reconnected. Initialisation of the computer to give the inverse K cursor display occurs without the keyboard being connected, so we can leave it disconnected until the fault has been found.

Fault Finding

Table 1 provides a quick fault-finding sequence: the numbers refer to the following paragraphs which give details of the procedure. Remember that there can often be more than one fault present, so repeat the sequence if necessary.

Table 1: ZX81 fault-finding sequence.



* See initial checks. Bracketed numbers refer to paragraph numbers in text.

(1) The power supply should provide about 11V at 400mA on load. Less than 7V will be insufficient for the regulator to function correctly. An excessive current reading indicates a fault on the board.
(2) The regulator should deliver 5V to each of the i.c.s on the board. Its heatsink normally runs hot to the touch, but not unbearably so.
(3) The signal from pin 16 of the ULA chip to the modulator should give a 'PH' indication on the logic probe (see Table 2). An oscilloscope should display a signal of 2V peak amplitude from the peak to the bottom of the sync pulses. Inverse K will produce a very faint signal near the end of the field trace.
(4) If the modulation signal is present but the TV output is absent check the modulator's supply voltage and the tuning adjustment screw – this should be approximately 3mm down inside the former.
(5) If the cursor is present, connect one of the contacts of the small keyboard socket KB1 to a contact on the large socket KB2. Check whether a character or keyword appears on screen. Don't worry about shorting more than one connector in either of the sockets as this won't cause any damage to the computer – but it won't produce a display either as the software checks that only one key (apart from the shift key) is being pressed before it produces a screen display.
(6) Two faults that can affect the keyboard circuit are shorts between the lines or open-circuit lines or diodes. They can be identified by their effect on the system. Open-circuits affect only the keys they connect (see Fig. 1). A short effectively holds one key on, disabling the whole keyboard. Faults can occur anywhere in the circuit, from the address bus side to the diodes to the ULA chip's KBD pins. Check for shorts where the PCB tracks run obliquely under socket KB1. The resistance between these KBD tracks should be a few thousand ohms.
(7) The keyboard connection tails are very vulnerable, so to avoid unnecessary work make a thorough check that the computer is working satisfactorily before reconnecting the keyboard. Connect each contact on the small five-pin socket KB1 to at least two contacts on eight-pin socket KB2, checking the screen entries. Finally make sure that the tails are not splitting across (see following paragraph) and that the metallised contacts at the ends are in good condition. Then reconnect the keyboard by turning the case face down, front towards you, with the PCB laid component side up on the case so that the edge connector is at the front left: loop the tails over and push them carefully into the sockets, with a slight rocking movement. Don't push too hard or the plastic will buckle and split. When both tails have been fitted turn the PCB over on to its screw pillars and secure with two short screws.
(8) Often one bank or row of the keyboard fails to operate. This is usually due to cracks across the plastic tails severing one or more of the tracks. If the crack is near the end of the tail a clean square cut can sometimes be made, removing the fault. If not too short the tail can then be refitted. As mentioned above the end contacts of the tails should be checked to make sure that there's a good contact for the connectors. If the ends look a little dirty don't be tempted to apply a liquid solvent cleaner – some of these attack the plastic (they don't soften it, they completely disintegrate it!).

If a satisfactory repair proves to be impossible a new keyboard will have to be fitted. These are readily obtainable and are easy to fit to the case with the self-adhesive backing.
(9) Here's a simple ROM check to establish that all the bytes of memory are being read correctly. Although it's unlikely that a ROM fault could continue to be present at this point in the test sequence without being detected the check will set your mind at rest. Enter and run the program below – it takes just over a minute to run. Check that the answer printed out is 855106. If the answer is 854885 the ROM is an early version. To prove this enter: PRINT SQR ·25 (square root of a quarter). An answer of 1·359 instead of ·5 proves that the ROM is an early type which has a few faults. Any other answer to the program indicates a ROM error. Here's the program:

```
10    FAST
20    LET L = 0
30    FOR N = 0 TO 8191
40    LET L = L + PEEK N
50    NEXT N
60    PRINT L
```

(10) At this stage it remains only to check the tape save/load operation and box up the computer. Put in a short program – the one above will do – and save it on tape. Switch off the machine to clear it, then restart and load the program. These operations are both described in Chapter 16 of the BASIC Programming Book supplied with the ZX81.

If the tape tests o.k. the case can be assembled, the four screws fitted and the rubber feet restuck in their sockets.
(11) This is the stage you'll probably end up at if the computer has suffered major damage. You've proved that the fault lies in one or more of the chips or on the PCB.

First check whether the computer has been repaired previously. If you find evidence of modifications or soldering, check the board carefully for solder splashes, shorted tracks etc. Where Sinclair Research fitted i.c. sockets originally I've found that they fitted them to all the i.c.s. So if you find a board that has sockets for some of the i.c.s treat it with suspicion – it's probably been modified.

I don't intend to tell you how to extract a suspect i.c. but let me tell you one of the pitfalls of the method I use in order to illustrate an elusive fault condition. I use a sucker on each pin of the i.c. and having removed most of the solder finally free each pin with a pair of pliers and if necessary the use of solderwick. This often leaves the odd pin still slightly secured in the hole: as the i.c. is carefully removed it's important to free any such pins before they lift and break the print. It's very easy to end up with a print crack on the top of the board and if undetected this crack will be covered when the socket is fitted. So if you have a particularly difficult fault, make sure that this hasn't happened. Check the signals at the i.c. pins and at the line end (the next component) to ensure track continuity.

Checking the ICs

Next, i.c. checks. Table 2 lists the conditions at each pin of the i.c.s. The readings were taken using the Tandy Micronta logic probe featured in last November's issue of *Television*. The computer was at the inverse K cursor stage and the supply for the probe was taken from the 5V rail – I always fit a short wire with a small loop to the 5V plated-through hole near the regulator.

To simplify checking, the pins are listed in numerical order in Table 2 though quick checks at selected pins might speed up the testing. For example I always make an initial check on the 5V and chassis pins of all the i.c.s, then the reset line and memory request pins of the CPU and the cell select and read pins of the ROM and RAM chips. But this is only my own view of what are the more important checks or those most likely to lead to a fault indication. All the pin signals are listed, even those directly connected to the pins of other i.c.s, as this makes for easier checking. As mentioned earlier when describing the circuit some data and address lines incorporate buffer resistors between the i.c.s. These can be very useful as failure of an i.c. at one end of a resistor won't affect the i.c. at the other end, so you can establish with certainty which i.c. is faulty.

It's often easy to locate a fault or anomaly in the signals on the lines but very difficult to establish the reason. The unnecessary removal of a 40-pin i.c. is a non-profitable pastime to be avoided if possible. Other approaches can be adopted. One that has been with us since the earliest days of printed circuits is to cut the track. This is useful for tracing shorts, the computer equivalent of which is the loss of a logic signal. When deciding where to make the cut remember what was previously said about track cracks under sockets and try to avoid making any cut that would subsequently be covered by a socket. Another method of checking a suspect i.c. is to mount a good one on top piggy-back fashion: the legs should be sprung in and care taken to ensure that there's contact at all the pins of the suspect i.c. This doesn't always work but it's worth a try when you have two or three suspect soldered-in i.c.s. The method complements track cutting as it's particularly effective with open-circuit chips.

One last tip. When you suspect that ULA chip and don't have a spare – I usually suspect the item for which I don't have a replacement – remember that the TV screen will be bright if the ULA is all right, even if all the other chips are defective. So a bright screen without a cursor usually means that you should look elsewhere for the fault.

Table 2: Signals on the i.c. pins.

Pin	*IC1 (ULA)*	*IC2 (ROM)*	*IC3 (CPU)*	*IC4a/b (RAM)*
1	P	P	P	P
2	P	P	P	P
3	P	P	PL	P
4	P	P	P	P
5	P	P	P	P
6	P	P	P	P
7	PH	P	P	P
8	PH	P	P	P
9	P	P	P	L
10	P	P	P	P
11	P	P	H	P
12	P	L	P	P
13	P	P	P	P
14	P	P	P	P
15	PH	P	P	P
16	PH	P	P	P
17	P	P	PH	P
18	P	P	P	H
19	P	P	P	
20	L	P	PH	
21	P	P	P	
22	OC	P	PH	
23	P	P	H	
24	P	H	PH	
25	H		H	
26	P		H	
27	H		P	
28	P		P	
29	H		L	
30	P		P	
31	H		P	
32	P		P	
33	H		P	
34	L		P	
35	H		P	
36	P		P	
37	P		P	
38	P		P	
39	P		P	
40	H		P	

P = pulse, high and low LEDs lit.
PH = pulse and high LEDs lit.
PL = pulse and low LEDs lit.
H = high LED lit.
L = low LED lit.
OC = no LED lit (open-circuit).

Spares

The above paragraph reminds me that I mentioned in the introduction to this series last month that Sinclair spares are readily available. The supplier I use is PV Tubes, 104 Abbey Street, Accrington, Lancs BB5 1EE – 0254 36 521 or 0254 32 611. I find that when in a hurry a phone call quoting my Access card number will rush a spare to me – sometimes by the following morning. (Editorial note: the full address of CPC, mentioned in Roger Burchett's letter last month, is CPC Electronic Component Distributors, 194 North Road, Preston, Lancs – 0772 555 034).

This concludes the notes on servicing the ZX81. Next month we'll start on the Spectrum and Spectrum Plus.

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a £1·50 cheque or postal order (made out to IPC Magazines Ltd.), the query coupon and a stamped addressed envelope. We can deal with only one query at a time. We regret that we cannot supply service sheets nor answer queries over the telephone.

SONY KV2704UB

There are vertical stripes right across the screen, darker on the left-hand side and more noticeable on a plain raster than a picture. There are also outlines to the left-hand side of verticals. These are more noticeable on faces and clothes. An outdoor aerial is in use, directly aligned with the transmitter.

For the striations we suggest you check the damping components in the line scan and EW modulator circuits – R828 (10Ω, 2W), R831 (2·2kΩ) and C834 (0·01μF). If these are in order suspect ripple on a supply line – the 250V supply reservoir capacitor C825 (22μF) is a strong possibility. Scope checks on the supply lines and at the c.r.t. electrodes should lead you in the right direction. If the ghosting effect is still present when the striations have been cleared, try the aerial with another set. If this gives ghost-free reception we would suspect the SAW filter SWF201.

THORN 9000 CHASSIS

The problem with this set is mains fuse blowing. Replacing the Syclops transistor restores normal operation, but only for a few days or weeks.

The cause of this trouble is generally either latchety sockets on the base and emitter pins of the Syclops transistor, dry-joints on the Syclops and/or line output transformer, or intermittent failure of diode W702 or W704 in the Syclops circuit. These things should all be checked, the diodes preferably by substitution.

PANASONIC NV366

The front panel controls frequently lock up – the cassette cannot be removed and all functions except for the clock and programmer are inoperative. Switching off the power for a lengthy period of time restores normal operation until the next lock-up.

Assuming that the supply lines are all present and correct, it sounds as if the syscon microcomputer chip is coming unhinged. Check first that its 5V supply (pin 39) is present and correct, with no ripple/hash. If all is well here you could try a mains "conditioner" before condemning the chip itself (MN1405VKK). A conditioner is likely to help only if you live in an area with a noisy mains supply. You'll most likely find one at the local computer shop – it goes between the VCR's mains plug and socket.

GRUNDIG 8610

The picture is bright and sharp but there's a red background with red flyback lines. Interchanging the red and green drives changes the background to green with green flyback lines. The effect is more noticeable with dark scenes and monochrome film.

Your R-G transposition check leaves little doubt that the problem lies on the RGB panel. Most often this inability to reach black level is due to a changed value component in the relevant R/G/B clamp/feedback circuit. R1916 (100kΩ) and R1918 (470kΩ) are the first suspects. R1902 (220kΩ) which with R1901 biases the base of the pnp transistor in the red output stage is also well worth checking. Make sure that the red drive control R1911 is in order, then if necessary check C1912 (4·7μF), C1914 (0·22μF) and the clamp pulse coupling capacitor C1917 (0·1μF).

RANK T20 CHASSIS

The channel indicator is stuck on 0. All touch contacts seems to try channel selection but 0 remains.

We suggest you dismantle and thoroughly clean the touch contacts, the associated insulating surfaces and even the back of the touch pads. If the fault remains on reassembly it's likely that the SAS580/590 chips are faulty – we generally replace them as a pair (take precautions against static charges when handling them).

THORN 9600 CHASSIS

Occasionally the set functions perfectly. Usually however after switching on it starts up then shuts down. In the shut-down condition voltages are still present at all major points.

The most common cause of this fault is dry-joints on the PCBs. Check the pins of the chopper transformer T512 carefully, then the pins of the line output transformer T801. If necessary check the line drive connecting pins of plug/socket 810 and the jointing and condition of the 0·47Ω series resistor R510.

SANYO CTP7118

The set has an appetite for e.h.t. triplers – a replacement lasts for only about six months. This happened again recently and an examination showed that the casing had burnt through from the inside, near the fixing lugs. R764, which is in series with the EW driver transistor, also needed replacement. This time the new tripler lasted for only half an hour however. The line output transistor, EW modulator diodes and small passive components in the line output stage all seem to be o.k. – we suspect the line output transformer. The h.t. is correct at 150V though excessive demand from the line output stage pulls this down to about 70V.

We would agree that the line output transformer T602 is probably faulty – we've had this happen with more than one of these sets. It's likely however that a faulty tripler ruined the transformer rather than the reverse. There

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should be no more trouble when both have been replaced, but make sure that terminals D and M on the tripler are wired correctly (incorrect connection of these is a common mistake).

TEST CASE

282

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

It's been a long and weary winter and on this spring day everyone in the workshop seemed to be out. Resident Workshop Sage (RWS) was gallivanting in Wales, RT (Real Technician) had taken a precious day's holiday to dig his garden while TS (Techno-Supersleuth) was out on the road fitting a teletext retrokit to a Sony TV set two villages away. The harassed Service Manager eyed the trainee with a beady eye: now was his chance to shine and put some of his college learning to practical use. Problem: his bench was equipped only for audio servicing. SM rigged up a portable 200W isolating transformer, then the mirror from the washroom, and supplied a conductive wristband – the latter a pointless if impressive gesture since there were unlikely to be any chips vulnerable to static in the motley collection of TVs in the waiting-repair queue.

The first of them was an ageing Pye colour set fitted with the 725 chassis. It was accused of intermittent low gain, the symptom being spasmodically snowy pictures. The trainee was in trouble from the moment he switched on! It took some time for the picture to appear, and when it did it was small and fluttering in size. Once tuned in the sound was present but was somewhat overwhelmed by a squeal from the area of the power supply circuitry on the right-hand panel. With these symptoms present the question of snowy pictures seemed somewhat irrelevant. Plainly the power supply department – a thyristor mains rectifier/regulator – was in pain. A circuit diagram was found and a brief study of the arrangements was made.

The trainee decided that a check on the 170V h.t. line at fuse F971 would be a good start, especially as it's so accessible at the centre of the baseboard. The voltage here was found to be low and varying – its average level seemed to be around 140V. The current passed by the fuse was less than 500mA, so the trainee rightly concluded that the problem was not due to any excessive loading on the line. His next move was to squirt all the components in the PSU with freezer. This made the picture contract a little more. A few minutes of poking and prodding in the PSU was terminated when the phone rang. It was TS! He knew all about Pye TVs! Could he suggest anything for the small, fluttering picture on the Pye 725?

TS was full of suggestions. Kick off by backing down the overvoltage trip potentiometer; if the picture still flutters check the trigger diac's 8·2MΩ bias resistor R924; make sure that the feedback resistor R897 hasn't changed value; then suspect the diac (D892) and the thyristor (D888) said he. Magic thought the trainee as he walked back to his bench with a new spring in his step. Alas for pride! So much for experience! None of these things did any good at all. With a new BR100 trigger diac and BT116 thyristor, with the overvoltage trip transistor VT881 taken out of circuit, with replacement resistors in the R924 and R897 positions – and several others – the problem remained. The control transistor VT902 was changed, also its 7·5V reference zener diode, but the fault remained.

Further thought led to a careful check on the huge 3·3Ω surge limiter resistor R978. It measured 3·21Ω. A mighty muffer was procured and substituted for the h.t. reservoir and smoothing capacitors C880 and C877 in turn. It made little difference. An oscilloscope was brought into play and hooked to various points in the PSU, with confusing and inconclusive results. The main message provided by the waveforms was that the h.t. voltage was fluttering and that the conditions around the control transistor VT902 were also fluttering. The one crucial and revealing point in the power supply circuitry never saw the scope probe! What was it? Where did the fault lie? See next month!

ANSWER TO TEST CASE 281
– page 452 last month –

The Hitachi VT33 VCR described last month was suffering from intermittent loss of drum servo lock, the effect being confined to the record mode. The fault condition was related to the white content of the off-air picture being received and recorded. The steps taken during the diagnostic procedure were logical and sensible – almost to the end! The cursory check of the video signal being received by IC202 on the Y/C board was inadequate. With a new i.c. fitted the symptoms remained the same. A more careful check was then made on the video waveform at the input to the Y/C panel. The field-rate display on the scope revealed that the video signal had a d.c. level that wandered wildly, with the field sync pulses on such a steep gradient that they fell across the same scope screen graticule as much of the video signal itself – the effect of poor l.f. response.

The same sorry waveform was present at the i.f./detector panel's video output, but not at the output from the video detector i.c. itself or at any of the three subsequent video amplifier transistors Q851/2/3. What had happened was that the video output coupling capacitor C859 (470μF, 6·3V) had dried up and gone low in value, knocking off the l.f. response.

The simple test to prove all this? The technician should have injected a baseband signal at the video input socket. This would have produced consistently good drum servo locking during record.

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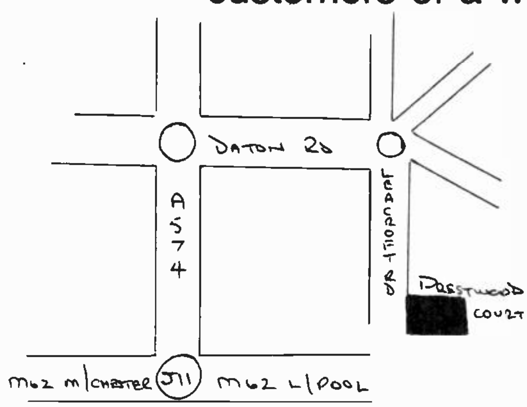

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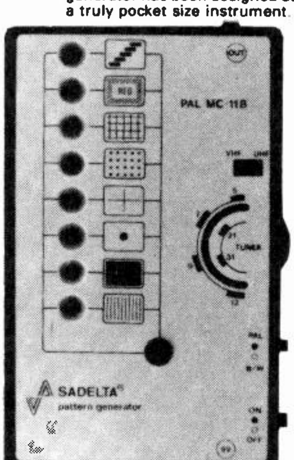

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AN211A	£2.25	CX160	£2.50	HA12035	£9.50	MB3712	£1.50	TA7145P	£1.80	UPC1035C	£1.20	2SA1015	£0.30	2SC1664	£2.50
AN214Q	£1.80	CX161A	£2.50	HA12413	£2.50	MB3730	£1.75	TA7146P	£2.50	UPC1037H	£0.75	2SA1102	£1.90	2SC1682	£0.30
AN217B	£2.20	CX162	£3.40	HA13402	£3.50	MB3731	£2.50	TA7150P	£1.80	UPC1043C	£1.20	2SA1103	£1.90	2SC1741	£0.30
AN228W	£2.75	CX170	£6.50	HA13403	£7.50	MB3756	£2.60	TA7152P	£1.70	UPC1156H	£1.40	2SA1104	£1.90	2SC1815	£0.25
AN236	£2.50	CX181	£8.50	HA13430A	£3.50	MB8719	£3.50	TA7173P	£1.60	UPC1158H	£0.60	2SA1105	£2.25	2SC1826	£0.60
AN239Q	£3.80	HA1124A	£2.75	LA1111P	£0.80	PLL01A	£2.30	TA7176P	£1.50	UPC1161C	£0.75	2SA1106	£2.50	2SC1849	£0.30
AN240P	£1.50	HA1125	£1.50	LA1201	£0.85	PLL03A	£4.95	TA7193P	£3.50	UPC1163H	£0.60	2SA1198	£0.35	2SC1945	£3.50
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AN262	£1.50	HA1156	£1.10	LA1320	£1.50	STK014	£6.25	TA7203P	£1.80	UPC1171C	£1.50	2SB341V	£2.60	2SC2021	£0.30
AN271A	£2.50	HA1166	£1.60	LA1365	£1.20	STK015	£5.00	TA7204P	£1.10	UPC1176C	£1.20	2SB405	£0.80	2SC2026	£0.65
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AN295	£3.25	HA1197	£1.50	LA1460	£1.95	STK020	£4.50	TA7207P	£1.50	UPC1178C	£1.00	2SB471	£3/50	2SC2075	£0.25
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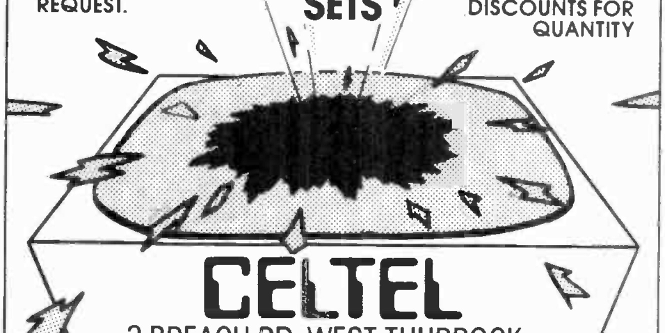

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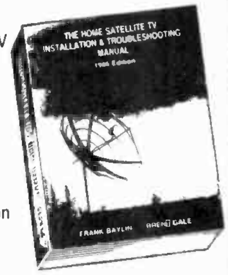

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SONY IC 109	£3.00
MJE660	25p
MJE661	25p
MJE3055	£1.00
MJE2801	30p
MJE2955	50p
MJE13005	50p
Sanikron Diode	30p

Philips Cartridges

GP412	£6.00
GP412/11	£6.00
GP406	£6.00

Transistors

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A1223	15p
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AC121	15p
AC124	15p
AC128	15p
AC137	15p
AC151	15p
AC131	15p
AC138	15p
AC152	15p
AC153K	15p
AC142K	15p
AC169	15p
AC176	15p
AC176K	15p
AC178K	15p
AC179	15p
AC186	15p
AC187K	15p
AC188	15p
AC188K	15p
ACY21	25p
AD143	50p
AD149	50p
AD161/162	pair 40p
AF17A	25p
AF139	25p
AF181	£1.00
AF239	25p
AF367	25p
AL102	£1.75
BC161	30p
BD507	50p
BD509	30p
BD510	30p
BD517	30p
BD519	30p
BD534	30p
BD535	30p
BD544D	30p
BD562	30p
BD610	40p
BD646	50p
BD676A	30p
BD678	50p
BD681	25p
BD807	20p
BD826	50p
BD948	30p
BDX75	20p
BDX32	£1.25
BLY49	50p
BF115	20p
BF121	20p
BF127	20p
BF137	20p
BF157	20p
BF160	20p
BF161	20p
BF164	60p
BF179	30p
BF180	20p
BF181	20p
BF182	20p
BF184	20p
BF194	10p
BF195	10p
BF196	10p
BF197	12p
BF198	10p
BF199	10p
BF200	20p
BF222	10p
BF224	15p
BF238	20p
BF240	16p
BF244	40p
BF245b	20p
BF257	20p
BF258	25p
BF262	15p
BF263p	25p
BF264	15p
BF271	10p
BF273	10p
BF274	10p
BF324	25p
BF337	50p
BF355	30p
BF362	20p
BF363	15p
BF367	15p
BF391	15p
BF394	10p
BF419	10p
BF422	30p
BF423	15p
BF448	30p
BF450	20p
BF458	30p
BF459	30p
BF468	30p
BF469	30p
BF470	20p
BF480	50p
BF494	30p
BF594	10p
BF597	10p
BF858	30p

BF694	10p
BF758	30p
BF760	30p
BFT34	15p
BFT43	10p
BFT84	8p
BFW11	20p
BFX29	30p
BFX84	25p
BFY50	15p
BFY52	20p
BFY90	25p
BLY49	25p
BPW41	25p
BRC116	25p
BRX43	15p
BRX48X	10p
BRY56	30p
BSS68	10p
BSY79	10p
BSY95a	10p
BTY80	20p
BSX19	17p
BSX20	17p
FT3055	30p
TCE82	30p
2N930	5p
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2N2222	8p
2N2906	10p
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2N3566	10p
2N3702	10p
2N3711	10p
2N3583	50p
2N3904	15p
2N4355	10p
2N4442	£1.00
2N4444	£1.00
2N5296	40p
2N5983	30p
2N6099	40p
2N6109	40p
2N6130	50p
2N6133	20p
2N6348	20p
2N6399	10p
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2SA437	20p
2SB407 Sanyo TO3	10p
2SB474	10p
2SB566	10p
2SC381	10p
2SC458	50p
2SC515	10p
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2SC1030	£1.00
2SC1520	25p
2SC1546	20p
2SC1725	20p
2SC2068	20p
2SC2073	8p
2SC2122A	£1.00
2SC2229	15p
2SC2688	20p
2SC7350	15p
2SD180 TO3 80v/6A	15p
2SD200	£2.00
2SD787	30p
2SD880	30p
2SK30A	10p
BC107	10p
BC108	10p
BC109	5p
BC113	10p
BC114	10p
BC115	10p
BC116	10p
BC117	20p
BC119	20p
BC125	10p
BC126	10p
BC139	10p
BC140	30p
BC141	25p
BC143	25p
BC147	10p
BC148	10p
BC149	10p
BC153	10p
BC154	10p
BC157a	10p
BC158	10p
BC159	10p
BC160/16	25p
BC171	10p
BC172	10p
BC173	10p
BC174	10p
BC183	10p
BC184	10p
BC204	10p
BC207	10p
BC212	10p
BC213	10p
BC214	10p
BC237	10p
BC238	8p
BC239	10p
BC250	8p
BC251	10p
BC252	10p
BC262	10p
BC263b	20p
BC294	30p
BC298	10p
BC300	30p
BC301	30p
BC303	30p
BC307	7p
BC308	7p
BC309	10p
BC327	10p
BC328	10p
BC328/338 pair	15p
BC337	10p
BC338	10p
BC347	10p
BC349b	10p
BC350	20p
BC365	10p
BC384	10p
BC394	10p
BC413	10p
BC414	10p
BC416	10p
BC440	30p
BC454	10p
BC455	10p
BC456	10p
BC460	25p
BC462	10p
BC463	10p
BC478	10p
BC527	10p
BC532	10p
BC546	10p
BC547	10p
BC548	10p
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BC559	10p
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BCX32	25p
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BD124 (metal)	30p
BD130Y	25p
BD131	30p
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BD135	25p
BD136	30p
BD138	30p
BD140	30p
BD176	25p
BD182	£1.00
BD183	70p
BD202	60p
BD204	60p
BD207	60p
BD221	20p
BD222	30p
BD228	30p
BD226	20p
BD233	30p
BD235	30p
BD238	30p
BD239	15p
BD240	50p
BD243c	30p
BD244	30p
BD250a	50p
BD252	20p
BD253B	50p
BD331	20p
BD373b	20p
BD416	25p
BD433	25p
BD437	25p
BD439	30p
BD678	30p
BD681	30p
BD682	30p
BF761	30p
BF769	30p
BF819A	30p
BF858	30p
BF871	30p
BFR39	15p
BFR52	7p
BFR79	15p
BFR81	15p
BFR87	10p
BFS60	10p
BFT42	20p
BFT57	20p
MR1366	20p
BRC-M-200	40p
BRC-M-300	50p
BRC 1330	75p
BRC 3064	£1.00
BTT822	£1.00
BTT6016	£1.20
BTT6018/	
ML237B	£1.50
BTT6218	£1.50
BTT8124	£1.00

Thyristors

BT151/800R	80p
BT106 Plastic	30p
BT106 Metal	£1.20
BT119	£1.00
BT120	£1.00
BRC4443	75p
GI1 Thyristor	60p
Decca 80-100	60p
2N4444	£1.00
MCR72-6	25p
OT112	£1.00
TF320M	£1.00
HC8441	£2.00
17052	£2.00
17088H	£2.00
17089R	£2.00
17053R	£2.00
SP2M	50p
MCR72/6	50p

Thermistors

G8 Degausing	35p
Philip type VA1104	70p
ITTP7266312	15p
PTH451 AOR	15p
PT37P Fits Pye & PT34	20p
Degausing Thermistor (fits most sets)	20p
GEC Double Thermistor	25p

Filters

5-5MHz	15p
6MHz	30p
I.C. Heat Sink	20 for £1
20×TO5 Heat Sink	£1.00
CVC 9 power supply board	£1.50
CVC 20/2 mains panel	£2.00
ITT Mains Filter .1/250v/ CVC 20 to 45 chassis	50p
Pots 10 k with Switch	25p
Mullard Surface Wave Filter RW 153P Colour TV Filter	40p
Mullard Surface Wave Filter RW 154 Colour TV Filter	40p

TV Crystals

4MHz	
4.433-619	
6MHz	
8.867238	
11.059.000	30p
Large or small	50p each
NEC 4730312	£3.00
Line Tran Tripler in Case	
Antistatic Isolators	
Disc Type Black	10p
RCA 1693	£1.00

I.C. Holders

DIL – DIL		DIL – QIL	
40 Pin × 4	£1.00	16 Pin × 10	£1.00
42 Pin × 5	£1.00	18 Pin × 10	£1.00
28 Pin × 5	80p	28 Pin × 4	£1.00
16 Pin × 10	70p	AB Mains Switch u/v	30p
24 Pin × 5	75p		
14 Pin × 10	70p		
18 Pin × 10	80p		