DECEMBER 1983

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TELEVISION

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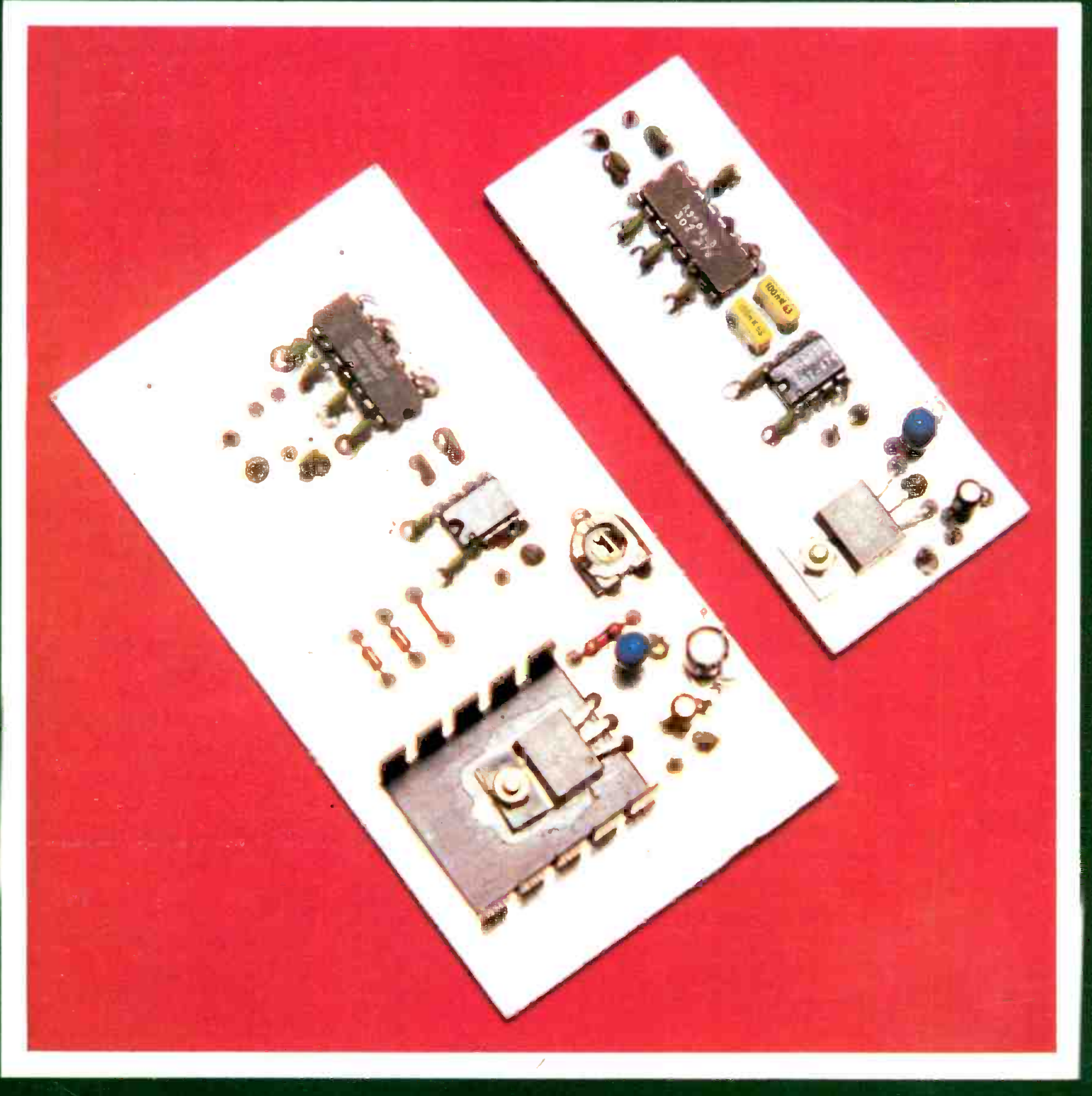

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AN UNUSUAL CHOPPER CIRCUIT

TELEVISION

December 1983

Vol. 34, No. 2
Issue 398

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 £11 in the UK, £12 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
Binders (£4.50) and Indexes (45p) can be supplied by the Post Sales Department, IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. Prices include postage and VAT. In the case of overseas orders, add 60p.

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

this month

65 **Leader**

66 **Practical Prescaler Modules** — *C. Toms*
Two economical prescaler designs capable of handling signals in the ranges 150MHz-2GHz and 150-650MHz. The prescalers are available in kit form or ready built and tested.

68 **Letters**

68 **Readers' PCB Service**

71 **TV Fault Finding**
Reports on TV faults from Mick Dutton, Peter H. Dolman, H. Davies and John Coombes.

72 **Teletopics**
News, comment and developments.

74 **VCR Clinic**
A modification devised by Richard Roscoe to cure tape slack in the JVC HR7300/Ferguson 3V30 range of machines plus fault reports from B. Atkinson, G3TEP, Les Harris and John Coombes.

76 **An Unusual Chopper Circuit**
The chopper power supply used in the latest ITT large-screen chassis (CVC1200 series) provides mains isolation and uses a rather unusual circuit. A brief account of its mode of operation.

77 **Underwater TV** — *Peter Graves*
Getting TV pictures from beneath the sea presents many problems. An account of current practice in this field.

80 **Adding Continental Sound** — *William Falkland*
A simple method of providing a switched 5·5/6MHz intercarrier sound channel for UK or system B/G sound reception.

82 **Quick Checks Q and A, Part 3** — *S. Simon*
How to tackle common fault conditions in the Thorn 3000/3500 series chassis.

83 **Christmas Story** — *Bryon Pascoe*
What happened last time round. A story with a moral about VCRs.

84 **Satellite TVRO System, Part 3** — *Nick Harrold*
This time the sound section of the receiver, including an expander circuit for correct reception from the Gorizont satellite.

86 **Servicing the Thorn 1600 Chassis** — *John Coombes*
A fault-finding guide on this popular 17in. monochrome transportable chassis.

88 **Long-distance Television** — *Roger Bunney*
Reports on DX reception and conditions and news from abroad.

91 **The Betamax Video system, Part 5** — *Eugene Trundle*
The sound section in Betamax machines and a survey of the main models using this format, with notes on some of their quirks.

94 **Who's Cognizant?** — *Les Lawry-Johns*
More admissions on how to do simple jobs the difficult way.

95 **Next Month in Television**

96 **Service Bureau**

97 **Test Case 252**

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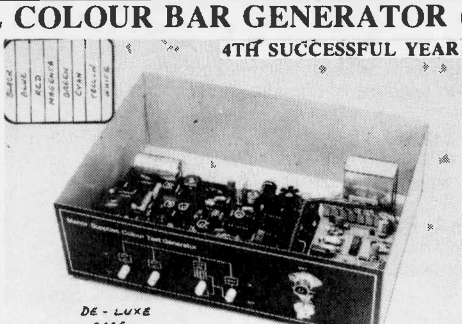

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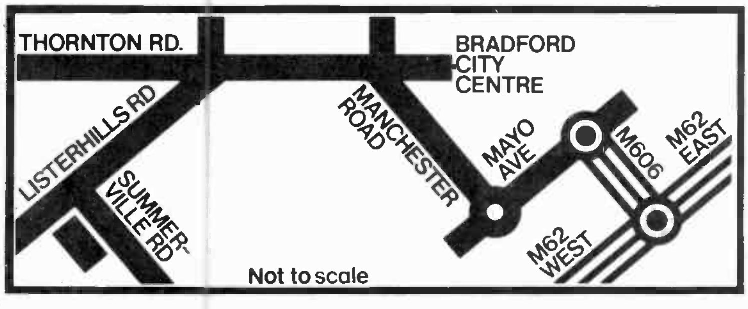

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74LS00	19	74LS37	19	74LS92	35	74LS160	60	74LS251	54
74LS02	19	74LS38	20	74LS93	35	74LS161	60	74LS253	1.00
74LS03	19	74LS40	20	74LS107	46	74LS162	85	74LS257	53
74LS04	20	74LS42	36	74LS109	27	74LS163	60	74LS258	67
74LS05	19	74LS47	80	74LS112	27	74LS164	65	74LS259	74
74LS08	19	74LS48	80	74LS113	27	74LS165	65	74LS273	80
74LS09	19	74LS49	80	74LS114	27	74LS174	57	74LS283	50
74LS10	19	74LS51	19	74LS123	52	74LS175	47	74LS293	70
74LS11	19	74LS54	19	74LS125	46	74LS191	66	74LS352	1.54
74LS13	37	74LS55	19	74LS126	46	74LS192	65	74LS353	1.10
74LS14	46	74LS73	28	74LS132	46	74LS193	66	74LS365	36
74LS15	19	74LS74	26	74LS138	48	74LS194A	69	74LS366	36
74LS20	19	74LS75	46	74LS139	48	74LS197	80	74LS367	36
74LS21	19	74LS76	22	74LS151	44	74LS240	80	74LS368	36
74LS22	19	74LS78	22	74LS153	44	74LS241	80	74LS373	99
74LS26	19	74LS83A	60	74LS155	44	74LS242	76	74LS374	99
74LS27	19	74LS86	26	74LS156	44	74LS243	76	74LS393	80
74LS30	19	74LS85	62	74LS157	44	74LS244	80	74LS670	1.20
74LS32	20	74LS90	35	74LS158	44	74LS245	1.18		

'4000 B' SERIES CMOS

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

SEMICONDUCTORS

AC107	35
AC126	30
AC127	32
AC128	32
AC128K	40
AC141K	39
AC142K	38
AC176	35
AC176K	32
AC186	41
AC187	35
AC187K	38
AC188	35
AC188K	39
AD143	82
AD149	98
AD161	54
AD161/2	1.15
AD162	54
AF106	49
AF114	89
AF118	1.20
AF121	75
AF124	48
AF125	46
AF126	46
AF127	38
AF139	58
AF178	1.54
AF239	60
AL102	2.00
AU106	2.50
AU107	2.00
AU113	2.00
BC107	20
(A),(B),(C)	20
BC108	20
(A),(B),(C)	20
BC109	20
(A),(B),(C)	20
BC114	12
BC115	17
BC116A	16
BC117	30
BC118	24
BC119	36
BC139	28
BC140	32
BC141	26
BC142	30
BC143	31
BC147	13
BC148	9
BC149	12
BC157	16
BC158	16
BC159	15
BC160	25
BC161	28
BC170B	15
BC171	15
BC171A	10
BC171B	10
BC172	15
BC172A	10
BC172B	10
BC172C	10
BC173C	12
BC174A/B	10
BC177	27
BC178	26
BC182	9
BC182L	12
BC183L	12
BC184L	14
BC204	10
BC208	13
BC209	10
BC212	9
BC212L	13
BC213	13
BC213B	10
BC213L	9
BC214	9
BC214	9
BC214L	15
BC237	14
BC238	14
(A),(B),(C)	
BC251A	18
BC252A	12
BC252B	12
BC261A/B	18
BC262A/B	18
BC300	50
BC301	33
BC303	33
BC307	20
BC308A/B	25
BC327	18
BC328	18
BC337	18
BC338	18
BC461	30
BC547	13
BC548	13
BCX32	30
BCX34	27
BC549	8
BC550	7
BC557	8
BC558	9
BCY72	13
BD115	45
BD116A	65
BD124P	79
BD131	50
BD132	49
BD133	60
BD135	38
BD136	38
BD137	38
BD138	35
BD139	35
BD140	44
BD144	1.70
BD159	65
BD160	1.90
BD166	52
BD179	70
BD182	1.20
BD183	75
BD201	85
BD202	91
BD203	80
BD204	99
BD222	46
BD223	56
BD225	47
BD232	68
BD233	60
BD234	63
BD235	60
BD236	65
BD237	57
BD238	65
BD243	85
BD244	85
BD410	79
BD434	74
BD437	86
BD438	94
BD507	52
BD508	55
BD509	56
BD510	60
BD517	60
BD520	75
BD526	62
BD696A	1.49
BD697	1.24
BD695	1.39
BD698	1.50
BD707	95
BDX32	2.10
BF115	38
BF117	36
BF125	26
BF127	47
BF154	23
BF158	18
BF160	27
BF167	24
BF173	22
BF177	52
BF178	46
BF179	28
BF180	39
BF181	39
BF182	36
BF183	29
BF184	36
BF185	36
BF194/394	16
BF195	16
BF196	16
BF197	16
BF198	18
BF199	21
BF200	35
BF224	25
BF225	20
BF241	25
BF256	55
BF257	28
BF258	25
BF259	35
BF262	84
BF263	75
BF271	24
BF273	24
BF274	24
BF310	30
BF311	30
BF336	36
BF337	41
BF338	41
BF355	56
BF362	68
BF363	72
BF371	30
BF457	35
BF458	43
BF459	43
BFR39	27
BFR90	1.74
BFT42	39
BFT43	39
BFW10	60
BFX29	40
BFX84	42
BFX85	30
BFX86	30
BFX88	46
BFY50	30
BFY51	30
BFY51	24
BFY52	24
BFY90	95
BR100	34
BR101	45
BR103	83
BRC4443	94
BRC4444	98
BRX46	40
BRY39	56
BRY56	57
BSW67	68
BSV57B	72
BT100	1.65
BT101	1.20
BT102/500	1.20
BT106	1.60
BT107	1.69
BT108	1.69
BT116	1.21
BT119	3.66
BT120	3.66
BT151/800	1.20
BU104	2.00
BU105	1.58
BU108	1.80
BU124	1.90
BU126	1.75
BU204	1.50
BU205	1.42
BU206	1.80
BU208	1.60
BU208A	1.65
BU208/02	2.10
BU326A	1.75
BU407	1.70
BU500	2.30
BU526	2.46
BU508	3.20
BU806	1.40
BU807	2.94
BUW81A	3.84
E1222	40
MJE340	68
MJ3000	1.98
OT112	1.91
OT121	1.91
R2008B	1.90
R2010B	1.92
R2265	1.50
R2322	62
R2323	67
R2461	1.50
R2540	2.80
RCA16334	90
RCA16335	90
TIP29C	43
TIP30A	47
TIP30C	43
TIP31C	55
TIP32C	42
TIP33B	75
TIP34B	1.06
TIP41C	47
TIP42C	50
TIP47	70
TIP120	65
TIP2955	90
TIP3055	63
TIS91	21
TV106/02	1.80
2N696	21
2N918	82
2N2904	51
2N2905	28
2N3054	60
2N3055	60
2N3702	11
2N3703	10
2N3705	10
2N3706	10
2N3708	17
2N2904	30
2N5294	48
2N5296	48
2N5298	69
2SB337	1.86
2N5496	53
2N6107	75
2N6109	81
2SA715	1.98
2SC495	1.10
2SC496	1.31
2SC643A	1.50
2SC1096	1.72
2SC1172Y	2.20
2SC1173Y	1.69
2SC1306	2.73
2SC1307	3.00
2SC1449	1.67
2SC1520	68
2SC1678	2.67
2SC1909	2.90
2SC1953	1.44
2SC2028	1.82
2SC2029	2.60
2SC2078	2.90
2SC2091	1.34
2SC2166	2.73
THY 15/80	2.20
THY 15/85 (General Purpose Thyristors)	2.20
DEC 1 Multipurpose Thyristor	
DEC 2 Multipurpose Thyristor	£2.20

THERMISTORS

VA1104	75
VA1040	75
VA8650	55
VA1039	35
GEC Dual Posistor	1.68
GEC Dual 2 0 4 0 (CK1)	1.98

L.E.D.s

5mm T1¾ TYPE	
Red	14
Green	14
Yellow	14
Amber	22
T1 TYPE 3mm	
Red	12
Green	14
Yellow	14
FLASHING	
COX21	62
COX22 Red Only	66
3 COLOUR	
Red/Green/Yellow V518P	76
PANEL CLIPS	
3mm	4
5mm	4

CRYSTALS & FILTERS

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

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	80
ECF82	88
ECH81	1.60
ECH84	1.66
ECL80	84
ECL82	1.30
ECL86	1.99
EF80	95
EF86	1.96
EF183	99
EF184	1.09
EH90	1.02
EL34	3.50
EL84	1.05
EL90	82
EY86/7	68
EY500A	1.50
EZ80/1	56
GY501	1.45
GZ34	3.50
KT66	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
PL95	1.00
PL504	1.65
PL508	2.90
PL509/19	5.30
PY88	81
PY500A	2.30
PY800/1	69
UCH81	2.25
UCL83	1.82
UY85	1.35
PL802T	4.00
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21LU8	3.00
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PHILIPS G9	7.75
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DECCA 1700	9.00
DECCA 1730	8.58
DECCA 2230	8.58
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GEC 2040	9.50
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ITT CVC 25/30/32	8.65
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THORN 3000 SCAN	7.95
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THORN 8500	11.33
THORN 9000	10.65
THORN 3000/3500 Mains	10.00
THORN 1591	8.68
THORN 1691	9.68
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THORN TX10	12.50
THORN 1615	9.75
PHILIPS KT3	8.15
RANK BUSHRANGER	10.00

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4W 1R-10K	22p
7W 1R-22K	23p
11W 1R-22K	25p
17W 1R-22K	28p

(Preferred values) *

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

Sold in packs of 10 per type

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WELLER Iron 25W	4.31
WELLER Gun	12.00
Pair Tips Gun	42
3/16" Tips iron	51
ANTEX 15W Iron	5.20
ANTEX 25W Iron	5.20
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20" A51/110X	53.00
22" A56/120X	43.00
25" A63/200X	55.00
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26" A67/120X	58.00
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A51 570X	63.00
A56 510	58.00
A66 510	92.00

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G11 Final Anode Lead	1.50
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or 39 3W resist.	60
THORN	
1591 Speakers Sm	4.10
Lg	4.50
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Frame 390K/line 470K Contrast 1K5	each 59
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Thorn/GEC	
8500 Mains Filter Choke	6.50
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DECCA	
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RR1	
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- ★ Tests cathode emission characteristics.
- ★ Separately checks condition of guns.
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- ★ Checks heater warm-up characteristics.
- ★ Rejuvenation of low emission cathodes with automatic timing.
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- ★ Complete with tube base adaptors.

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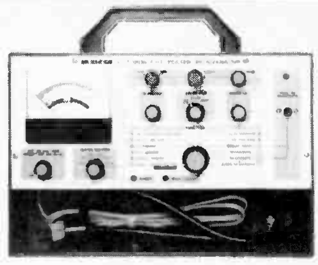

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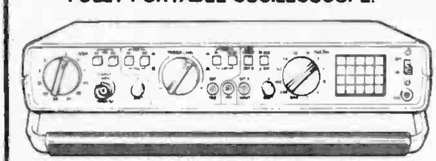

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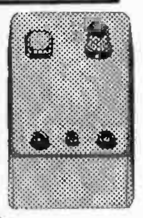

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REVOLUTIONARY L.O.P.T. TESTER.
OPERATES IN DYNAMIC MODE WHICH ACTUALLY TESTS THE L.O.P.T. UNDER HIGH VOLTAGE CONDITIONS WITHOUT DE-SOLDERING OR REMOVAL.
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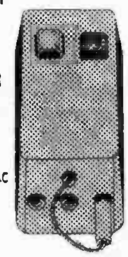
TESTS AND REJUVENATES BLUE, GREEN & RED GUNS SEPARATELY. FITTED WITH DELTA AND P.I.L. SOCKETS. COMPACT SIZE 120 x 65 x 60 mm. SUPPLY 240V AC



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SPECIFICATION:
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TELEVISION

The World of Instant Piffle

One can't help wondering why the world becomes a worse shambles day by day when we have available this wonderous tool, our much vaunted information technology, that should have brought about an era of sweet reason. Time was when access to more information in itself seemed to be a good thing that would lead to a better world. After all, most bad decisions stem from inadequate knowledge. Increase the amount of information available and we should all be able to make wiser decisions. But there's a difference between knowledge and information. Raw information by itself means little. It has to be put into context and assessed before it can contribute to our understanding. And that takes time.

We seem to have a growing problem here. Information is available to those who need it in vast quantities, while communications have become instantaneous world wide. The two sometimes seem to be making matters worse rather than better however. Instantaneous communications have led people to expect instantaneous answers and decisions. They are getting them – because the communications/information technology available to decision makers seems to impose upon them the need to react immediately. What's the point of having a hot line if you can't make a hot decision? But time is required to arrive at considered decisions. Your computers and satellites don't understand this, and the technology they represent doesn't allow for it. Computers crunch numbers and satellites crunch communications time. The human brain still has a trick or two, but there seems to be the feeling that having created all this technology we should be able to act within the same microsecond time scale. The ultimate daftness now seems to have arrived: obviously ill considered decisions are made by those in authority, and before they or anyone else can think the matter through the decision makers are on TV screens all over the world explaining that there's no alternative.

Sooner or later someone must yell "wait!" We don't want to go back to the situation where it took several weeks to communicate with a distant part of the globe and get a reply. But the technology we increasingly rely upon must be put in its place. At the moment it often seems that the information technology tail is wagging the dog. The result is an increasingly muddled world and increasing difficulty in getting considered policies adopted and put into effect.

There is also, I've noticed, a growing lack of clarity as the amount of information that rains down upon us increases. A statement can be made, retracted, altered, commented upon, reformulated, made non-operative and so on at such a rate that no one can be all that sure what's going on. Sometimes it seems that this is a deliberate ploy to confuse the issue. Then there's a tendency to sort of manhandle information. First it's leaked ("figures to be released later today show that . . ."), after which it suddenly becomes old hat ("yesterday's announcement has led to comment that . . ."). It's going to be damn difficult for future historians to figure out just what was going on towards the end of the twentieth century despite the mountains of data they'll doubtless have at their disposal.

It's difficult to know what can be done about all this. The ultimate horror of course consists of those stories of possible nuclear hostilities due to information being misunderstand, misused or just mistook. It seems urgently necessary for us to put this monster we've created in its place, to make sure that we control the communications system rather than the other way round. I often breathe a sigh of relief nowadays when I hear someone say "no comment".

Within the domestic context information technology has to some extent come to mean the personal computer. The UK has more personal computers per head of the population than any other country. I must be one of a decreasing minority who wonder just what people do with them. The question was put in an interesting article in *The Guardian* recently, and the reply seemed to be not much. You can perhaps regard the personal computer as a cross between a calculator, a glorified typewriter with memory and a video games console. Calculators are cheaper and simpler however, and laboriously typing into a computer's memory information that can be jotted down on a scrap of paper doesn't help all that much. But games are better on a computer than a games console. It seems people do just that, play games with the thing – video games and computer games. This is harmless enough of course, but has one or two interesting implications.

For many people computers have replaced live electronics as a hobby interest. This brings to mind the arguments that once raged in the world of amateur radio. Were you a true ham if you bought your equipment and chose the role of an operator, rather than concentrating on building your equipment, experimenting with it and seeing what it could achieve? A swing away from an interest in live electronics to computers will inevitably go hand in hand with an increasing tendency to regard electronics in black box terms, whether the box is a computer or whatever. Possibly this is inevitable – a consequence of silicon chip technology. So much modern equipment would be totally uneconomic to consider in terms of construction bit by bit. When, one wonders, did the last hi-fi enthusiast solder together his kit amplifier? Inevitable or not, the consequence must be a diminution in the general appreciation of what electronics is all about.

Where all this will eventually lead remains to be seen. For the moment the urgent need is to teach those who use communications technology to do so wisely. It would be nice to see an end to the dominance of instant comment and instant piffle. It would also be nice to think that something could be done about the information clutter in which we now seem to live. But I fear I'm shouting into the wind.

PLEASE NOTE

Our next issue dated January will appear well before Christmas, on December 14th, so that you can get your copy before the usual chaotic conditions in the retail trade at this time of the year. Our best wishes to TV/video men everywhere.

HELD OVER

Part 24 of our VCR Servicing series will appear next month.

Practical Prescaler Modules

C. Toms

Two prescaler modules are presented in the present article. Both stem from the frequency counter-timer project featured in the April-June 1983 issues of the magazine.

A prescaler capable of handling inputs in the range 150MHz-2GHz was promised in the previous series of articles – prescaler no. 2. The main reason for the delay in providing details of this has been the difficulty in obtaining supplies of the Plessey SP8668B ECL divider chip. The cost of this i.c. is appreciable – exceeding £40 trade. As a result, it was decided to present an alternative, prescaler 3, which is cheaper to build but has an upper frequency range of 575MHz guaranteed, 650MHz typical. It should be noted that the typical upper figure of 2GHz given for prescaler 2 is assessed, not that specified by Plessey. The SP8668B is guaranteed to work at up to 1·5GHz. The prototype unit exceeded an upper range of 2GHz however. Obviously to achieve an upper range of 2GHz the associated 8629 divider i.c. must be capable of achieving the specified typical operating limit of 200MHz.

Prescaler 2 covers typically 150MHz-2GHz and costs around £55 to build. Prescaler 3 covers typically 150MHz-650MHz and costs approximately £22 to build.

The circuit of prescaler 2 is shown in Fig. 1. The input signal is a.c. coupled to IC1 (SP8668B) via C2. IC1 divides by ten and drives IC2 (SP8629) which divides by 100 (this i.c. was used in prescaler 1). In this way the required division by 1,000 is obtained, with a capability well in excess of 1·5GHz. Pin diodes D1-2 (input protection) are optional.

The circuit of prescaler 3 is shown in Fig. 2. An SP8680B (IC1) gives division by ten and again operates with an SP8629 to give a total division of a thousand, this time with an upper limit of typically 650MHz. D1-2 are optional.

Figs. 3-6 show the print patterns for the two prescalers and Figs. 7-8 the component layout details. Both prescalers use a "ground-plane" PCB. Care should be taken not to omit any top side connections and to avoid using excessive heat on the i.c.s. The voltage regulator circuit (IC3 and associated components in both circuits) should be assembled and tested *before* the divider i.c.s are soldered in. In the case of prescaler 2, check that VR1 gives a range of 5V to approximately 7·5V, then set back to 5V (VR1 fully anticlockwise). After completing the board assembly by soldering in IC1 and IC2, slowly increase the supply voltage to 6·8V, adjusting VR1 whilst checking that the supply voltage to pins 1 and 8 of IC2 does not exceed 5·5V.

Both prescalers were found to operate perfectly when installed on the main frequency counter-timer board (mounted vertically, to the rear in front of the battery) without extra screening. Prescaler 2 was originally designed to be mounted inside a 60 × 110 × 25mm deep diecast box however. Some readers may wish to take advantage of this extra screening precaution: in this case, don't forget to earth the box. The connections to the main board for both units are as shown in Fig. 11, June 1983 (page 428), with the chassis connections made to the nearest 0V pin on the main board.

WKF Electronics can supply full kits for the prescalers as follows: prescaler 2 £53, prescaler 3 £21. Alternatively the prescalers can be supplied built and tested at £59 for prescaler 2 and £26 for prescaler 3. These prices do not include VAT. The boards for prescalers 2 and 3 are available from Readers' PCB Services Ltd. at £4·50 and £3·50 respectively, inclusive of VAT, post and packing. The address in both cases is Fleet House, Whitwell, Worksop, Notts S80 4TW.

Components list – Fig. 1

C1-9	·01 ceramic	D3-4	1N4148
C10	100μF tantalum	IC1	SP8668B
C11	1μF electrolytic	IC2	SP8629B
C12	47μF electrolytic	IC3	LM2931 T5·0
D1-2	BA379	R1	1k

VR1 470Ω subminiature horizontal preset

Components list – Fig. 2

C1-8	·01 ceramic	D1-2	BA379
C9-10	0·1 polyester	IC1	SP8680B
C11	100μF tantalum	IC2	SP8629B
C12	1μF electrolytic	IC3	LM2931 T5·0

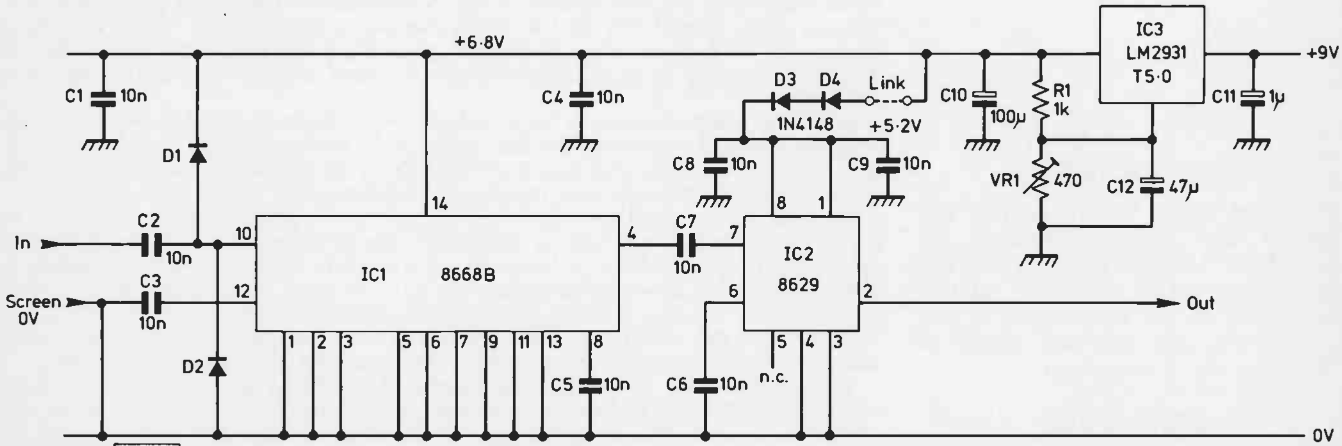


Fig. 1: Circuit diagram, prescaler 2.

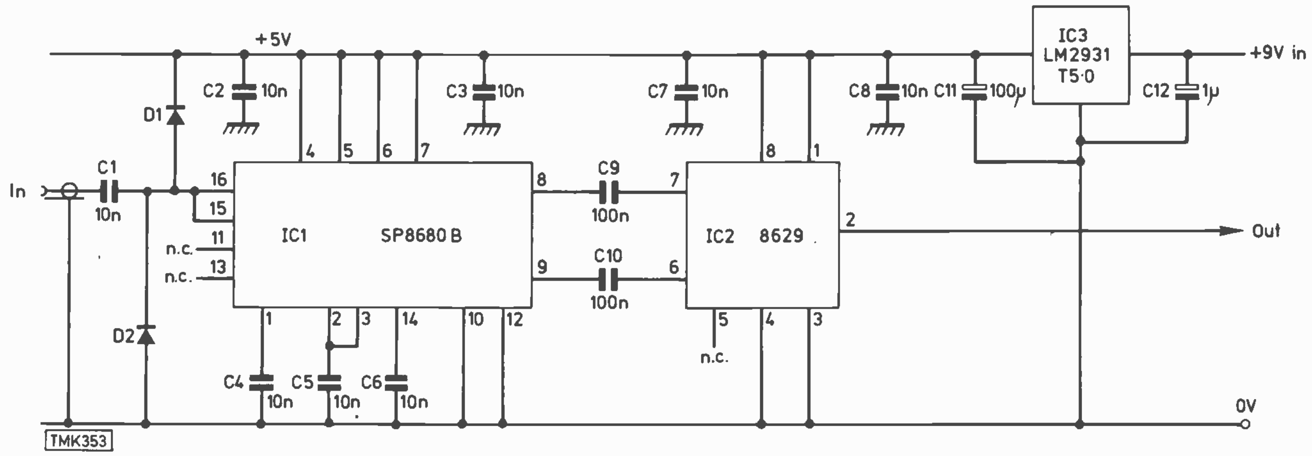
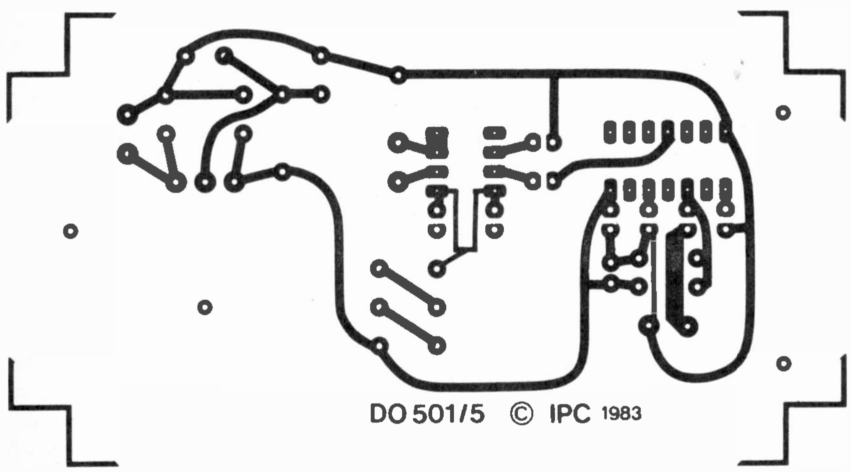


Fig. 2: Circuit diagram, prescaler 3.



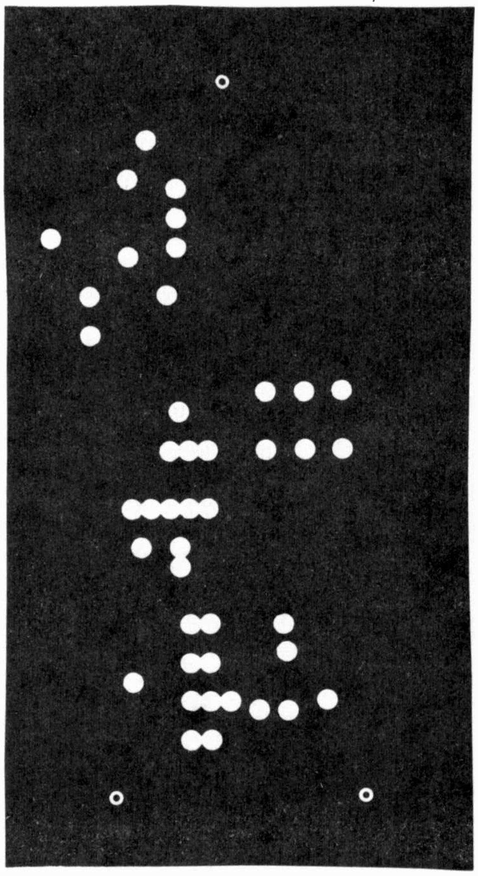


Fig. 3 (above): Prescaler 2 board track pattern (scale 1:1).

Fig. 4 (right): Prescaler 2 board pattern, component side.

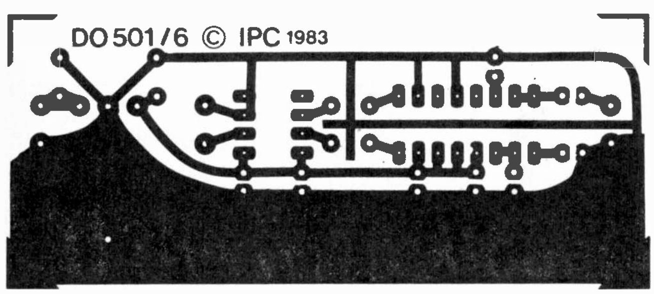


Fig. 5: Prescaler 3 board track pattern (scale 1:1).

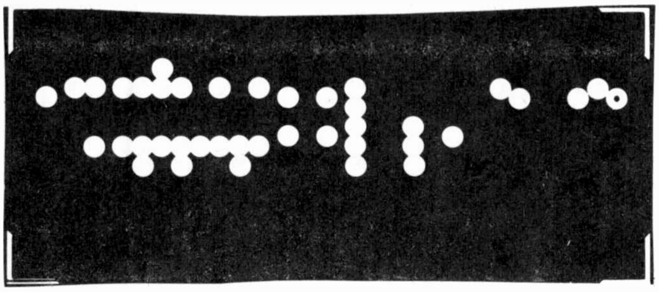


Fig. 6: Prescaler 3 board pattern, component side.

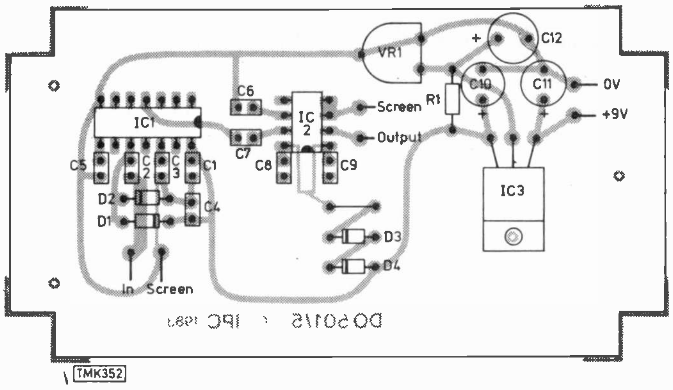


Fig. 7: Component layout, prescaler 2.

Finally a list of corrections and modifications to the original frequency counter-timer project. IC9 on the main panel is type LM2931 T5·0 – shown incorrectly in the components list. R14 and C12 are not shown in the component layout, Fig. 7. R14 should be fitted in the position shown as a wire link to the right of S7/8. C12's negative lead should be fitted in the vacant hole beside the thick track to the right of S6 – the positive lead goes to the

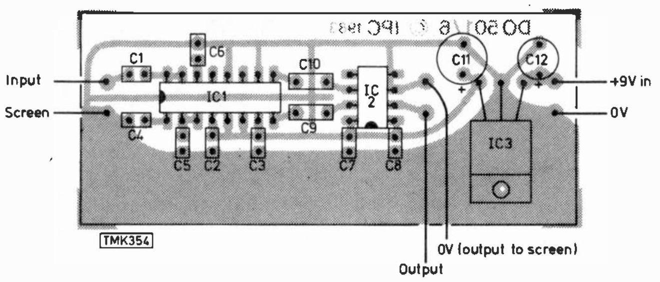


Fig. 8: Component layout, prescaler 3.

5V rail. S1-4 are one interlocking bank: S5-8 are also interlocking but independent of S1-4. S9 is push on, push off. S10 is push to make (momentary). In the main logic circuit (Fig. 6) pins 1 and 2 of IC4b are shown reversed. There are two errors in IC2's pin numbers. The pin to the left of the chassis pin 36 is pin 31, that to the right pin 30. The regulator is shown as IC8 instead of IC9. Also, pin 5 of IC4b connects to pin 10 (number omitted) of IC4a.

IC2 (prescaler 1) should have been shown as type LM2931 Z5·0 in the components list and in Fig. 5. It's shown reversed in Fig. 10, i.e. the flat should face the edge of the board. No socket need be used for IC1.

The regulator output decoupling capacitors C2 (Fig. 6) and C8 (Fig. 5) should be increased in value from 1μF to 100μF (tantalum). Otherwise the regulators can take off at around 15MHz and block the prescalers.

The measurement (113mm) shown at the top of the front panel cutout diagram (Fig. 8) should read 103mm. If the recommended enclosure is used, the front panel slots can be made by scoring with a sharp knife or scalpel. Don't fit the adhesive fascia until all the holes have been made in the plastic panel. Once the adhesive fascia has been fitted, the hole and slot sections can be removed by making diagonal cuts through the aluminium, bending back the unwanted sections, then cutting off with a fine file abraded along the hole and slot edges. The rear edges of the plastic front panel must also be chamfered to allow for the thickness of the fascia within the panel guides.

Letters

CLOCK CONVERSION

In the December issue last year Derek Snelling wrote an article on twelve-hour VCR clock conversions. I've recently modified a Sharp VC8300H in this way. The details may be of interest to other readers as they are not given in the manual and Sharp won't even admit to the possibility of doing this.

To convert the clock unit fitted to this machine, which uses an in-house clock-timer microcomputer i.c. type MP2794S, proceed as follows. Remove the top cover (release three screws) and the front of the VCR, then unclip the clock panel and lay it forward without unplugging it. Locate the common print connection to D5009, D5010 (not fitted in this model) and D5011, then cut the print between D5010 and D5011 or remove D5009, whichever is more convenient. Finally reassemble. The clock will now operate in the twelve-hour mode, with a.m. or p.m. illuminated as appropriate.

C. T. Marden,
Ecton, Northants.

LIVE CHASSIS

At last it seems that engineers are ignoring the "half-mains" labels and warnings on sets fitted with mains bridge rectifiers and are treating the chassis in such sets with the respect they deserve. A letter of mine on the hazards associated with these receivers appeared in the November 1977 issue of the magazine. Many manufacturers and technical authors have continued to put about the half-mains 120V story however, some opting for terms like "floating chassis" – hardly floating as the set is clearly tied to the mains supply whichever way it's connected. Thanks then to Keith Cummins for making the danger so clear in his letter in the October issue.

T. I. Birnie, Tech.(C.E.I.).
Lancaster.

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TV Fault Finding

Reports from Mick Dutton, Peter H. Dolman, H. Davies and John Coombes

Philips KT3 Chassis

The fault on a set fitted with the Philips KT3 chassis was no results. The output from the mains bridge rectifier was correct and was present at the collector of the chopper transistor T1463, so we checked the voltages around the TDA2581Q chopper control i.c. The only incorrect voltage was at pin 12, to which T7336 is connected. This transistor had developed a collector-emitter leak, a replacement clearing the fault.

Another of these sets suffered from very intermittent loss of sound. This was eventually traced to a dry-joint on the 6MHz input ceramic filter on the sound panel. **M.D.**

Decca 130 Chassis

When we unpacked this set there was only a very faint picture with normal sound – the contrast and brightness controls had some effect. We measured the voltages in the RGB output stages, which are of the cascode type, and found the readings at the collectors of the upper transistors in each pair (Q203, Q208 and Q211) high while those at the bases of the lower transistors were 0·5V instead of approximately 2V. After a good deal of head scratching and a comparison between our faulty set and a working one we discovered that capacitors had been fitted instead of 100kΩ resistors in the feedback networks (R226/244/251). This upset the biasing no end! Fitting the correct resistors provided a lovely picture. Subsequently we encountered a set with a capacitor in place of the feedback resistor in the red output stage. **M.D.**

Thorn TX9 Chassis

The problem with this set (Thorn TX9 chassis with remote control) was that the tuning kept drifting while it was not possible to get channels at the bottom of the band. The 33V tuning rail was correctly stabilised, but in the fault condition the output from the tuning controls would vary very slightly. Also it was not possible to tune these controls down to get zero volts at the tuner. We found that the fault could be made to come and go by moving the main chassis, and after a lot of searching a crack was discovered in the earth track beneath where the line output transistor's heatsink is mounted. As a result, the lower ends of the tuning controls were floating. **M.D.**

Fidelity CTV14R

We encountered a rather elusive intermittent fault in a new Fidelity Model CTV14R recently. The owner complained that the sound and vision disappeared after about a quarter of an hour, "as if the aerial had been disconnected". There was loss of channel indication at the same time. A soak test confirmed this description, but in addition we noticed that just prior to failure the channel selected would spontaneously step to a new position (there are six in these sets).

Sequential channel change is effected by applying a negative-going pulse to pin 6 of the ML232 channel selector i.c. These pulses are supplied from the collector of the step driver transistor TR2, and an oscilloscope check revealed that the cause of the problem was the occasional presence of positive-going pulses at the base of this transistor, though these didn't originate in the remote receiver/decoder section. The source of the trouble was finally traced to current leakage on the print side of the panel from the 77V line via the lacquer coating on the copper track connected to the base of TR2! The problem is due to the 4W resistor R121 (5·6kΩ) which provides the supply to the TAA550 voltage stabiliser – its broad mounting legs straddle the adjacent print area, and in this case the lower leg pressed tightly on the lacquered print. Easing R121 away from the board cured the problem. Presumably as R121 heated its leg penetrated the lacquer, bringing 77V to within a hair's breadth of TR2's sensitive base circuit. It would seem that if TR2 is held on for long enough all channel selection positions are cancelled, causing the eventual no signals effect. On earlier circuits R121 is shown as being a ½W device, which could explain the problem. **P.H.D.**

Remote Control Trouble

A fault we had with a Pye 1062 teletext receiver (Philips K30 chassis) turned out to be rather embarrassing. The customer's complaint was that the remote control didn't function, neither would the set change channels using the manual controls. We naturally assumed that the set rather than the remote control transmitter was at fault and took it back to the workshop. Another engineer looked at the set and found that it worked all right with our own remote control handset. He said he'd done some soldering to eliminate the possibility of an intermittent dry-joint.

On returning the set to its owners however the problem was exactly as before. The remote side of the set was as dead as ever, stuck on channel one, and it wouldn't change manually. This time I took the remote control back as well. When we tried this on another identical set which was known to be working correctly the symptoms appeared. What was the handset doing to these sets? It seems that the faulty remote control unit was constantly transmitting, the freak signal locking the whole remote control side solid, with no control by either remote or manual operation. **H.D.**

Rank T20 Chassis

Random tripping with poor e.h.t. regulation is usually due to the e.h.t. tripler. If the problem persists after replacing this, check whether 5R13 (330Ω) is open-circuit – the resistor links one of the tripler's connections to chassis.

Intermittent picture flickering and jumping is usually caused by the coupling capacitor 4C9 (1μF) in the field amplifier circuit playing up. If there's also a very slight hum however the 12V regulator transistor 4VT7 (2N5296) is suspect. You may find that its emitter voltage is varying slightly, but this is not always the case. **J.C.**

Hitachi CBP260

In the event of lack of width in this model (NP9A chassis), check whether R756 (30Ω, 1W) is open-circuit. This will remove the drive to the EW diode modulator. **J.C.**

Teletopics

VIDEO MOVES

It seems that portable video enthusiasts will soon have plenty of hardware to choose between. We already have the VHS-C and CVC systems, and now the Sony Betamovie cam-corder, which uses a standard Betamax cassette, is available in the UK. It won't stop there! Looming ahead is JVC's competitor to Betamovie, the Victor Movie, shown so far only in prototype form in Japan. It's lighter than Betamovie (1·9kg compared to 2·48kg, without batteries) and has playback facilities, though it's likely to be a bit more expensive. Meanwhile Philips intend to introduce an 8mm format cam-corder in the second half of 1984, provisionally designated Model VKR850. It uses a half-inch Newvicon tube, has an electronic viewfinder that enables the tape to be played back, and a six times power zoom lens. Philips have yet to make a decision on the suggested price.

Announcements from both Philips and Grundig that they are to produce VHS machines have led to a certain amount of speculation about the future of the V2000 system, to which both companies remain committed. Philips point out that they sell VHS machines in the American and other markets, and that it's logical for Philips to manufacture the machines themselves. Grundig were apparently approached to produce VHS machines for sale in a non-European market. One suggestion is that the V2000 system could become a full-specification format for the European market, with VHS machines being introduced as bread-and-butter lines. We shall have to see. The latest defector from the V2000 camp is Bang and Olufsen, who have recently announced an Hitachi-sourced VHS machine.

BOOMING TRADE

The TV/video boom continued during the first half of the year, with deliveries of large-screen colour sets up 18 per cent, small-screen colour sets up 56 per cent, and VCRs up 46 per cent compared to the same period in 1982. Deliveries to the trade are not the same as sales of course, and there's a suggestion that VCR stock levels are at present high. The small-screen colour set market seems to be very lively at present however. This is something that can't be said about sales of teletext equipped sets – deliveries have been only marginally up on last year.

ORIENTAL MOVES

A colour TV chassis developed by a government-assisted research body has been adopted by ten leading Taiwan setmakers. Most of the circuitry is incorporated in two chips, reducing the component count by some twenty per cent whilst increasing the reliability factor. It seems that production runs in Taiwan – there are over twenty setmakers – are relatively small in comparison to those common in Japan and South Korea.

The lengthy process of establishing dumping charges against Taiwan and South Korean setmakers in the USA has moved a stage further. Allegations were first made last May, and the US Commerce Department has now reached a preliminary finding that dumping in violation of the Anti-dumping Act has taken place – the finding is that South Korean sets have been entering the USA at prices over 9·5 per cent below fair market value while sets from Taiwan have been exported at over 30 per cent down. It seems that further processes have to be gone through before dumping duties can be levied.

ITV DBS

The Bill to enable the IBA to set up a DBS TV service is expected to be introduced before Christmas and to be enacted by the late spring or early summer of 1984. The IBA will then be able to advertise DBS contracts. These will indicate the range of options open to potential applicants, lay down technical standards, indicate the means of funding that will be possible and the types of programming that could be considered. Companies or consortia of companies applying can but need not be those with current ITV contracts. The IBA hope to start preliminary discussions with those interested in providing such services at an early date. Existing ITV companies are pressing for an extension to their franchises, which are due to end in 1989, on the basis that this time scale makes it difficult to take the investment decisions that would be required for DBS. Under the arrangements at present envisaged, the IBA will control the uplink but the programme contractor will be responsible for the provision of the satellite. It's stressed that the financial risks for programme contractors will be considerable.

DIGITAL TV ICs

Three new i.c.s have been added to the ITT Digivision range of i.c.s for processing signals in TV sets digitally (see *Television*, November 1981). Two are for chrominance and luminance signal enhancement in NTSC receivers, the third providing a low-cost teletext decoder.

Several firms, including Philips and Sony, are working on TV receiver i.c. memories that store a complete TV field, the idea being to double the number of lines by reading the information out of the memory at 100Hz. The Philips memory uses seven chips and is designed in such a way that it's cheaper than the equivalent RAM. The use of a memory increases the apparent definition, reduces noise and luminance/chrominance crosstalk and enables special effects such as freeze frame to be incorporated.

VINTAGE WIRELESS CO.

After trading for twelve years at Staple Hill, Bristol, The Vintage Wireless Company has moved to larger premises at Tudor House, Cossham Street, Mangotsfield, Bristol BS17 3EN (telephone 0272 565472). The staff is being increased and the aim is to improve service to collectors and all users of valve based equipment. A trade counter with vintage items on display will be opened on November 30th, but the firm operates primarily on a mail order basis.

NEW VCRs

ITT's latest introduction is a mid-range VHS machine, Model VR3975. It supersedes the TR3942 and features stereo sound with Dolby B, full-function infra-red remote control, and an eight-event, two-week timer. Suggested price is around £525. Sanyo's Betamax Model VTC6500 has an eight-event, two-week timer with daily and weekly repeat, infra-red remote control and forward colour picture search. Suggested price is £480. Bang and Olufsen's Model 4462 is a VHS machine with infra-red remote control, a five-event, two-week timer with daily and weekly repeat and a suggested price of £625. The Sharp Model VC387H features concealed controls, infra-red remote control and a height of just 3·7in. Suggested price £680. There's Dolby sound, a five-event two-week timer and other top range features.

RTEEB LEN BRIGGS AWARD

The third Len Briggs Award for the most outstanding candidate in the Radio, Television and Electronics Examination Board's "Certificate of Competence in Colour Television Servicing", for 1983, was awarded to Gordon J. Roberts at a luncheon of the Council of Management on October 18th. Mr. Roberts studied at South London College and is Service Director of Forbes Rentals Ltd., Croydon.

FILM-TO-VIDEO TRANSFER SERVICE

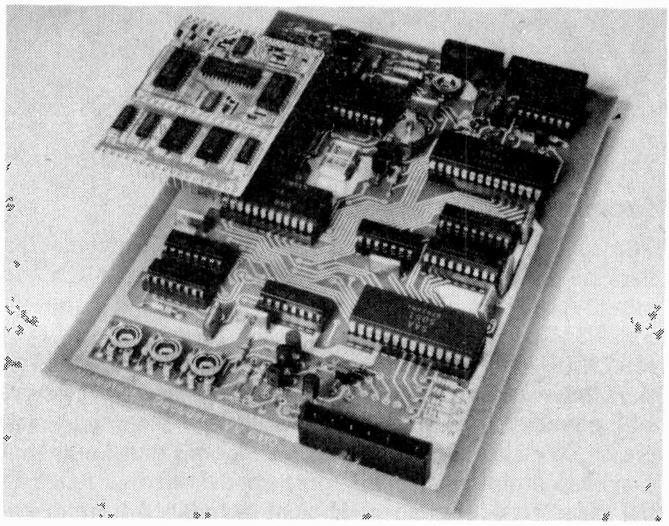
A service which Rediffusion call "Video Album" is now available at some 250 of their branches throughout the country. The service enables customers with Super-8 or 8mm films, and 126 or 35mm slides, to have these transferred to VHS or Betamax video cassettes no matter what the condition or how old the film material. For an extra charge, titles and music can be added. The charge for the basic processing ranges from £30 for a fifteen minute (200ft) movie or up to 80 slides, to £100 for a two-hour film or up to 700 slides. The original material is first professionally cleaned and then colour-graded for best results – John Reay, Rediffusion's sales director, comments that old films can actually be improved.

4GHz SATELLITE RECEIVER

Hugh Cocks (Cripps Corner, Robertsbridge, E. Sussex TN32 5RY) is now able to supply 4GHz satellite receivers, type KB1. The head unit has a helical feed and consists of a four-stage gallium arsenide f.e.t. LNA with a minimum gain of 43dB and a noise figure of 1·25dB, followed by a down-converter tunable over 3·65-4·2GHz with 46dB of i.f. amplification at 750MHz (nominal – adjustable at the receiver). The indoor unit incorporates second conversion to 40MHz, quadrature vision detection, CCIR de-emphasis, video amplification and clamping, two-position audio demodulation and expansion. The basic receiver costs £385 plus carriage – this does not include the dish or connection cable. The head unit alone is available at £230 and the indoor unit at £155, plus carriage in both cases.

SURFACE MOUNTING TECHNOLOGY

Mullard have initiated a major campaign to increase awareness of the advantages of surface mounting component technology in the UK's electronics industry. Advantages include: increased component packing density (board sizes reduced by 35-50 per cent, with a packing density of six surface mounted devices per square cm instead of three components in conventional encapsulations); assembly costs reduced by as much as 50 per cent; much better h.f. performance; and much improved reliability (abolition of radial/axial leads eliminates failures caused by breaking or cracking when bending or cropping). In addition to a wide range of active and passive



Comparison between a teletext decoder using conventional through-panel component mounting and the equivalent using surface mounting technology.

components for surface mounting, Mullard are offering the Philips Elcoma range of automatic placement machines – their first ever commercial foray into the production equipment market.

At present the cost of components in surface mounting packs is higher than those with conventional leads – prices are expected to equalise when production levels become similar. There are however savings in board material, factory space and so on. When it comes to a complex assembly such as a TV chassis, severe design constraints are imposed by the use of surface mounting due to the limited number of different items the placement equipment can handle. As a result, surface mounting in TV sets is likely to be encountered first in sub-assemblies such as teletext decoders, then possibly in hybrid surface mounting/component insertion panels.

Mullard believe that the future lies very much with surface mounting, and express concern that its growing use in Japan and the USA could leave the UK's electronics industry at a considerable disadvantage unless substantial investment in the new technology starts now.

TV SETS

Some interesting new sets have been released recently. The Network 20in. Model NWC2044R colour receiver for example incorporates a switch-off system that operates five minutes after the end of a transmission. This could operate from the a.g.c. line, with gating and a delay circuit, though we've no details at present. The set is of Italian manufacture and features synthesised tuning with full infra-red remote control. Sony's latest 14in. colour set, Model KV1430, supersedes the KV1400 and features a front connection for video games or a computer: the screen is raised a few inches so that the game console/computer can be placed in front without obscuring the display. Fidelity's Model CM14 14in. colour monitor will accept RGB, RGBY or a composite video input, plus audio, via a 21-pin scart socket and can be used with almost any games console or computer. The price is under £200 and the set is fitted with a high-definition, 90° high-brightness tube. The video bandwidth is quoted as being over 12MHz. A detachable, anti-glare tinted glass front is provided. A new range of large-screen colour sets has been introduced by Philips. They are fitted with the K35 chassis, an uprated version of the K30.

VCR Clinic

Reports from Richard Roscoe, B. Atkinson, Les Harris and John Coombes

Tape Slack Modification

The following modification was devised to prevent tape slack on the JVC Models HR7200EK and HR7300EK and other VCRs that use the same chassis, e.g. the Ferguson 3V29/3V30. The problem initially arose with a JVC HR7300EK. It would occasionally stop after rewind with slack tape sticking out beyond the flap. When the cassette was extracted this slack tape would of course snag and crease. We also handle Hitachi VCRs, and thus know that a similar problem plagued some models in this range in the past. To overcome it, Hitachi introduced a modification in the form of a small additional circuit board which produces a short pulse (800msec duration) at the end of the rewind cycle. The pulse is used to kick the mechanism so that any slack is taken up. For further details see VCR Clinic, November 1982. We've fitted this board in the past and thus know that it does indeed solve the problem.

The HR7300EK is completely microcomputer controlled however, and already has a pulse for the purpose. It's called "short REW" and lasts for 240msec. As a result we decided to turn our attention to the mechanical components initially. We made sure that the brake drums and pads were o.k., checked the various springs and bearings and made sure that the mechanism was as responsive as possible. This improved matters, but the fault persisted. We then contacted the JVC service department who said they'd not come across the problem. So all we could do was to check the action of the control circuitry as closely as possible.

After putting the machine through innumerable operating cycles the conclusion we came to was as follows. The circuitry was operating correctly, but sometimes the mechanism simply didn't have enough time to respond to the 240msec short REW pulse. Since Hitachi had opted for an 800msec pulse, we wondered whether stretching the JVC machine's short REW pulse to 800msec would provide a cure? So we did it and tried it and for anyone with the same problem we can recommend this modification as a complete cure.

The pulse stretcher circuit is shown in Fig. 1. It uses three CMOS 4011 quad two-input NAND gates which are supplied from the 10V line used to power the microcomputer i.c.s. No additional decoupling was found to be necessary. The circuit was built on a small piece of Veroboard which was held in place by the wiring loom between the mechacon and the servo panels. Since the pulses are relatively slow, radiation or crosstalk is no problem. The connections between the pulse stretcher circuit and the control circuitry are shown in Fig. 3.

The four outputs from port G of microcomputer IC2 (pins 22-25) control the direction of the reel motor. Its speed is controlled by various outputs depending on the mode the machine is in. The output we are concerned with comes from pin 10 of IC4 – the reel motor unloading/idler power control. As the timing diagram (Fig. 4) shows, this line carries other pulses besides the short REW pulse: one of the jobs of the logic circuitry in the modification is to detect which is which. To this end one of the outputs from port G (IC2, pin 23) is fed to gate 1a. This line is low except when the reel motor is performing a rewind function, when it goes high. So gate 1a is blocked except during a rewind operation. Its output will be high, gate 1b's output low and gate 1d's output high. This opens gates 2c, 2d, 3d and 3c to respond to whatever is on their other inputs. Thus during a non-rewind operation, the pulses fed to R54 follow exactly those at pin 10 of IC4, via gates 2a and 2c. Similarly the control lines to the reel motor via pins 3 and 4 of IC8 follow the outputs from port G (pins 23 and 22 respectively). In addition, the control line to the brake solenoid, from pin 18 of IC2, is fed out undisturbed to pin 5 of IC9. This bit hasn't been mentioned before, but clearly if the motor is to rewind for 800msec instead of 240msec the brakes must be held off for 800msec as well. Thus any function other than a reel motor rewind one is unaffected by the modification.

Inspection of the timing diagram will show that there are three situations where a pulse is present on the unloading/idler line during a rewind operation, i.e. when pin 23 of IC2 is high. First, during unloading. Secondly, when the 1·5sec slow rewind pulse leading into fast rewind is present. And finally when the 240msec short rewind pulse appears. Gates 1b and 1c form a monostable multivibrator with a time-constant of about 800msec, set

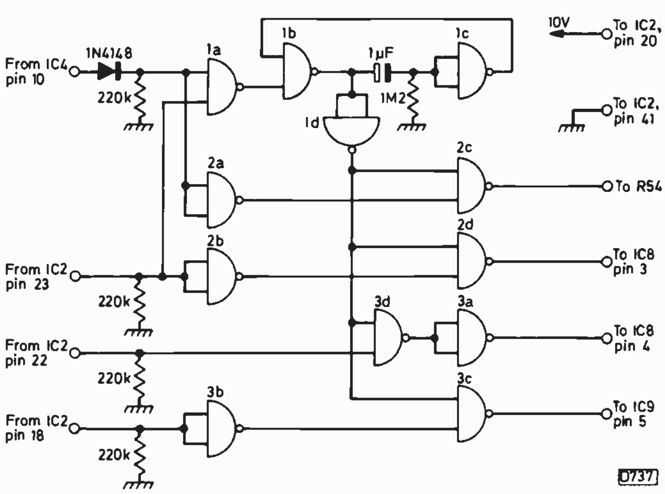


Fig. 1: Pulse stretcher circuit for the JVC HR7300EK.

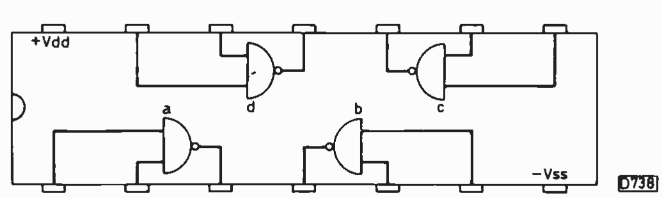


Fig. 2: Pin connections for the 4011 gate i.c.

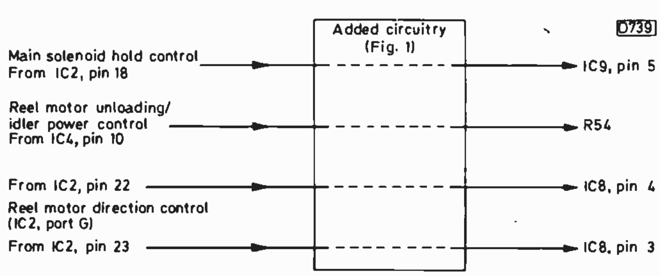


Fig. 3: Connections to the pulse stretcher circuit.

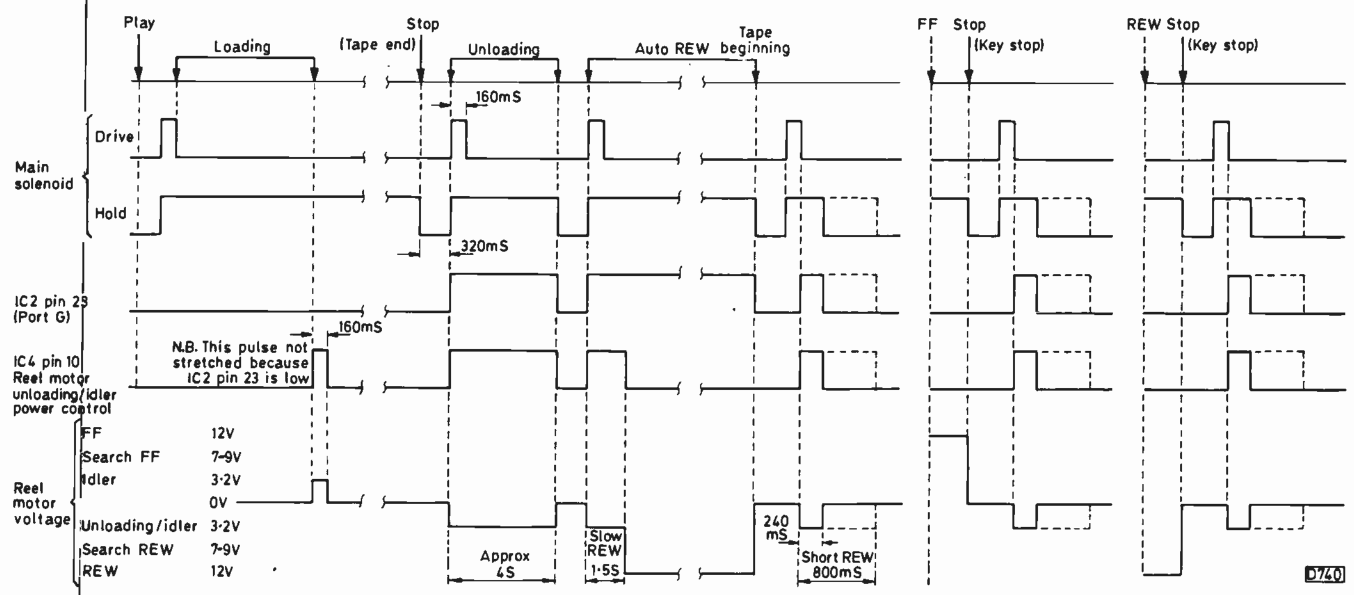


Fig. 4: Timing diagram for various control functions.

by the values of the 1μF capacitor and the 1·2MΩ resistor. It's triggered by the pulses on the control line to gate 1b (since gate 1a will be open). The pulse output from gate 1b has the nice property of being 800msec long if the trigger pulse is shorter than this or as long as the trigger pulse if it's longer than 800msec. This is just what we want, since the unloading and slow rewind functions will be unaffected but the short REW pulse will be stretched to 800msec. This stretched pulse is fed to the other control lines so that the motor rewinds and the brakes are held off for 800msec.

Connecting the board to the existing circuitry involves breaking the print between the relevant pins of IC2, IC8 and IC9, lifting one end of R54 (or mounting it bodily on the Veroboard), and soldering the ten connections to the relevant points on the mechacon panel. Since this panel is quite densely packed, thin wire is best – preferably colour coded for future reference. Care is obviously required, but as long as a sharp knife and a clean, fine-tipped soldering iron are available no real difficulty should arise.

One final point. If any mistakes that have the effect of turning the reel motor driver chip IC12 hard on are made in the wiring up, the chip protection device CP2 will blow. So if the motor fails to turn, check CP2. If it has blown, check your wiring before replacing it and trying again. **R.R.**

A Click Tip

No, not a Japanese video engineer but a reminder that could save a service call. If the complaint is mechanical clicks while the tape is moving, the "fault" is probably the tape counter sticking on a particular number and clicking as it tries to jump to the next. A press on the reset button is usually all that's required. This doesn't apply to later machines with electronic counters of course – but they have problems of their own! **R.R.**

Sharp VC8300

The customer's description of the fault was that the VCR worked all right for the first or second playing of a prerecorded tape or one recorded on the machine, but after this the picture would get noisy and eventually disappear.

We recorded a colour-bar signal and played it back. Sure enough the picture was perfect at first, but after the second replay it started to get noisy while after the fourth playback it had disappeared into the noise. When we played the tape on a new machine we found that it had been erased. We then checked the erase oscillator and found that it was producing the correct output on record and also a very low output on playback. This led us to the record/playback i.c. (I601). The low playback output should be 0·5V but in fact was 1V. This was just enough to start the erase oscillator, though not to produce a full-amplitude output. It seemed that the low-amplitude output was too little to erase the tape in one pass, taking three or four plays for the purpose. Rather expensive with prerecorded tapes! A replacement chip restored normal operation. **B.A.**

Hitachi VT5500

This VCR had been to another company who seemed to have done it more harm than good. First there were no functions due to a short, as a result of which there was no regulated 12V supply. After we'd dealt with that we found there was no clock display. There was still no display after replacing the clock i.c. (IC101), but flicking the on-off switch lit up the display and enabled it to be set. On pressing a channel select button the display went out again! The channel select i.c. (IC701) was found to be running hot, a replacement finally clearing the fault. **L.H.**

Hitachi VT8000 Series

In the event of intermittent colour, check IC203 (HT4209) on the luminance/chrominance panel by replacement. For colour drop-out/no colour, if the top of the picture is affected but the bottom is correct, check Q225 (2SC2021) by replacement. We've had several cases of intermittent fast forward or rewind operation due to the reel motor. **J.C.**

Mitsubishi HS310

In the event of no colour on prerecorded tapes, remove the bottom cover and resolder the joints around crystal X6F1. **J.C.**

An Unusual Chopper Circuit

A feature of the latest large-screen ITT chassis (CVC1200 series) is its rather unusual switch-mode power supply. This employs discrete component circuitry and provides mains isolation, but the precise mode of operation is not easy to see when you first glance at the circuit in the manual. The chopper transistor itself can be spotted readily enough of course, but the control circuitry contains quite a number of transistors and diodes whose functions are not so clear. We are indebted to Arthur Thomas of ITT for his assistance in the preparation of the following brief description of the circuit (see Fig. 1).

In normal operation the chopper circuit is driven at line frequency by a pulse-width modulator on the mains isolated part of the switch-mode power supply panel. The isolating transformer Tr712 couples the drive to the mains connected chopper circuit.

T713 is the chopper transistor, T721 the pulse-width modulator and T711 the chopper driver. T731 varies the d.c. conditions at the base of T721 to provide regulation against mains voltage variations. This action takes place as follows. The negative voltage swing at tag k on the chopper transformer Tr711 is mains dependent. This excursion is rectified by D731/C725 and used to set T731's base voltage, in turn influencing T721's base voltage. The latter also depends on the setting of the set h.t. control R726 and the loading on the h.t. line, since this supplies R726 via R734 and R736. The d.c. conditions at the base of T721 thus depend on the h.t. load and the mains input voltage.

T721 is switched on by a sawtooth voltage produced by integrating the line flyback pulse appearing at tag 1 of the line output transformer. D723/722 clip the pulse, R725/C724 providing the integration. The point at which T721 switches on during the sawtooth ramp depends on the d.c. conditions which, as we've seen, depend on the h.t. and mains voltages. The output from T721 is thus a variable mark-space ratio squarewave which is coupled to the base of T711 via Tr712 and D701. During the chopper transistor's "on" period, T711 provides T713 with drive current via R713 and D711. T712 is then reverse biased. When T711 switches off, T712 switches on, being forward biased via R714. As a result, the base of T713 is returned to the negative rail provided by D713/C713 and it rapidly switches off.

Something has to be done to get this lot going at switch on. C703 charges from the 300V rail via R716, producing a sawtooth which is coupled to the base of T703 via C728. T703 thus switches on, connecting the lower end of R708 to chassis. As a result T711 is brought into conduction, driving T713 on with drive current supplied by C728.

Since the chopper transformer Tr711 provides T713 with an inductive load, the current through T713 rises linearly, producing a sawtooth voltage across R721 in its emitter circuit. This sawtooth is negative-going with respect to chassis, so T702's emitter is driven negatively with respect to its base. T702 thus switches on, in turn switching T701 on. T711's emitter and base are thus shorted together and T711/T713 both switch off. Circuit operation is then sustained by feedback action. In addition to playing a part in the start-up action, T702/T701 act as a trip under excess current conditions.

In the absence of drive via the line output stage the

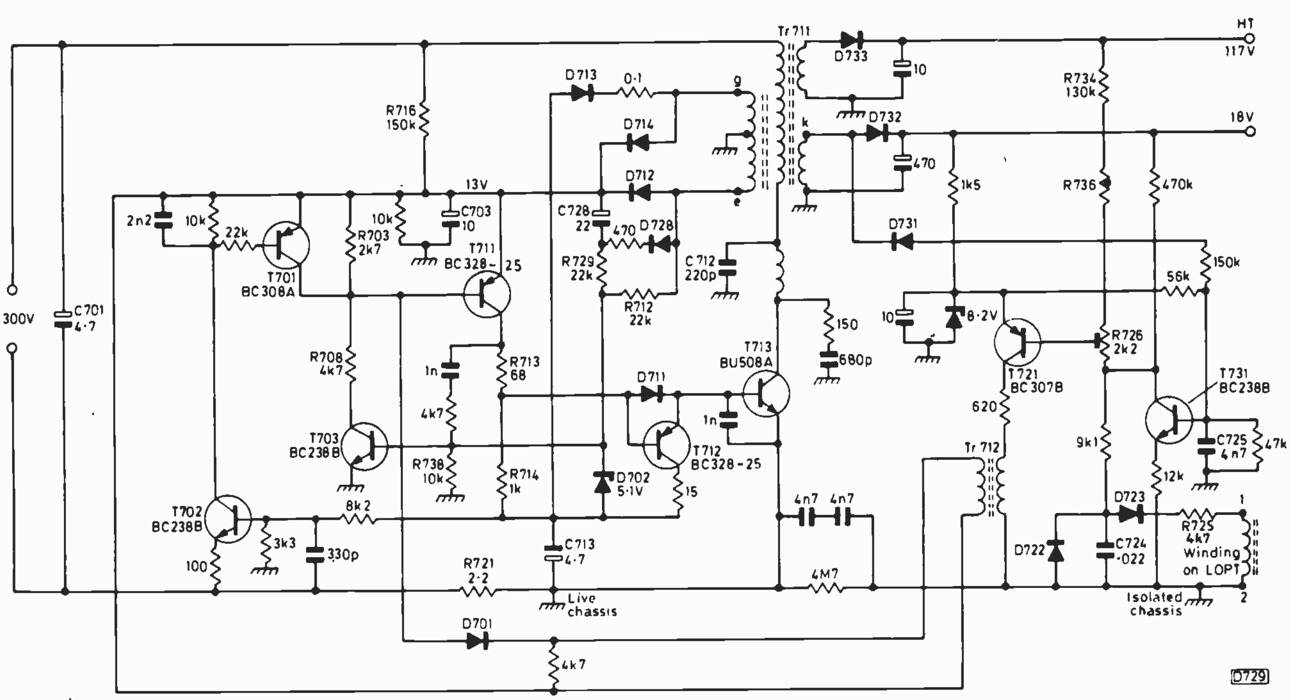


Fig. 1: Simplified circuit of the switch-mode power supply used in the ITT CVC1200 series chassis. The h.t. is 117V in the 90°, 20in. version, 145V in the 110° 22/26in. version, the l.t. rails being 18V and 24V respectively. The values of the flyback tuning capacitor C712 and the resistors (R734/R736) feeding the set h.t. control R726 differ in the two versions of the chassis: the values shown above apply to the 90° version.

chopper circuit free runs at approximately 20kHz, with feedback from tags g and e on the transformer. D714 conducts when T713 switches on, providing a start voltage (D714 functions only in the absence of drive from the line output stage). T703 is driven from tag e via R712. Since there's no regulation in the free-running condition, the output voltages must be limited. This feature is provided by zener diode D702 in T703's base circuit. In the free-running condition the 18V and 117V rails will both be below normal. If D702 is short-circuit the switch-mode power supply will not start; if it's open-circuit, the output voltages will rise above limits.

Under normal conditions C728 remains discharged, both plates being returned to tag e on the chopper transformer via D712 and D728 respectively. If the load on the chopper outputs is reduced, the pulse amplitudes at tags e and g vary and C728 charges, shutting the power supply down. The set must be switched off for at least 17 seconds before the switch-mode power supply will restart.

In some early sets there were differences in T703's base drive circuit – in particular R738 was connected between the junction of R729/C728 and chassis. If the chopper transistor fails, ensure that R738 is fitted between the base of T703 and chassis.

An isolation transformer rated at 500VA, 240V must be used when working on the switch-mode power supply.

Underwater TV

Peter Graves

Few manufacturers other than the makers of underwater equipment expect their products to work reliably after being thrown into dirty water and then pulled down to crushing depths by unskilled operators! There's a greater pressure change between the surface of the sea and a point forty feet below it than between the surface and the outer edge of the atmosphere. At quite modest depths the pressure on an underwater camera housing is measured in hundreds of pounds per square inch, and a camera lowered too far will quite literally be crushed flat.

Most cameras for underwater use are based on the use of a circular tube for strength and have a thick glass or Perspex front plate sealed with neoprene O-rings. The back plate is made of metal and carries the camera's cable connector. Connectors can be fitted for lights and diver communications. Both the connectors and the back plate are sealed with O-rings. The finest camera housings are made from titanium, which is light, strong and corrosion resistant. It's also expensive and difficult to machine. For general use the choice lies between stainless steel and aluminium alloy.

Underwater cameras are similar to their surface counterparts electronically, with the controls made automatic or remotely operated. The tube and scan coils are mounted along the central axis of the housing, with circuit boards arranged around or behind them. For some applications separate-head cameras are used, with the lens, camera tube, scan coils and head amplifier in one unit which is connected to the rest of the electronics by a multicore cable. Since most of the electronics are at the surface, the business end can be made very compact for intricate inspection jobs such as checking the insides of pipes. General purpose underwater cameras are self-contained, with the complete camera inside the underwater housing. Power is supplied down the cable, usually as low-voltage d.c. for safety and to avoid hum pickup on the video via the long cable run. The composite video signal returns to the surface via a separate cable, further cores carrying the remote controls such as focus.

For diver hand-held use the camera is fitted with a pistol grip and a bar for carrying a light. Viewfinders are rarely used because of the extra bulk, complication and handling difficulties they cause. Operations are directed from the surface by verbal commands down the diver communications circuits – the communications cables can be separate, going down with the diver's air lines, or form part of the camera cable, coming out to a small underwater connector on the camera's rear bulkhead.

With a rigid diving helmet the communication leads go to a microphone and a miniature loudspeaker mounted in the air space inside. A diver with a closely fitting soft helmet uses a bone conductor – a small encapsulated microphone/loudspeaker that fits tightly under the helmet and presses against the mastoid bone beneath the ear. The thin film of water trapped between the bone conductor and the skin provides good acoustic coupling, allowing two-way conversations through the vibrations in the diver's skull bones.

Cables

Underwater cables operate in a harsh environment – continually wet, crushed by pressure and being dragged over the sides of boats and the sea bed. A thick outer sheath of polyurethene or neoprene seals the cable and provides resistance to abrasion. Load bearing cables have an additional sheath of steel armouring wires or, for less strenuous applications, a central core of braided strands of Kevlar, an immensely strong polyamide plastic.

If there's the slightest cut in the cable's outer sheath at depth, water under pressure will be forced up inside the cable, ruining the affected section which has to be cut off and the dry part reterminated. Some cables have a waxy or rubbery filling between the cores inside to prevent water ingress, a technique known as water blocking.

Most underwater connectors are moulded on to the cable to give a good mechanical joint that's also watertight. The disadvantage of this type of connector is that repair in the field is difficult. Some kinds of connector can be stripped and remade without moulding. They are prone to leakage and mechanical damage however. The choice of connector can thus be a difficult one.

The video signal usually travels to the surface via a high-grade 75Ω coaxial cable. Some systems use a twisted pair cable, with a balanced line driver circuit in the camera and a balanced-to-unbalanced circuit in the surface equipment. Twisted pairs are less prone to electrical interference (when used as a balanced system) and mechanical damage, but the send and receive circuits are more complicated. With very long cables, say over a few thousand feet, the video signal can be modulated on to a low-frequency carrier (typically 10MHz) and sent via a screened twisted pair to a demodulator at the surface. Although cable attenuation is greater at higher frequencies, the losses across the band are reduced and compensation is easier.

Cable handling in the field must be carefully supervised.

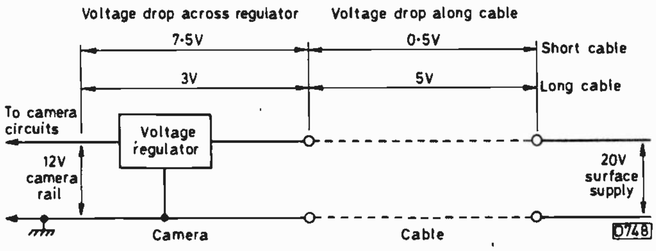


Fig. 1: Constant-voltage supply arrangement.

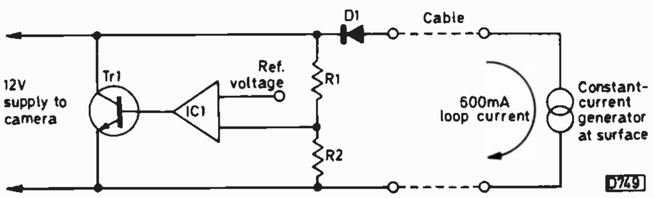


Fig. 2: Constant-current system with shunt regulator.

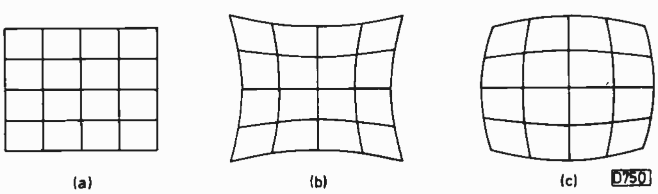


Fig. 3: Image distortion. (a) Object; (b) pincushion distortion; (c) barrel distortion.

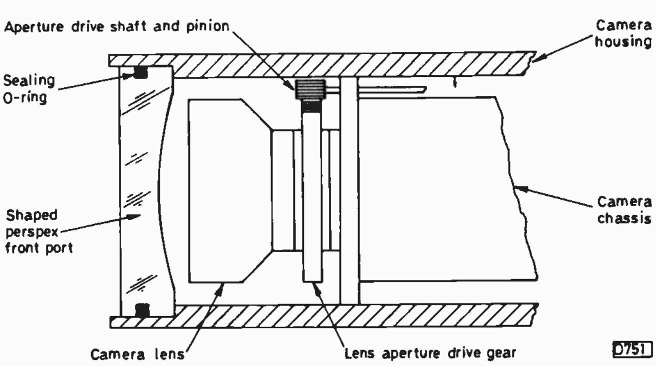


Fig. 4: Underwater camera port and optical arrangements.

Too little cable played out will hold back a diver or an underwater remote-controlled vehicle while too much will form loops that add to the cable drag and are likely to get caught on underwater obstructions or sucked into the ship's thrusters – the thrusters always win and have been known to chew up entire underwater vehicles. Unskilled helpers regard the cable as a sort of rope that can be knotted to a convenient railing or left in a tangle on the deck when it's been hauled in. Cable on the deck has a fatal fascination for the handlers of heavy machinery and welding torches however: more damage can occur to a cable out of the water than in it.

Voltage Regulation

With a long cable run the voltage drop along the supply cores becomes significant. Thus some form of compensation is required to keep the camera's rail voltages constant. The simplest system consists of a variable power supply at the surface. It's adjusted with the cable connected until the camera rail voltage is correct. If the cable length is changed and the supply is not readjusted the camera voltage can go disastrously high or uselessly low. So some form of automatic cable voltage drop compensation is

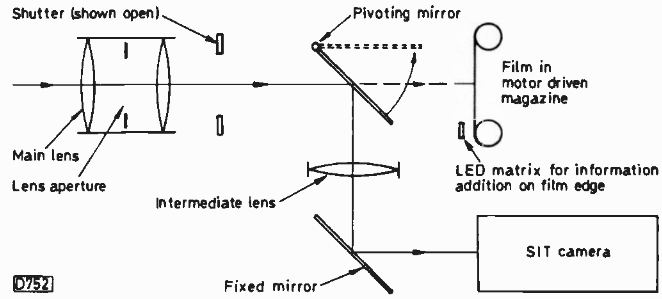


Fig. 5: Simplified diagram of a combined stills and TV camera.

generally required. The two most common systems are loosely described as "constant-voltage" and "constant-current" arrangements.

The constant-voltage system employs a series voltage regulator in the camera and a voltage supply at the surface. In a typical set up, shown simplified in Fig. 1, the camera rail voltage is 12V and the surface supply 20V. The difference between the two voltages is taken up partly by the voltage drop along the cable and partly by the voltage drop across the regulator. Changing the cable length alters the proportions of the voltage drops between the cable and the regulator. With a short cable the voltage drop along the cable will be negligible and the whole voltage difference between the surface supply and the camera rail will appear across the regulator. Sufficient heatsinking must be provided. Provided the sum of the voltage drop along the cable, the minimum voltage drop across the regulator (so that it's just working), and the camera rail voltage does not exceed the supply voltage on the longest cable used, compensation will be automatic for all cable lengths up to the maximum.

In a constant-current system (Fig. 2) the camera and cable form part of a constant-current loop, typically 600 or 800mA. The camera incorporates a shunt regulator that keeps the camera rail voltage constant. This voltage is nominally 12V. A portion is tapped off by the potential divider R1, R2 and compared with a fixed reference voltage from a zener diode by voltage comparator IC1. The comparator's output drives the shunt transistor Tr1 in the appropriate manner to compensate for voltage changes on the rail. If the rail voltage increases, the transistor is driven harder into conduction to shunt current from the rail and restore the voltage to the nominal value. Diode D1 protects the camera from reversed supply voltages. As long as the sum of the voltage drop across the shunt regulator (rail voltage plus diode D1 drop, about 13V) and the voltage drop along the cable does not exceed the open-circuit voltage of the constant-current generator at the surface, the camera rail voltage will not change with different cable lengths.

Optics

Water is optically very thick compared to air, and light rays travelling from the water are refracted (bent) as they cross the front port and enter the air inside the camera. With a parallel sided front port the image appears to have pincushion distortion (Fig. 3) and also appears to be closer to the camera than it actually is. To correct for this distortion, the inside surface of the port is shaped and polished to form a plano-concave lens that distorts the image in the opposite direction (barrel distortion). By careful choice of the curvature of the port and the focal length of the camera lens the pincushion and barrel distortion will cancel. Fig. 4 shows how the port is shaped and how it's sealed into the camera housing.

An alternative to the shaped port is the domed port formed from Perspex. Light rays cross both boundaries of the port at right angles to the surface and refraction is zero. There are one or two alternative lens systems for underwater work, but they are rarely encountered in TV practice. Narrow-angle lenses (about 12mm or over) with parallel sided front ports can for example be used. With the narrow field of view, the light rays forming the image enter the camera at a small angle to the central axis of the lens. The refraction is thus small and distortion minimal.

Water is a light attenuator and this limits the maximum range of a camera. It's a filter that progressively absorbes the longer wavelengths (i.e. red first, which is why underwater scenes look blue). If this was not enough, most naturally occurring bodies of water contain particles of mineral and organic matter that scatter the light rays, further reducing image contrast and camera operating range. Conditions vary greatly, and it's often difficult to convince a customer unused to underwater TV images that the poor pictures are due to the environment rather than the camera. Broadcast television studio shots taken in brightly lit studios with everything in focus lead some people to think that all TV pictures should be like this!

Almost all underwater jobs require some form of additional lighting. The suspended particles in the water make its provision something of an art rather than a science. There are two main types of lighting in use: gas-discharge and incandescent lamps.

Thallium iodide (predominantly green) and mercury vapour (blue) are the commonest gas-discharge types, though others have been tried. The spectral output of a gas-discharge tube consists of a few sharply defined frequencies, making them unsuitable for use with colour cameras. Discharge lamps are very efficient in turning electrical energy into light energy but they are expensive, cannot easily be dimmed, and need high voltages and special control circuitry.

Incandescent lamps – usually tungsten-halogen bulbs – are cheap, can be dimmed easily and have a spectral output that's continuous over the visible spectrum. They are inefficient however, so that more power has to be supplied for the same light output as an equivalent discharge lamp. The excess is dissipated as heat. Fortunately, in operation underwater lamps are surrounded by an excellent heatsink! The higher wattage lamps can be operated in air for only a few minutes before they overheat. Lamp sizes range from about 10W, used for close-up inspection with a sensitive camera, to several kilowatts for long range colour viewing.

Whatever kind of lighting is used, the suspended particles in the water scatter light back into the camera, reducing the image contrast. The equivalent situation on land is that of driving in fog. Increasing the amount of light thrown forward from the car by turning on the headlights doesn't improve the visibility – all you see is a solid wall of white, caused by the light scattered back to the eye by the water droplets suspended in the air. Better visibility is obtained if additional light is kept to a minimum.

There are several underwater solutions to the problem. The first is the car driver's – use less light and a more sensitive camera, minimising the blinding effect of back-scattered light. Alternatively, the lighting unit can be arranged to be at one side of and angled towards the central axis of the camera, so that the majority of the scattered light is scattered off towards the other side of the camera and doesn't enter the lens. This method requires some experimentation for best results, and it's often difficult to get enough separation between the light and the camera. Divers object to long arms dangling off the side of the camera – they get snagged and broken off.

If a short focal length lens is fitted (between about 4.5 and 8mm) the field of view of the camera is very wide and the camera can be taken very close to the object being examined while still seeing a useful amount of it. The closer you get the less the number of scattering particles between the object and the camera, so the clearer the picture.

In really murky water a clear water cone is used. Its simplest form is a transparent plastic bag filled with clean water and sealed. The bag is pressed between the object and the camera so that all dirty water is removed. More elaborate versions use a Perspex cone fitted to the front of the camera. The flat face of the cone that goes against the object can have a measuring scale engraved on it, a useful facility as it's difficult to estimate lengths underwater with no points of reference. Crude estimates are made by asking the diver to put his hand or knife in the field of view.

Tubes

Most types of camera tube have been tried in underwater cameras. The current trend is away from the more easily damaged vidicon towards Newvicons, Chalnicons and silicon-diode array tubes in the 1in. and ⅔in. versions. There's no best tube – all have advantages and disadvantages.

The more sensitive the tube, the less extra light needed. This reduces back-scatter problems. Because of this, cameras using the silicon intensifier target tube have become popular for many underwater applications, despite cost, size and complexity – the tube alone costs between £700 and £1,000. It consists of a conventional silicon-diode array tube (tough enough to withstand electron bombardment) with an electron image intensifier mounted at the front. The combination gives an enormous increase of gain over the unassisted tube – the SIT tube is roughly two thousand times as sensitive as a vidicon tube.

Colour cameras are useful where the fault conditions being looked for are differentiated by colour rather than brightness, e.g. rust patches amongst green weeds. Underwater colour cameras are usually standard surface units stripped of nonessentials such as viewfinders and shoehorned into an underwater housing with the controls made remote at the surface. They tend to be bulky, less sensitive and have a poorer resolution than equivalent monochrome cameras. Solid-state image pickup cameras are still in their infancy in the underwater world, where the emphasis is on rugged reliability rather than state-of-the-art development.

Photographic Stills

The high-sensitivity, continuous pictures from a TV camera can be combined with the high resolution and accurate colour rendering of a stills photographic camera by using a SIT camera as the viewfinder of a single-lens reflex camera. The system used in the Osprey type OE2300A TVP camera is shown in simplified form in Fig. 5 in its normal, TV active, position.

The pivoting mirror reflects the image from the lens on to the fixed mirror and then on to the faceplate of the SIT tube. The shutter is open. The lens aperture is under the control of the TV camera's aperture servo circuit to compensate automatically for changes in scene illumination. The lens focus is controlled from the surface, and the optical path is arranged so that focusing the TV camera also focuses the image on the film plane. Using the TV picture, the whole unit is lined up on the object to be photographed, the stills camera trigger is pressed, the shutter closes completely, the pivoted mirror swings out of the way, and the TV aperture control circuits loose control of the aperture which is set by a remote f-stop control to suit the film speed. The shutter opens and closes to make the exposure on the film and the film is wound on by a motor drive. Provision exists for firing an external flash gun. During film wind-on data such as time, frame number and other identifying data can be exposed on to the film edge by an LED matrix. The pivoted mirror swings back into place, preventing stray light entering the film magazine, the shutter opens and the TV camera regains control of the lens aperture.

In Conclusion

Some of the problems associated with underwater television have been described – there are still many to be solved and a considerable amount of development work is going on. The use of 3-D systems, the transmission of slow-scan television pictures through the water by acoustic pulses, and techniques for improved pictures in poor visibility conditions are some of the more interesting.

The problems are psychological as well as technical. The human perception system does not work well with images of strange objects in unusual surroundings. Watching a monitor for long periods leads to operator fatigue. An example is the inspection of oil and gas pipelines on the sea bed. The surface operator must move a remotely controlled vehicle just above the pipe for extended periods, looking for defects in a pipe which is boringly the same for mile after mile. Big problems like an anchor caught round the pipe are easily seen, but equally important small cracks in the concrete pipe coating may be missed due to wandering attention. Another example is the exterior of a concrete oil platform that has to be inspected in its entirety and consists of literally acres of featureless concrete.

The rising cost of diving and the increasingly complex regulations affecting every part of this work are leading to greater use of remotely controlled vehicles underwater. These range from simple powered camera platforms to multirole vehicles with multiple cameras and a range of remotely operated tools. Unlike divers they can stay down indefinitely. The combination of diver and a hand-held camera remains a powerful one however. A diver can be directed from the surface to cover an area in a way that no underwater vehicle can. There's an additional safety factor in having a camera supervising a group of working divers, while the fact that the client can watch the job in progress from the surface can be highly motivating!

Adding Continental Sound

William Falkland

You don't have to be a DX-TV enthusiast to want your set to be able to handle 5·5MHz sound. In the southern and eastern parts of the UK, especially near the coast, signals of entertainment quality can often be received from the continent for hours at a time – given favourable weather conditions and a well-sited wideband aerial. Programmes from Holland in particular include a great many that have English-language speech. The ordinary UK set will reproduce the picture all right but the only thing to be heard on the sound channel will be a loud hiss, due to the subcarrier being at 5·5MHz instead of 6MHz.

Input Filter Switching

Fortunately most modern sets can be adapted to receive 5·5MHz sound fairly simply – reception of French signals is another matter altogether. Sound selectivity is usually provided by a miniature ceramic filter, so conversion may involve little more than the addition of switching to select a 6MHz filter for the UK system I or a 5·5MHz filter for the continental systems B/G.

The switching can be done by an electronic switch such as the CD4066 i.c. (see Fig. 1). This chip includes four single-pole switch sections and each can be individually controlled by applying CMOS logic levels to the relevant control pin (low for off, high for on). A pair of switches is used for each ceramic filter to ensure good isolation of the unwanted filter. Fig. 2 shows the switching for a typical intercarrier sound channel.

It may be possible to dispense with the two input switches if the video detector is capable of driving both filters at once. In this case an additional matching resistor should be provided to ensure that the signal fed to the extra filter has the correct source impedance, and to avoid interaction between the filters.

Detector Circuit Switching

Further switching is required in the demodulator stage. One of the most commonly used intercarrier sound i.c.s is the TBA120 series, which is generally operated with an *LC* tank circuit. To retune this to 5·5MHz, some extra parallel capacitance can be switched into circuit. A single-pole switch is required, but it's important to use one with a low resistance in the on state to ensure that the tuning remains sharp. A small relay would do the job, but a semiconductor device will probably be easier to fit in the space available. The VN10LM MOSFET shown in Fig. 2 acts as a voltage-controlled switch: it's turned on by applying to the gate a voltage between about 2V and 10V with respect to the source. In the on condition the source-drain resistance is a few ohms.

In some sets, including those that use the TBA120T intercarrier sound i.c., a ceramic filter is used in the demodulator circuit. There are two types, and both are different from the input selectivity type – it's important to

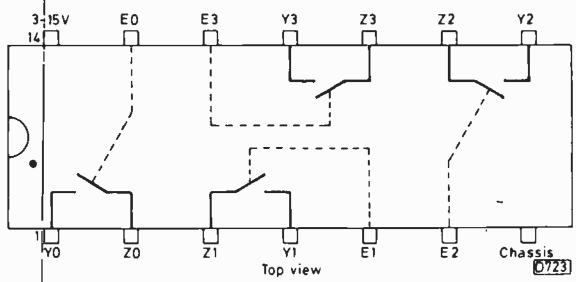


Fig. 1: Pin connections for the 4066 switch i.c. Pins E0-E3 are the control terminals for the four switches.

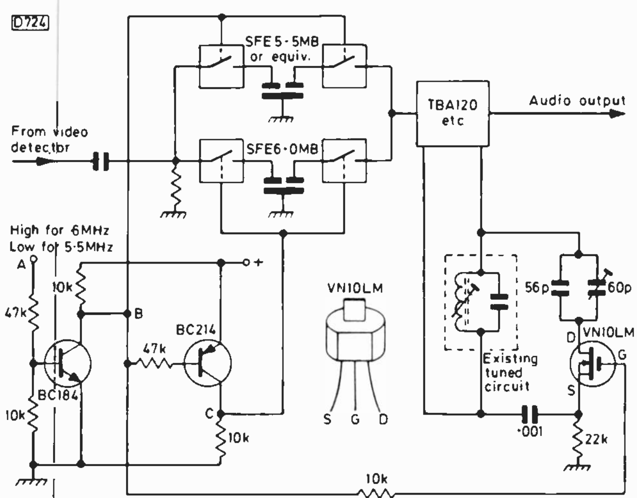


Fig. 2: 5·5/6MHz switched sound circuit with a 4066 selecting one or other ceramic input filter and a small power MOSFET switching in or out extra capacitance in the detector tuned circuit – the exact value of the added capacitance will depend on the existing detector circuit.

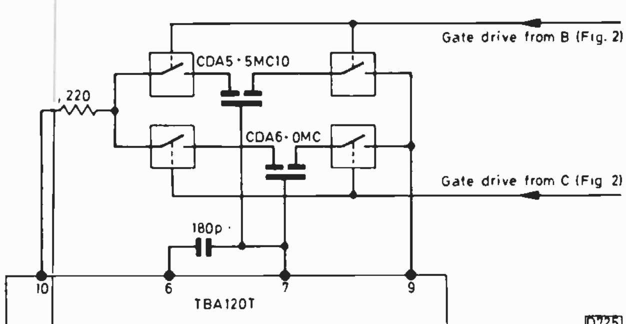


Fig. 3: Use of a second 4066 when ceramic filters are used in the detector circuit.

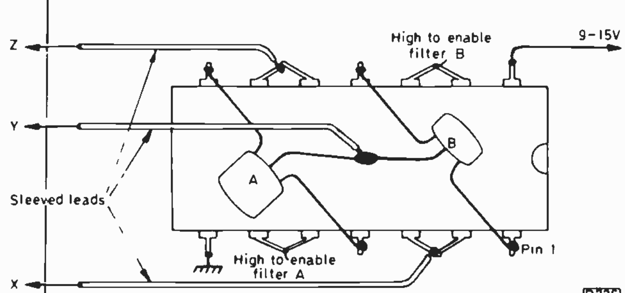


Fig. 4: Solder the filters directly to the pins of the 4066, on its underside. Wires X, Y and Z can then be inserted in the holes used by the original filter – their stiffness will support the assembly above the board. Keep the connecting wires as short as possible.

use the correct one. A further 4066 chip can be used to provide switching (see Fig. 3).

Practical Details

By wiring the switches Christmas tree fashion, with the filters and the connecting wires soldered directly to the i.c. pins, a very compact assembly which should fit comfortably into whatever space is available is achieved (see Fig. 4). The filters are symmetrical about the centre pin and can be fitted either way round. Keep the connecting wires short to avoid r.f. instability, especially if the intercarrier chip's output circuitry is close to the input. The current drawn by a 4066 is negligible – its supply can be taken from that of the intercarrier sound chip. Standard 4000 series devices require a supply of between 3-15V.

It's important for the health of a 4066 i.c. that the voltages applied to the switches lie somewhere between those at the supply terminals. If the potential applied to a switch is close to one or other of the supply rails the switch's linearity may be degraded, but since the signal is frequency modulated this will have no adverse effect. Drawing current through the switches should be avoided. The resistance of a CMOS switch in the on condition is typically about 50Ω, low enough to make little difference to the level of the intercarrier sound signal or to the matching of the filters. Control voltages to turn the switches on and off can be provided by a couple of bipolar transistors as shown in Fig. 2.

The remote-controlled Grundig set (CUC220 chassis) for which the modification was originally devised has a button on the keypad intended for selecting the sound circuitry for transmissions using the German stereo/bilingual system. This button, which produces a level change at terminal 12 of the frequency synthesizer board, provides a convenient way of switching between the 5·5/6MHz sound standards. A connection was made between terminal 12 and point A in Fig. 2. The two bipolar transistors were fitted inside the tuner/i.f. can near the filters, with a wire lead to them fed through a slot in the can. This set makes an excellent receiver for DX use incidentally: the multiband electronic tuning allows rapid band scanning and the digital channel number display makes station identification very simple.

With sets that use a TBA120T, no alignment is required when adding the extra filters. Where an *LC* tuned circuit is used in the demodulator stage, make sure that the extra wiring and components have not detuned the circuit too much. Tune to a UK station, set the switch to 6MHz, and adjust the coil slug *very slightly* to find the position giving clearest sound. Then switch to 5·5MHz and adjust the trimmer for the loudest hiss – or, if a continental station is available, for clearest sound.

The 4066 is sold under various guises such as the CD4066, MC14066 or simply the 4066 by most constructor component dealers. A suffix beginning with B means that the device will work on supplies up to 18V. The VN10LM power MOSFET, a Siliconix device, is available via RS Components Ltd. The VN10KM, which differs in incorporating protection diodes, is available through Tandy stores. Suitable 5·5MHz input filters are available from Sendz Components. For i.c.s such as the TBA120T, TA7146P, μPC1391H and μPC1382C the correct detector filter is type CDA5·5MC10. With i.c.s such as the CA3065, TA7176P and AN241 use detector filter type CDA5·5MD3. The difference is between quadrature and differential peak detection.

Quick Checks Q and A

Part 3

S. Simon

The Thorn 3000/3500 Series

The problem is "no results" with the tube heaters out. What's the first thing to check?

The red button cutout. If there's an a.c. supply at one tag but nothing at the other it's obviously open-circuit. Did it die or was it killed? Before subjecting it to another possible strain, check the rectifier diodes W601-4 at the front of the power supply panel for shorts. If these read correctly, press the red button and see if it holds. If the set now functions correctly it's likely that the cutout itself is beginning to feel old and is in need of replacement, or that there's an intermittent short which has yet to show up.

If the tube heaters are alight but there are no other obvious signs of life, what initial checks should be made?

First ensure that the full d.c. supply is present at the body of the R2010 chopper transistor at the front left of the power supply panel. If it's not reaching the transistor, the surge limiting resistor R609 near the h.t. fuse (F603) could be open-circuit. If the full d.c. is reaching the chopper transistor, its drive circuit is probably not working. The key check point is the 100Ω section (R607) of the "dropper" resistor assembly at the rear of the panel – the right-hand section. The tag at the right side end should read about 12V, the next one in about 45V. If the latter figure is more like 30V, suspect the 45V supply reservoir capacitor C607, 1000μF 63V – it's likely to be open-circuit. This is a frequent cause of non-operation.

If however the tag is at some 45V and the end tag registers much the same voltage instead of 12V, the chances are that the 30V supply fuse F602 (500mA) on the underside of the panel or, if this is intact, the chopper driver transistor VT605 (E1222) is open-circuit. VT605 is underneath, on the left-hand side, with a heatsink on it. If the voltage at the right-side dropper tag is a lot less than 12V and the dropper itself is hot, VT605 could be short-circuit or is perhaps being turned on too hard.

Diode W610, which is in series between the emitter of VT605 and chassis, should not be overlooked. If it's open-circuit, this could be the reason for the voltage at the end tag being high. If it's short-circuit, VT605 will be turned on too hard (low voltage at the end tag).

There are many other possibilities of course, including the front right 30V zener diode W605 which, if defective, will stop the chopper working.

The picture is very distorted, in an hour-glass fashion (amongst other things), and there's a hum on the sound. What are the main suspects and where are they?

The 1000μF electrolytic previously mentioned (C607) and the main h.t. electrolytics under the front left side (C602/3/6) are the main suspects. A small mirror can be used to view the condition of C602/3/6 without removing the power supply panel. Severe corrosion may be seen. This check should be made as a matter of routine, since the unit often leaks without other signs of distress, spilling corrosive fluid on to the lower panel. This upsets the working conditions of the offset pulse generator with the result that the picture goes dark etc.

The effects of this leakage can be hard to clear – a replacement panel as well as a new electrolytic unit may be required. In addition to using the mirror, a torch or bench light should be used to examine the condition of the components at the front left of the video panel – look for the presence of dampness, which can often be cleared before damage is done.

The complaint is that the picture got darker and darker. Which key component in the set could be responsible?

The key component is the 1·5Ω wirewound resistor R907 on the small beam limiter panel at the top. The reason for the dark picture is that the voltage across this resistor, which is in series with the line output stage, has brought the beam limiter circuit into operation. The voltage should be 1·3V under no-load conditions. If it's higher, R907 is likely to have increased in value.

R907 is a key check since no voltage across this resistor (with the resistor intact) shows that the line output transistor is not being switched on whilst excessive voltage (with the value of R907 correct) indicates the presence of an overload in the line output stage.

There's a sudden drop-out of one primary colour. For example green may be lost, leaving red and blue to give a magenta picture. What and where are the first checks to make?

Voltage checks should be made at the tube base socket. If green is lost, check at pins 5 (green first anode) and 6 (green cathode). Pin 7 is the green grid pin, which is connected to the other two grid pins. Compare the readings at pins 5 and 6 with those at the equivalent red and blue gun pins. In all probability, the voltage at pin 5 will be much lower than the 400-900V specified. If so, check the convergence panel to ensure that all three beam switches are on. Leakage through these switches is extremely common and is the main cause for one of the primary colours being absent. If a replacement switch is not to hand, remove the faulty one and join the centre to the top contacts or divorce the lower contacts from chassis. The associated decoupling capacitors can go short-circuit – if necessary check after disconnecting one end. These are the ones on the convergence panel – those on the tube base (spark gaps) are also not above suspicion.

If the first anode voltages are all above 400V, what else is likely to cause the loss of one primary colour? We are talking about sudden loss, not a gradual loss that could throw suspicion on the tube.

Since the first anode voltages are correct it's likely that one of the cathode voltages is incorrect. One is probably much higher than the other two. Note that the three RGB output transistors are on the left-side video panel, at the rear with heatsinks.

First check the relevant collector voltage to ensure that the supply is actually reaching the collector. Then switch off and check the suspect output transistor with an ohmmeter to ensure that it's not open-circuit base-to-collector or base-to-emitter. This is the most likely situation. If the transistor is all right, check back from the emitter to the preceding pnp driver transistor and if necessary to the npn transistor prior to this.

What are the weak links in the design of the RGB output stages?

The weak links are where the heat is. Apart from the output transistors themselves, the thick-film unit used as the load and biasing resistors in later models is a source of trouble. Earlier models had three separate wirewound load resistors which were much more reliable. The thick film unit is similar to (but not the same as) that used in the Pye 725 etc. chassis. They all tend to deteriorate, giving intermittent results depending on which section is affected. Change the unit if there's the slightest doubt.

The picture is marred by regular vertical rippling, accompanied by a high-pitched twittering noise. This can be caused by an open-circuit electrolytic on the power supply panel, but what should be checked first?

It's quite common for the core of L502 to fall out and drop on to the decoder panel. L502 is in the 60V supply line to the line output stage, and is located under the left side of the swing-up panel. If the coil former is empty, look below. Provided the set has not been disturbed, the core will be found. Refit and lock it in firmly.

The complaint is of smoke and a smell of burning. Inspection shows that some of the resistors on the convergence panel are burnt. What's the cause?

There are two large wirewound resistors (R707/8) on the panel. In the 3000 chassis both are 10Ω but in the 3500 chassis one is 18Ω. When one of these resistors goes open-circuit, current is diverted through small components which are unable to bear the load. Hence the burn up. The first move should be to identify the large, open-circuit resistor and replace it, after which the burnt components can be checked and replaced as necessary.

Christmas Story

Bryon Pascoe

As Christmas approaches I recall last year's events.

Mike phoned the day before Christmas Eve to say he thought the tube in his Siemens colour set (FC211) had gone. The set's been a decidedly awkward customer and the news of its failure so close to Christmas gave rise to a sinking feeling in the stomach. A quick nip of the Christmas booze, whilst the lady of the house wasn't looking, turbo charged the system however and off I went. Mike's wife came to the door and bustled me in out of the cold, and the usual conversation that always goes with a TV breakdown followed. During this she said that Mike had finally given in to pressure and agreed that they could have a video for Christmas – provided the tube in the telly hadn't gone. A challenge indeed.

So with fingers crossed we set about the monster. The fault turned out to be an open-circuit line flyback tuning capacitor (0·01μF, 1·5kV) that had knocked out the BU208. Mind you I went through three BU208s before finding the cause. No wonder they sell them in tens nowadays. Then smiles all round.

"I'll bring a video along tomorrow, about 7 p.m." I said, bearing in mind all the other promises I'd made for Christmas Eve. Topped up with four hours' semi-conscious slumber, I woke up to find the temperatures outside below freezing. So on with the thermal underwear. Along with all the other gear loaded into the estate car went two VHS machines – I'd a full day's calls ahead.

"It'll be after seven" I said to Mike's wife over the phone. "That's all right, he won't be back till 8·30" said she. "By the way the telly's o.k. except when it goes very bright and red." That gut feeling again, with thoughts that it may well be the tube this time.

I arrived at 8·45 and was again bustled inside out of the cold. Deposited one video in its sealed carton on the floor. "You'd better check the set first. Shouldn't think it's very much." What confidence!

"No problem" I said as I pushed the loose tube base connector back into place. What an engineer! More chat as I slit the carton open.

"Easy to work?" asked Mike.

"Piece of cake! Here we go" I said, touching the play button. There was this ghastly whining noise as something inside the machine attacked the tape. "Faulty tape" said I quickly as I managed to get the machine to present me with the cassette and a long length of mangled tape. "It's that common is it?" asked Mike.

"Not really, but I've known it before." I inserted my own cassette containing a recording of a film I'd not yet seen. That noise again! Touching the stop button didn't seem to have any effect.

"Machine's got a fault. No problem, I've another one in the waggon." Out into the cold again, quick dive into the muddle, extract recorder number two and dash back into the warm. Unpack again, more chat, unwrap new cassette, insert, touch play. Once again that noise as yet another tape got done in. Gut feeling as I caught sight of Mike's expression. Beginning to run out of chat. "Got to be something silly." "Sure has" said Mike.

Sweating now, and not all due to Mike's central heating. Look at instruction book. Print going out of focus. Keep calm. Then it dawned. "I know what the problem is — it's the dew. You know, condensation" I explained to a bewildered Mike.

Half an hour later after a drink and an uncomfortable wait, I loaded another cassette. Touch play. That welcome, silky sound greeted my ears. Smiles all round and an exchange of Christmas greetings, then off to the homestead. Got back just before Christmas Day began.

A week later I pulled into Geoff's garage. Whilst filling up we exchanged Christmas business stories. Told him about the video demonstration at Mike's and he laughed like a drain.

A couple of days afterwards Geoff brought his video in for attention. It had a recording fault. Fixed it within an hour and kept it for the night to watch that film on my tape, since repaired with a large chunk missing. Down to the garage the following morning, another cold one. No Geoff, so I left the recorder in his office for him to take back that evening. Phone rang just after eight. It was Geoff.

"This recorder you were supposed to fix. It's just knackered my best tape" he bawled.

Immediate recall by me. "Remember what I told you about the demonstration at Mike's? Well, it's just happened to you!"

"Oh no, the bloody dew" came the faint reply. Laughed like a drain I did.

Satellite TVRO System

Part 3

Nick Harrold

This next part in the series deals with one way of handling the audio signal. There are many 4GHz satellite signals that can be received on even a small terminal such as this. Unfortunately however there's no single sound standard. Some transmissions carry the audio on a subcarrier, some use a different transponder entirely, whilst some use sound in sync. The circuit to be described caters for the multitude of different audio subcarriers in use, being tunable over the range 5·5-8MHz.

By far the strongest signal receivable in the UK at the moment comes from the Russian Gorizont satellite, which is in orbit at 14°W (London coordinates 30° elevation, 198° true azimuth). The 3·675GHz spot beam can even be received without a dish by just pointing the open end of the waveguide at the satellite. This spot beam carries two sound channels, the TV sound on a 7MHz subcarrier and a radio channel on a 7·5MHz subcarrier. To achieve a good signal-to-noise ratio, these two channels are both compressed at the uplink and must therefore be expanded again in the receiver if the correct dynamic range is to be obtained.

The Sound Board

A block diagram of the tunable sound i.f. board is shown in Fig. 7. It consists of two parts, a tunable phase-locked loop to demodulate the signal and a pilot-tone gain-controlled amplifier. An NE564 i.c. is used in the PLL while the amplifier is built around an NE571 i.c.

Fig. 8 shows the PLL circuit. The sound subcarrier is taken from the output of the wideband f.m. demodulator described in Part 1 – from the emitter of Tr3, Fig. 3. This point is prior to any de-emphasis or filtering, which would attenuate the subcarrier. The signal is first amplified by Tr1 and then fed via the drive level control RV1 to the NE564's input at pin 6.

As with the NE564 video demodulator described last month (IC1, Fig. 5) the drive level is adjustable for optimum quality output. The oscillator frequency is set by varicap diode D1 in conjunction with C13 – RV2 applies a variable d.c. bias to D1 for tuning over the required frequency range. The audio output at pin 14 is fed to Tr2 for further amplification, up to a level of about 100mV, before being fed to the expander circuitry.

Expander Circuit

The expander circuit is shown in Fig. 9. The audio input is fed to pin 2 of the operational amplifier IC3a. The output at pin 12 follows two paths.

The first path consists of a high-Q 11kHz tuned amplifier whose active sections are IC3b, IC4a and IC4b. The amplified 11kHz pilot-tone signal output at pin 10 of IC4 is at a suitable level to drive the rectifier circuitry in IC2 (input at pin 2).

Path two feeds the signal to the variable-gain section of IC2 via the notch filter comprising IC5 and the associated components. This notch filter is tuned to 11kHz and is included to remove the annoying whistle that would otherwise be present on the final audio output.

The processed audio output appears at pin 7 of IC2 and is then passed to the de-emphasis network C31/R32. The resultant audio is suitable for feeding to a good quality amplifier.

RV3 sets the pilot-tone level. Simple switching is all that's necessary to enable the expander to be taken out of circuit with a non-companded signal.

Construction

The PPL and expander circuitry were built on a double-sided printed panel, with the tracks on one side and the other completely covered with copper. The components were all mounted on the copper-clad side. There's no reason why Veroboard should not be used, provided care is taken.

All the supply rails should be adequately decoupled, and the connections around the PPL in particular need to

Components list – Figs. 8 and 9

Resistors:		R30	95k4‡	C20	100µF, 16V
R1	5k6	R31	56k	C21	470µF, 16V
R2	1k2	R32	10k	C22	330µF, 12V
R3	47Ω	RV1	1k	C23	10µF, 12V
R4	470Ω	RV2	5k	C24	·001
R5	1k2	RV3	10M	C25	·001
R6	1k	*13k+1k		C26	·002
R7	1k	†6k8+200Ω		C27	10µF, 12V
R8	18k	‡100k/2M2		C28	0·1
R9	2k2			C29	0·22
R10	15k	**Capacitors:**		C30	100µF, 16V
R11	15k	C1	2p	C31	·01
R12	10k	C2	100p	C32	10µF, 16V
R13	5k6	C3	·01	C33	·01
R14	1k2	C4	100p	C34	150p
R15	1k	C5	·01	C35	150p
R16	2k2	C6	100p	C36	·01
R17	10k	C7	·01		
R18	2k2	C8	·001	**Coil:**	
R19	5k6	C9	·01	L1	3·9µH
R20	14k*	C10	·001		
R21	14k*	C11	·001	**Semiconductor**	
R22	7k†	C12	·001	**devices:**	
R23	1k	C13	47p	IC1	NE564
R24	6k2	C14	·001	IC2	NE571
R25	3k3	C15	1µF, 12V	IC3-5	747
R26	100k	C16	1µF, 16V	Tr1-2	BC109
R27	95k4‡	C17	10µF, 16V	D1	BB109
R28	100k	C18	10µF, 16V	D2	6·2V
R29	100k	C19	100µF, 16V	VR1	7805

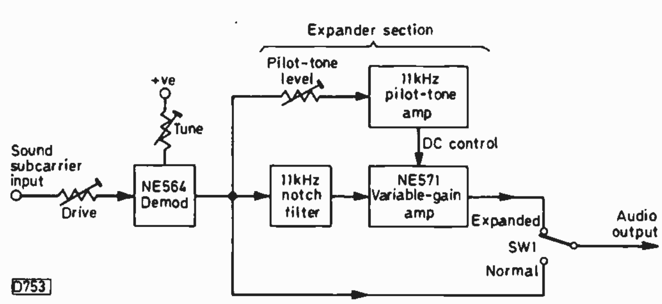


Fig. 7: Block diagram of the sound board.

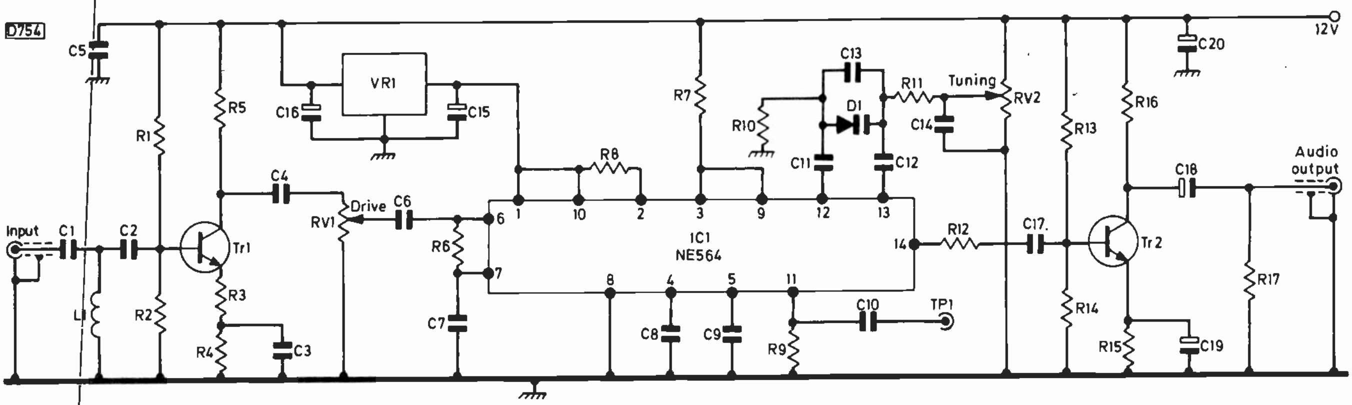


Fig. 8: The PLL sound detector circuit.

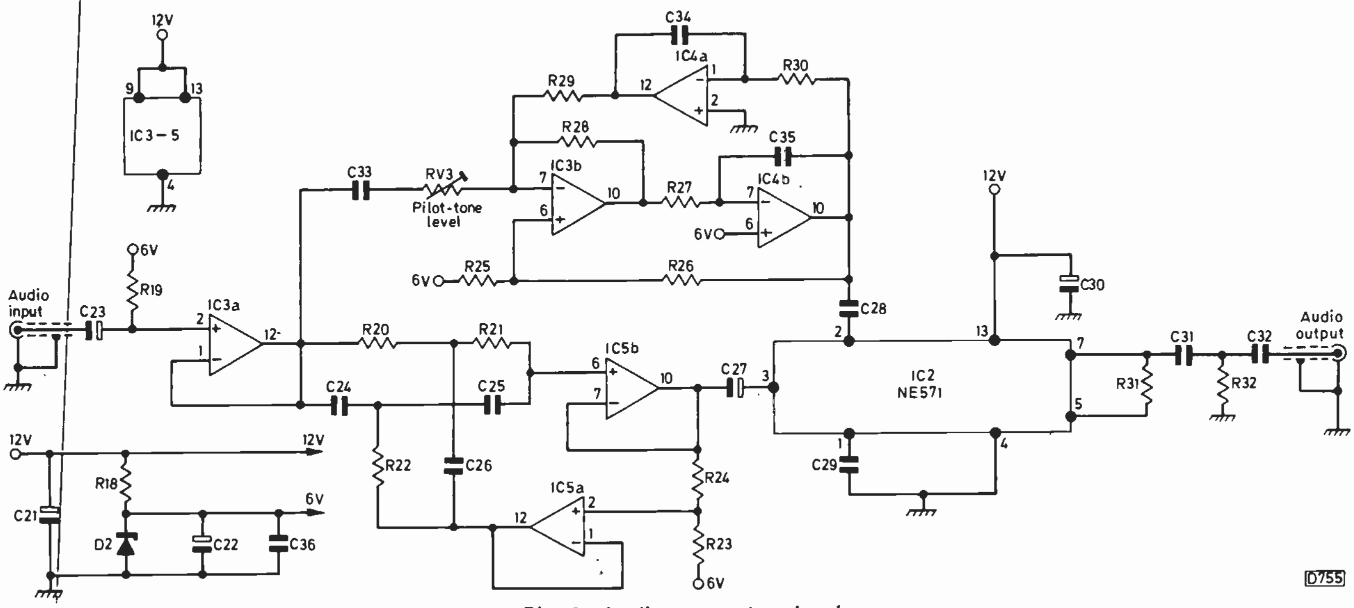


Fig. 9: Audio expander circuit.

be kept as short as possible. RV1 and RV2 are both front panel mounted controls. Use screened cable for the input and output connections to and from the board.

Any varicap diode with a nominal capacitance of 30pF can be used in position D1. The type of varicap diode used in colour decoder crystal oscillator circuits has been found to work well. Types HC7007 and MV2108 are suitable alternatives.

Construction of the expander circuit is less critical and no problems should be experienced provided the leads are kept short.

Testing and Setting up

Assuming that a 12V supply is present, check that pin 10 of IC1 is at 5V. Connect a frequency counter to TP1. When RV2 is rotated, the oscillator frequency should vary over the range 5·5-8MHz. If this range cannot be obtained, try altering the value of C13 slightly.

To check that this part of the sound board is operating, connect a short length of wire to the input capacitor C1. With RV1 set at maximum, shortwave broadcasting stations should be heard as RV2 is rotated. Alternatively, coupling the input close to the video detector stage of a conventional TV set should enable the 6MHz intercarrier sound signal to be resolved.

Moving on to the expander circuit, check that the voltage at the cathode of zener diode D2 is approximately 6V. Connect the output from an audio signal generator to input capacitor C23 and, with an oscilloscope connected to pin 3 of IC2, tune the generator through the range 0-12kHz. A sharp notch should occur at 11kHz. Depending on component tolerances, slight adjustment might be required to the values of R20/21/22 and C24/25/26 to achieve this.

Connect the oscilloscope to pin 2 of IC2 and again tune the generator through the range 0-12kHz. This time a sharp peak should occur at exactly 11kHz. Slight changes in the values of R30, R27, C34 and C35 can be tried, but be careful not to increase the bandwidth too much. This part of the circuit has a Q of 100 and a bandwidth of 110Hz: these characteristics must be preserved if the circuit is to function correctly. Too great a bandwidth will result in spurious operation of the expander caused by high-frequency speech sibilants etc.

Next couple the output from the PLL to the expander's input. Assuming that you are receiving the Gorizont satellite, tune the PLL to 7MHz. With the expander switched out, adjust RV1 for best sounding audio consistent with minimum video buzz. Switch the expander into circuit and adjust the amplitude of the pilot-tone signal (RV3) so that the NE571 i.c. operates over the linear portion of its gain range. A dramatic change in the signal's dynamic range should be noted when the expander is switched into circuit.

A correction should be noted to Part 1, where the 38V supply reservoir capacitor was shown in Fig. 4 with a voltage rating of 35V instead of 64V.

Servicing the Thorn 1600 Chassis

John Coombes

This solid-state monochrome chassis was used in three 17in. transportable sets — the Ferguson 3831, Marconiphone 4831 and the Ultra 6831. They date from the mid-seventies. It's a somewhat unusual chassis with a simple half-wave mains rectifier, a "dropper resistor" assembly and a shunt regulator which is in series with the line output stage (see Figs. 1-2).

Field Collapse

The most common fault is field collapse. The field output stage was modified twice, so that any of three circuits may be encountered (see Figs. 3-5). Failure of the amplifier/output i.c. is the usual cause and for replacement purposes Thorn supply the small module used in final production. Whenever the chip has failed it's worth checking that the supply is correct at 28V. This voltage can rise if the shunt regulator is inoperative due to R157,

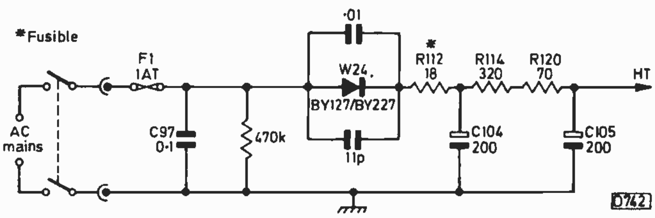


Fig. 1: Mains input/h.t. rectifier circuit.

which is part of the dropper assembly, being open-circuit.

If necessary check R108, C99, R109 and the scan coils for being open-circuit, and C88, C101 and C102 for being short-circuit. The height control R95 can also go open-circuit, sometimes causing intermittent field collapse.

If the field hold control is set at one end of its track, check the field oscillator transistors VT7 and VT8 (both BC147) and the value of R88 (470kΩ) which is in series with the hold control.

No Results

No sound or raster can be due to several things of course. First check the mains input fuse F1. If it's open-circuit, check the mains filter capacitor C97 and the h.t. rectifier W24 for shorts. If the fuse is o.k. but there's no h.t., check sections R112, R114 and R120 of the dropper assembly. If R112 (fusible) is open-circuit, check the h.t. reservoir capacitor C104 which could be short-circuit.

Alternatively the trouble could be in the line timebase. The first check is to ensure that the shunt regulator is working, i.e. that there's 30V at the junction of R146/R156. No voltage here could mean that the line output stage is inoperative. Check the e.h.t. stick rectifier by removing the e.h.t. connector – beware of possible shocks. If the sound then comes up, the e.h.t. stick (Thorn recommended replacement type TS20-11HAC) could be faulty or the line output transformer could have shorted

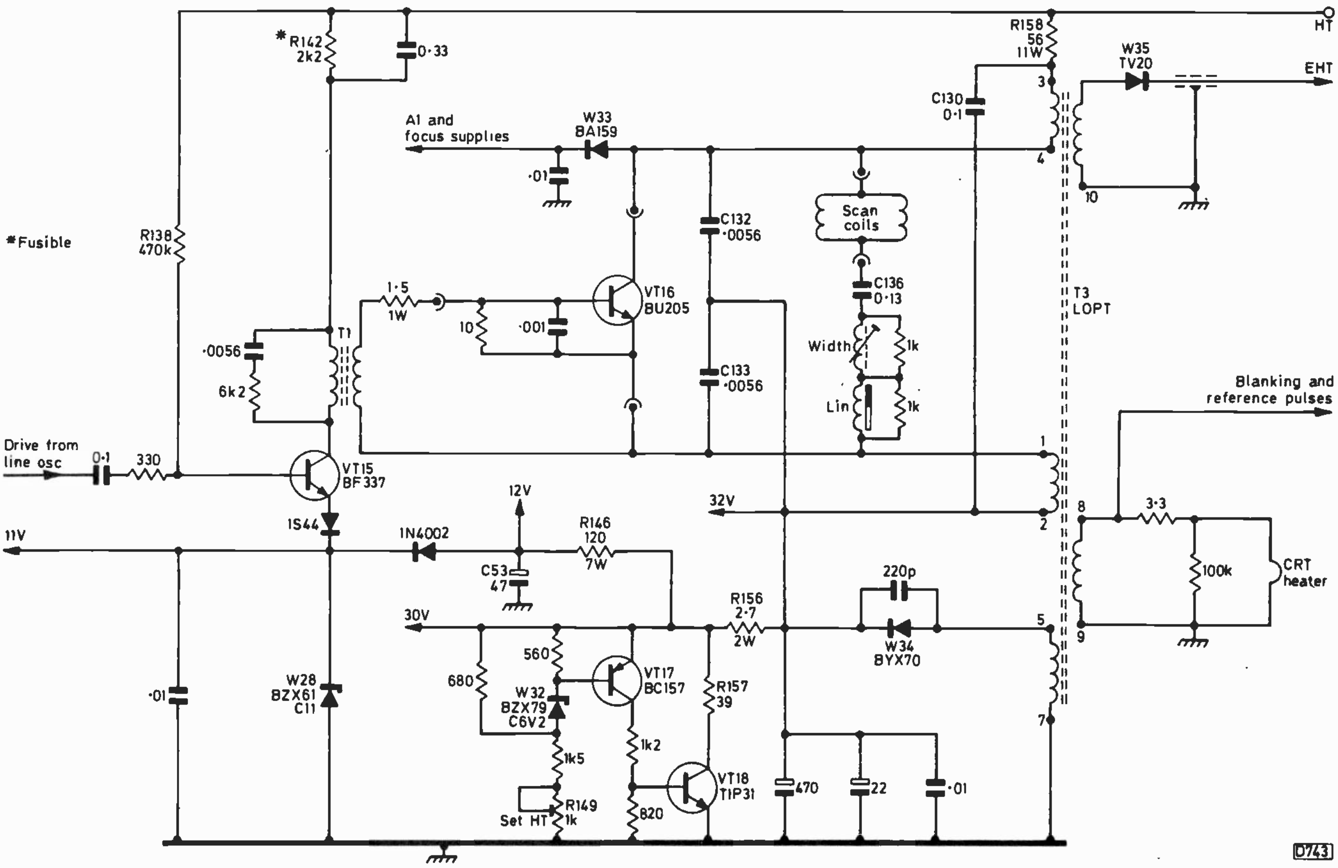


Fig. 2: The line driver and output stage circuits, with shunt regulator VT17/VT18 and associated components.

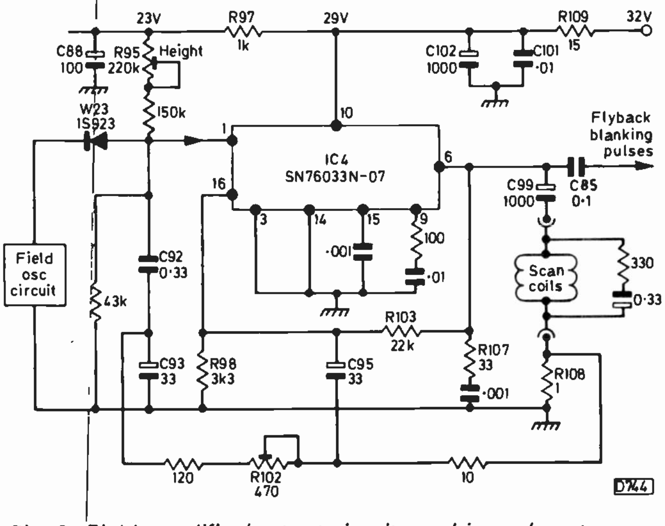


Fig. 3: Field amplifier/output circuit used in early sets.

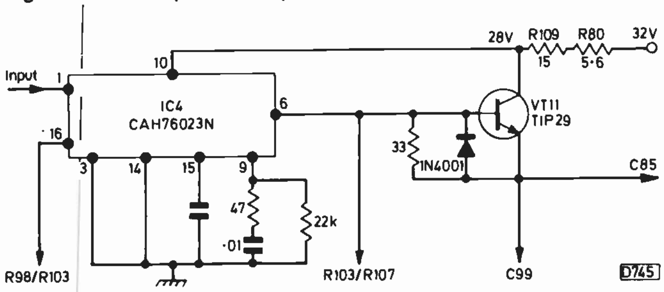


Fig. 4: Modified field output circuit with VT11 added.

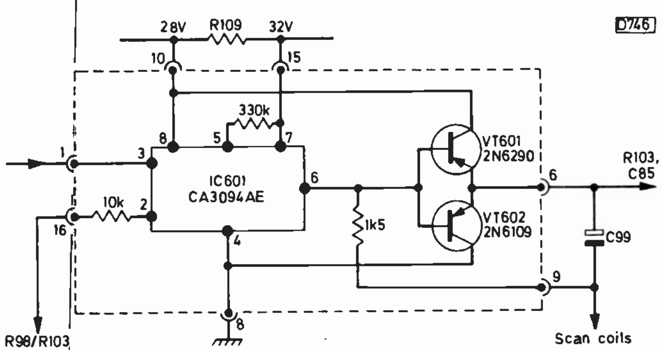


Fig. 5: Final field amplifier/output circuit using module.

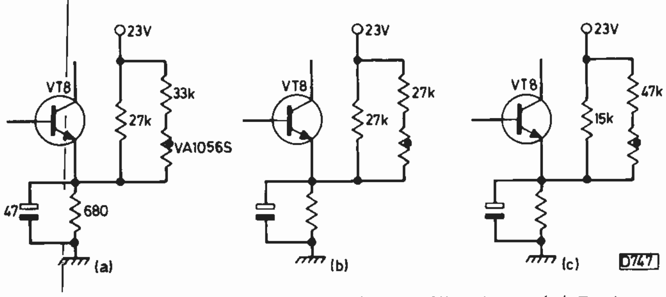


Fig. 6: Field oscillator bias circuit modifications. (a) Early. (b) With circuit shown in Fig. 4. (c) With Fig. 5.

turns (this can be intermittent, the set working for an hour or so before loss of sound and raster). If there are still no results, check the line output transistor for being short-circuit and the driver transistor's feed resistor R142 (fusible) for being open-circuit. The driver transistor VT15 (recommended replacement type BF259) could be short-circuit. Other possibilities are an open-circuit primary winding on the driver transformer T1 or shorted turns on the line scan coils L25/26.

A point to watch out for is the driver transistor's base bias resistor R138 (470kΩ) going very high in value. The result can be a dead line output transistor or a very hot one with the line output stage working at a very low level of efficiency.

Set HT Control Inoperative

If there's a normal picture but the set h.t. control R149 has no effect, check whether R157 is open-circuit. As previously mentioned, this can contribute to failure of the field timebase chip. The correct procedure for adjusting R149 is to connect a meter (20kΩ/V) switched to the 250V range between the junction of R158/C130 and the cathode of W34 and then, with the brightness, volume and contrast controls at minimum, set R149 for a reading of 140V.

No Sync

In the event of no sync, first check the sync separator transistor VT9 (BF197). If necessary check C111 (270pF) for leakage and C103 (0·22μF)/ R115 (3·3MΩ) for being open-circuit.

Tuning Troubles

Tuning troubles are not unusual. There's a varicap tuner (ELC1043/05 or Thorn SC4) and a TAA550 tuning voltage stabiliser. If R5 (24kΩ) which feeds the stabiliser goes high in value the result can be no signals at all. In the event of tuning drift the first suspect is the TAA550 (IC5) — check whether the voltage at the junction of IC5/R5 is varying. Beware however — this can be due to faulty pushbuttons, and may affect one channel or several. The other possibility for drift is of course the tuner.

Sound, No Raster

The most likely cause of sound but no raster is that the BF337 video output transistor VT5 is open-circuit. The recommended replacement is type BF258. Other things to check if necessary are the video driver VT4 (BC147) and the TCA270SQ detector/a.g.c. chip (IC1). Check the voltages around the i.c. carefully: if incorrect, replace the i.c. The chip can be responsible for sound with a blank raster.

Weak Signals

In the event of a snowy picture with noisy sound, check the i.f. transistors VT1, VT2 (both BF196) and VT3 (BF197), the tuner supply resistor R13 (10Ω) and the tuner.

Sound Faults

For no sound, first check whether the 27V supply is present at pin 10 of the SN76013ND-07 audio output chip (IC3). If not, check R74 (56Ω fusible) for being open-circuit and W19 (BZX61-C27) and C82 (470μF) for being short-circuit. Next check whether the TBA120AS intercarrier sound chip (IC2) is being supplied at pin 11 (13·5V). If not, check the feed resistor R46 (1kΩ) and the decoupler C58 (100μF). If necessary check whether the loudspeaker (35Ω) or the output coupling capacitor C84 (220μF) is open-circuit. Either chip can be responsible for no sound or distorted sound. The inter-chip coupling capacitor C72 (0·22μF) and a displaced speaker cone are other causes of sound distortion we've encountered.

Long-distance Television

Roger Bunney

The early autumn traditionally produces enhanced tropospheric activity. Certainly tradition ran true to form in 1983. Prevailing high pressure towards the end of the month gave excellent reception at v.h.f. and u.h.f. from the 22nd to the 30th, though the ATV contest during the weekend 10-11th unfortunately occurred during a wet and depressing couple of days. Sporadic E propagation has wained and was concentrated in the first part of the month. SpE loggings are as follows:

- 6/9/83 TSS (USSR) ch. R1; RTVE (Spain) E2.
- 9/9/83 TVP (Poland) R1; MTV (Hungary) R1; ORF (Austria) E2a; ARD (W. Germany) E2.
- 10/9/83 RTVE E3.
- 11/9/83 TSS R2.
- 12/9/83 RTVE E3; ARD E2.
- 13/9/83 RTP (Portugal) E2; RUV (Iceland) E3.
- 18/9/83 Unidentified ch. E2 programme material (1710 BST).
- 23/9/83 Many short periods of unidentified programmes throughout the band. CST (Czechoslovakia) R1; ARD E2.
- 24/9/83 Auroral activity throughout Band I. Programmes and test cards, mainly unidentified.
- 26/9/83 As 24th.

The enhanced tropospheric propagation during the last ten days of September gave excellent results for many enthusiasts throughout the UK, with a high incidence of tropospheric ducting in many parts. Here at Romsey for example ORF ch. E9 Bruck (20kW e.r.p.) was logged on the 26th at 0850 though other ORF stations were absent – Bruck is close to the Hungarian border, a distance of some 830 miles. Later that same hour Switzerland ch. E35 (TSI) was seen, though the other high-power outlets were not present. The various u.h.f. French channels (TDF) spread into southern Scotland (over land paths), W./E. German stations as usual swamped the eastern UK, and farther to the north east many NRK (Norway) and SR (Sweden) Band III/u.h.f. signals were logged. Arthur Milliken (Wigan) noted strong Swiss signals from Saentis (TSI) on the 29th for example. Band III was very active at Romsey, with W./E. German stations. The Belgian TV services were seen in full colour in S. Devon, Presteigne (Wales) and on the east coast, and NRK ch. E2 was observed at several locations (rather an unusual logging).

The high-pressure system was drifting away by the 29th, with rain spreading from the west. Thus ended what had been a very rewarding period. Though good, the opening can't be classified as memorable or intense. U.H.F. reception from W. Germany was too selective – at my distance it was necessary to seek out the signals. The increasing problem now of course is the many UK u.h.f. channels used for early morning TV programmes.

ATV reception at 435MHz proved exciting, with the Belgian station ON5VW providing P4 level pictures at Romsey on the 27th, along with another co-frequency picture. Several UK stations, including G8LES (see later), were also received. There were several reports of W. German/Dutch ATV signals being received in E. Anglia.

There have been widespread reports of RTL (Luxembourg) using the 5534 pattern (5544 with a clock inlay) on ch. E7, with their new system B transmissions from a newly replaced mast. Paris has been seen testing scrambled transmissions on ch. 5, in preparation for the Canal Plus service. The 315m TV mast at Wavre, Belgium, carrying v.h.f. and u.h.f. aerials, has collapsed. Fortunately the earlier mast was not dismantled, enabling the v.h.f. services to be continued.

My thanks to Arthur Milliken (Wigan), Iain Manzies (Aberdeen), Simon Hamer (Powys), Brian Renforth (Torquay), Nick Harrold (Southend) and David Moller (Eastbourne) for sending in logs of their reception.

Chain Letter

A chain letter suggesting that if the recipient continues the chain he will receive in short time over 1,000 picture postcards is circulating in DX circles. My personal view is that such activities should not be encouraged – I returned the letter sent to me to the last name on the list.

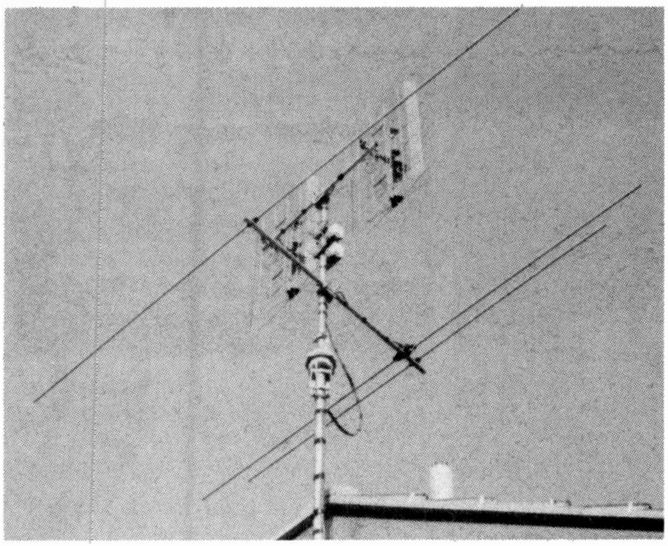
News Items

Taiwan: The Chinese Television Service (CTS) in Taipei recently opened its first u.h.f. transmitter on an experimental basis, with some two hours' programmes daily. The intention is to provide an educational service on this outlet.

Australia: It seems that the cultural TV services at present being transmitted in Melbourne and Sydney on ch. 0 are to close on January 1st, 1985, leaving just the u.h.f. outlets in operation.

Falkland Islands: There are rumours of a possible Falklands TV service following the installation of a grade

Left: The Basque (N. Spain) ch. E33 Bilbao transmitter's station identification slide – the transmitter was logged in the UK (south coast) during the recent enhanced tropospheric conditions. Centre: Saudi Arabian ch. E7 test pattern. Right: Standard test pattern used by Bulgarian TV – courtesy BDXC.



A. Palfreyman's aerial system at Sheffield.

B Intelsat ground station on the islands. The only TV available at present is via cassettes.

E. Germany: The last Band I transmitter, Cottbus ch. E4, is to close during 1985 when the DFF-2 service moves to u.h.f.

Satellite TV

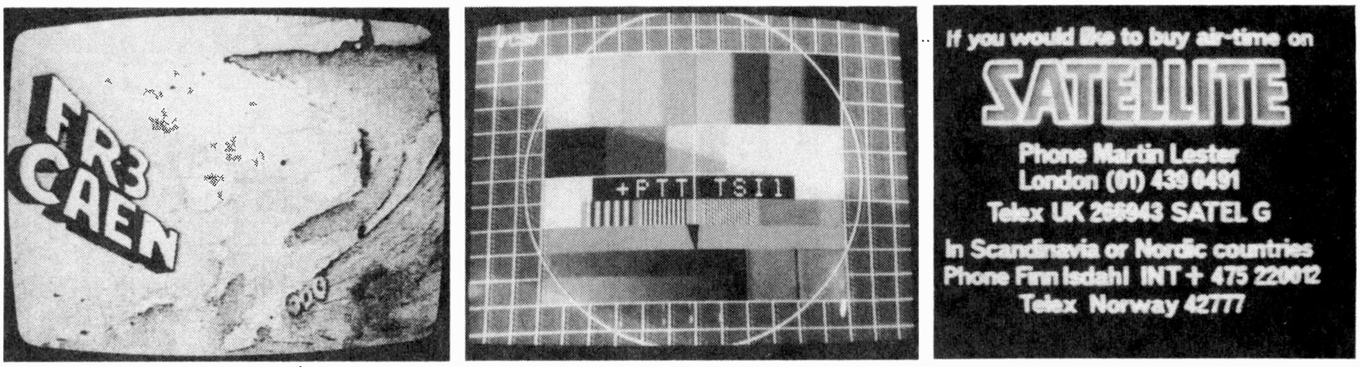
From the various US satellite/electronics magazines we receive it's evident that prices of satellite receiving equipment across the Atlantic are falling fast. Most quality systems now come within the $1,400–$1,700 bracket, though a complete system comprising 6ft dish, mount/support and the electronics has been seen for just $760! A trade catalogue lists a 100° LNA with spun dish and electronics at just $1,295. Reports show that 90 per cent of home satellite receiver users live in rural areas.

On the commercial front, Hugh Cocks (Bre Cottage, Cripps Corner, Staplecross, Robertsbridge, East Sussex TN32 5RY) is now offering a 4GHz receiver package (electronics) for under £400 complete in the UK. The receiver consists of a four-stage LNA and a double-conversion converter with video and audio outputs, a.f.c. to defeat the Gorizont 1 dispersal signal and an optional audio expander. Further details of the KB1 unit are available from Hugh (send SAE please).

Spectrum Changes

Gösta van der Linden reports that the re-engineered French Band I service will have three channels instead of four. These will be as follows: ch. 1 55·75MHz vision carrier, ch. 2 60·5MHz vision, ch. 3 63·75MHz vision, with the sound carrier spaced 6·5MHz below the vision carrier in each case. The Band III channels previously referred to as chs. 1–6 are now known as chs. 4–9.

As mentioned last month, there are to be changes in UK Band III spectrum use, taking effect from January 1st, 1985. These will present profound problems as far as UK DX-TV operation is concerned. Considerable information, including the frequencies for private mobile radio use, is contained in a news release sent in by Robin Crossley – it's intended for PMR manufacturers. The services will be restricted to mainland UK, i.e. excluding Northern Ireland. They will give users "high quality circuits" based on 50 per cent location and 90 per cent time. Potential users are to be specified shortly by the DTI



Left: Caen FR3, ch. E28, received by John Tellick during the August enhanced tropospheric conditions. Centre: FuBK test pattern in use by TSI, Switzerland. Courtesy Alexander Wiese. Right: UK Satellite TV caption received on cable in Helsinki via the OTS-2 satellite. Courtesy Petri Pöppönen.

and it's expected that they will include those displaced from Band II, which is to be emptied for further domestic broadcasting, i.e. police, fire, ambulance etc. Other operators will be large concerns with multi-channel needs for message handling or "common base stations providing a service to users generally". The frequencies listed last month are suggested as a guide and have not been finalised (there was also an error – sub-band 3 mobile starts at 216·5MHz). The transmit/receive spacing will be 8MHz with a 1MHz guardband between transmit/receive. The frequency allocations will be chosen to minimise interference to continental services.

We are are present awaiting further information on the future of Band I – indications are that the future use of this spectrum will be delayed.

Cordless Phones

The use of the 49MHz cordless phone (which is not approved by BT) is being closely monitored by the authorities in certain areas. In a recent case a company advertising 50 mile range cordless phones was visited by BT and the entire stock seized, including information identifying the importer. A vigilant DXer actually heard the transmission at 49MHz by the owner, telling his staff to "hide everything as there are a couple of BT blokes at the door"! The authorities seem to be taking a firmer line now that the 47MHz cordless phone band is in use.

From our Correspondents . . .

A. Palfreyman has just started DXing in Sheffield, using a twin-Triax u.h.f. grid system and a wideband Band I array at the end of his house and a Grundig 6400 v.h.f./u.h.f. colour receiver. Between the end of July and the present time he has received a large number of signals including TVR (Rumania). The u.h.f. aerials were installed just in time for the August tropospheric openings which gave excellent noise-free colour from NOS (Dutch TV) on various channels, also ARD (W. Germany) chs. 39 and 56.

A DX contact at present resident in Jordan within a few miles of the ch. E3/6 transmitter mast has sent us a local paper showing typical programme timings, as follows: the Koran at 1730 local time then programmes with Arabic news at 2000 and 2300 and close down at 2400. That applies to the main (E3) JTV service. The "Foreign" channel (E6) comes on air at 1800 (French) with 1900-2030 Hebrew, 2030–2300 English and Arabic news 2300–2330.

Kevin Jackson (see October column) reports that during "lift" conditions very good quality signals have been received from Denmark and W./E. Germany using just a Band III folded dipole at his ninth floor flat in Sheffield. All channels through to E11 are resolved with ease. The August Perseids gave him RAI (Italy) ch. D and SR (Sweden) ch. E5!

Gosta van der Linden (Holland) reports that the AFN-TV service at Soesterberg will be on ch. A80, which is just above the European u.h.f. band at 867·25MHz (vision carrier). The idea apparently is to prevent the local populace viewing the programmes. He's seen Rumania using the PM5544 pattern with "TVR-BUCURESTI" identification in the lower black section, also the electronic pattern favoured by DFF (E. Germany) though without identification insert.

Amateur Television

I've received a long letter from Mike Sanders (G8LES) providing information on his ATV activities. If any reader receives vision with his call sign the signal will have come from his home at Thames Ditton, Surrey. He operates at 10kW e.r.p. peak directional in the 435MHz band, using a rotatable MBM88 (70cm) aerial, and at up to 1kW e.r.p. peak in the 1240-1290MHz band (24cm) with a quad stack of 23-element Yagis. The signals are fed via 1in. diameter coaxial cable with, at 430MHz, a twin Mutek gallium-arsenide f.e.t. preamplifier providing a gain of 26dB with a maximum noise figure of 1·5dB.

144·75MHz is normally used for ATV communication – the Daiwa SR9 receiver with appropriate crystal is the cheapest means of getting this frequency – with visual response via a camera. The 435MHz band is shared with certain PMR users, and as a result ATV pictures sometimes suffer from interference. There are plans to establish 24cm repeaters, some a.m. and others f.m. – the eventual aim is for all 24cm video to be f.m. From Thames Ditton video exchanges are possible with stations in the Midlands and along the south coast, with signal enhancement via aircraft reflection!

Mike also transmits ATV from his car, with a range of typically six miles at 435MHz. Flutter is particularly troublesome and 24cm is to be investigated to see if f.m. mobile working is better.

Any readers seeking further information on ATV, e.g. BATC addresses etc., should drop a line with SAE.

Some days after receiving Mike's letter I heard G4HMG at Iver discussing TV on ·750 with a station in Somerset. I called G4HMG who suggested that a "one way" video link would be possible, and in due course grade P1½ pictures were received from Iver over a most difficult path. The local home counties' ATV club is G6HCT – write with SAE to Phil Miller, 33 Switchback Road North, Maidenhead, Berks. Visitors are welcome.

The Betamax Video System

Part 5

Eugene Trundle

The low linear tape speed used in the Betamax system is not conducive to good sound reproduction. An audio frequency response of 50Hz to 8 or 10kHz, with 40dB signal-to-noise ratio and 4 per cent distortion, is typical. Whilst this is no worse than with many machines of other formats, it's unlikely to send a hi-fi enthusiast wild. Even to the non-critical user, the shortcomings of VCR sound are obvious on certain types of programme material. The advent of stereo sound, with narrower sound tracks, tended to degrade the signal-to-noise ratio further. Beta Noise Reduction (BNR) was introduced to bring about an improvement.

Beta Noise Reduction

BNR is in principle similar to the Dolby noise reduction system. During record, h.f. enhancement is given to the audio signal, the higher frequencies being boosted prior to recording on the tape. The degree of h.f. boost is proportional to signal amplitude in a manner that may be familiar to video men as the non-linear pre-emphasis used for the luminance signal in current VCRs. The playback audio amplifier has a non-linear, i.e. amplitude-dependent, gain characteristic, with a falling h.f. response – the characteristic is complementary to that of the recording amplifier. Hence hiss, whose energy is largely in the h.f. part of the spectrum, is minimised during playback – an impovement in signal-to-noise ratio of up to 12dB is achieved.

A degree of "companding" (compression of the dynamic range on record, with a corresponding expansion during replay) is inherent in the BNR system. This can have the effect of slightly raising the background noise during quiet parts of the sound track, the subjective result depending much on the programme material. There's been some adverse comment about this in some quarters, particularly where critical appraisal of BNR sound is made by a listener used to audio hi-fi equipment. Longitudinally recorded video sound will never be as good as conventional hi-fi sound, but BNR certainly gives a worthwhile improvement over the original Betamax sound system.

Beta Hi Fi

While BNR improves the signal-to-noise ratio and with it the dynamic range of the sound signal, it will do nothing for the other parameters of the sound system such as bandwidth, distortion and wow and flutter. Further improvement can be achieved by a system called Beta Hi Fi. This has been pioneered by Sony for use in the USA but has not appeared in European machines. It's quite revolutionary in its operation, though something along similar lines has been announced recently by Matsushita for VHS system use.

The key to high-quality sound with a helical VCR system is to record the sound helically as well in order to get the benefit of the much higher read/write speed. It can't be done at audio base band – whilst the octave range would be adequate and the h.f. response fantastic, with 33 micron tracks the signal-to-noise ratio and other important characteristics would be very poor. As for video, a modulation system is necessary: the sound signal (mono or stereo) is frequency modulated on to a carrier in the region of 1MHz, so that it sits in the sort of no-man's land between the outer sidebands of the f.m. luminance and the colour-under signals. During playback the fairly narrow-band sound signal is selected by a sharp cut-off bandpass filter before demodulation.

The system appears to work well, and the performance figures quoted are very good – signal-to-noise ratio 80dB, frequency response 20Hz to 20kHz and distortion 0.3 per cent. To retain compatability with existing machines, the sound signal is also recorded conventionally on longitudinal tracks. The crunch is that the system is at present limited to US machines working to the NTSC standard, because the NTSC luminance and chrominance signals occupy less bandwidth (and tape spectrum space) than European signals. The reasons are tied up with the narrow I and Q (chrominance) signal bandwidths and the 60Hz field frequency. In PAL standard machines the tape spectrum is chock-full of video information, and on playback the presence of sound carriers could cause unacceptable beat and interference effects with the sidebands of the luminance and chrominance signals. Perhaps this gives some clue to the Matsushita "depth multiplex" system, which is understood to be suitable for European use.

Picture Channel Audio Recording

The PC (picture channel) audio idea is nothing to do with recording TV sound but is available for use with VCRs. For vision recording, a wide bandwidth and high information packing density are required. Why not use these desirable characteristics for sound? An adaptor such as the Sony PCMF1 can be used to convert the incoming audio signal to pulse code modulation for recording on the tape helically. The adaptor samples the audio input at about 44kHz (above Nyquist frequencey for the specified 20Hz–20kHz input) and produces a digital 14 or 16 bit word signal chopped at TV line and field rate so that it's recognised and accepted by a conventional VCR. The digital signal is fed into the VCR's video input and helically recorded in the same way as a video signal – it occupies virtually the same bandwidth. During replay the VCR's output is fed back to the adaptor (now acting in the decode mode) and converted to base band audio. The performance is impeccable, with 90dB dynamic range and parameters such as distortion and wow and flutter being virtually non-measurable.

The system doesn't like VCRs, such as the Sony SL8000 and Sanyo VTC9300, without a capstan servo. In these machines the capstan speed during playback is tied to the mains frequency and its stability is not good enough to prevent distortion and dropouts on replayed audio. The dropout compensator, so important for TV applications, is not required in the audio PCM mode. In fact it degrades the results, which is why later Sony VCRs have a PCM switch to disable the DOC circuit. VCRs without this facility will work with PCM audio but the performance may be degraded, though not usually to the extent that it becomes noticeable. In all cases a high quality video tape is recommended, of preferably no longer than two hours' playing time, i.e. the L500. The PCMF1 adaptor works perfectly well with VHS machines – with the above constraints. The longitudinal audio track is left free for cue, identification and announcement use.

Why the choice of two PCM modes, 14 and 16 bit? This depends on the specification and performance of the VCR. The 16-bit mode offers best dynamic range and lowest distortion, and is suitable for machines such as the Sony F1 and C9. For use with three-hour tapes or in machines without a PCM button the 14-bit mode is preferred, as it gives higher data redundancy and error protection, at the expense of slightly reduced performance.

As with any system, an audio chain is only as good as its weakest link. While PCM won't degrade an audio signal, it won't improve it either! Why use it? The advantages seem to be that off-air timed stereo radio recordings can be made, unattended, for up to three hours, using the VCR's timer; as a transcribing machine for audio use there will be virtually no quality degradation, even on multi-generation copies; while in the professional audio field performance better than that of a conventional quarter-inch tape audio machine is provided. The cost of the PCMF1 is around the four figure mark however, so we won't be coming across many of them in domestic environments. To realise and justify a 90dB signal-to-noise ratio with an audio signal you would need to be in a sealed cave under a mountain at night, having killed off all insects and cut off your blood circulation . . . How ridiculous to buy stereo equipment with low distortion and high signal-to-noise ratio for use in a car, which is moving most of the time – ambient conditions will in these circumstances offer a signal-to-noise ratio of maybe 20dB, but I digress.

SURVEY OF BETAMAX VCRs TO DATE

To round off this series, there follows a brief run down on the main Betamax VCRs that have been sold in the UK. There are three main manufacturers, Sony, Sanyo and Toshiba. There's not been much "badge engineering", the main exception being the Bush Model BV6900 which is basically the Toshiba V5470B.

Sanyo

VTC9300P and -PN: Large, piano-key operated single-motor machines. Notable as being amongst the first domestic consumer products to use a microcomputer i.c. – it operates in the clock/counter circuit. Three-day, one-event plus serial timer and simple colour picture-pause facility (see Fig. 7). A wired remote pause control is provided, but the VCR/aerial switch is inconvenient. These machines commonly sold at under £300, and in doing so did much to increase the Betamax system's share of the market.

These models have a well-known tendency to shut down due to failure of the 12V regulator transistor Q702 (on panel W3). A reliable substitute is the TIP41.

VTC5600P: An attractive looking machine with sloping front and touch controls. Full infra-red remote control and a one-week five-event timer. Simple pause in colour and a slow-motion facility (25 per cent of normal play speed) are provided. A comb-filter circuit for luminance crosstalk cancellation is fitted.

These machines have proved reliable in service, and such faults as have occurred seem quite random in nature.

VTC5300P: A light and relatively slim machine for its time, with direct drive motors and light touch control including the eject function, performed by a solenoid. One-week one-event and serial timer. The tape counter is mechanical, in contrast to earlier models. Simple picture-pause facility with colour. Luminance comb filter circuit.

Apart from an occasional aversion to worn tapes, few troubles have been encountered and reliablity is reasonably good.

VTC5000P: A touch-control replacement for the early VTC9300 series, aimed at the same economy end of the market. All secondary mechanical functions on the deck are performed by the loading motor via a threading ring. Light and small with very low board and component count. Eight-day one-event timer with serial facility. Monochrome pictures during simple still frame and picture-search modes. Fluorescent tape counter/clock display, as on early models. Luminance comb filter circuit.

At the time of writing these machines are too new to be able to assess their reliability. It promises to be good, though I've had one or two instances of random blowing of the mains fuse and the odd failure of infra-red spool rotation detectors.

Sony

SL8000UB: The first Sony VCR on the UK market. Pinao-key operated and fairly bulky single-motor machine. Three-day one-event timer. Simple picture-pause with colour. Wired remote pause control. TV-video switch.

Like the early Sanyo VCRs this machine was built to last! There are few common faults that routine maintenance will not cure. A tendency to shed drive belts is sometimes apparent now these machines are a few years old – a set of new belts will cure this. An occasional fault encountered is sudden stopping of the machine during forward, fast forward or rewind: while this can be due to the CX141 syscon chip, or even to the tape-end sensor coils, more often the joints and connections to the end sensors or the associated presets RV701/2 are responsible. Another potentiometer that's prone to intermittency is RV14 on the Y/C panel: this causes spasmodic colour-lock trouble on replay. The luminance and audio signals are mechanically switched between record and replay: the slide switches can be a source of trouble, causing intermittent audio and picture break-up or dropout. Cleaning of these switches is difficult, so replacement is recommended.

SL8080UB: As for the 8000UB, but with cue and review. The picture and sound are disabled in these modes, which serve to avoid the need to disturb the play and stop keys. A simple form of automatic tape search was also incorporated in this machine – a cue signal is recorded at each operation of the record key. In the fast forward or rewind mode, selecting automatic picture search will initiate stop at the first cue signal.

SL3000UB: Piano-key portable with direct drive head drum and an early form of clean assembly edit facility. Gives good results when used with HVC2000P camera. Not a very common machine, at least in my part of the world!

SLC7UB: Fairly large touch-controlled machine with sophisticated electronics. Two-week four-event timer. Full infra-red remote control of all deck functions and broadcast channel selection. Self-seek u.h.f. tuning with twelve preset stations. Picture search (cue and review), triple speed, still, slow motion and frame-by-frame advance – all in colour, but noise bars visible in search mode (in the other trick modes the noise bars are shunted to the top and bottom of the picture by the capstan servo). Automatic tape programme search, as described for the SL8080. Luminance comb filter circuit. Clean assembly edit facility. Autorewind at tape end.

The C7 has a switch-mode power supply to provide the main 12V power lines within the machine – the first application of this principle to a domestic VCR so far as I am aware. In spite of this it's not a light machine.

Considering its sophistication and high component count, the reliability of the C7 is good. I've had a few cases of micro-madness in the syscon circuit. Diagnosis is not easy, and in one or two cases I had to return the machine to Sony for servicing. The one weak spot mechanically is the friction drive system for fast transport (fast forward and rewind). The symptom is that the spools will slow down and maybe even stop in these modes. Cleaning the appropriate friction surfaces and idlers will effect a temporary cure, but the permanent solution is to fit the modified idler kit supplied by Sony. It's not expensive or difficult to fit – for machines up to serial no. 355300 the part no. is A6706-348-A; for serial nos. above 355300 it's X3653-315-0.

SLC5UB: Similar in appearance to the C7 but aimed at the middle sector of the market – its more modest price tag reflects the absence of some of the features incorporated in the C7. Touch button controlled. Remote control by optional wired handset RM75T. One-week one-event timer. Monochrome simple still picture and monochrome visual search (cue/review). Clean assembly edit facility.

Reliability is good, but rewind modification kit remarks above are also applicable to this machine. All C5s will take kit A6706-348-A.

SLC6UB: Sony's first UK front-loading machine. A middle-of-the-market model with pleasing appearance – the front styling is more conventional than Sony's earlier touch-control VCRs described above. One-week one-event timer. Two options for remote control: simple wired RM72 handset offering picture search and pause, or "bolt-on" infra-red receiver kit RM-C6K which passes the same simple commands via an infra-red link. Picture search and simple still frame in colour. Luminance crosstalk comb filter circuit.

The C6 has not been around long enough to establish any nasty habits, but the part no. for the rewind kit is A-6706-391-A. A few cases of failure to eject have been reported – this is caused by failure of switch S7103 on TT-2 panel.

SLF1UB: A small, high-technology portable VCR with low power consumption. There's a wide range of accessories for location work. It's a dual-purpose machine in that the styled-to-match tuner-timer TTF1UB completes the ensemble to make up a full-specification "static" system. Where applicable, the following remarks apply to the combination F1 system. Light-touch controls. LCD tape time elapsed counter. Two-week nine-event timer. Full-function remote control. Clean edit facility. Picture search. Simple still, slow motion, frame-by-frame, double speed, normal and slow-backwards playback modes, all in colour. Go-to-zero facility.

SLC9UB: Magic! The current top-of-the-range domestic machine. A slim and well styled front loader. Stereo sound and BNR. Full-function remote control. Light touch controls. Two-week nine-event timer. Eleven times normal speed picture search in colour, with only wire-thin mistracking bars. Very good still frame. Colour replay in continuous forward or reverse at double speed, normal speed, one fifth normal or one tenth normal, plus slow motion and frame-by-frame advance. Programmed APS with up to nine cue points. Tape time elapsed counter. Go-to-zero facility. Auto back-space clean editing. Tape remaining indicator. Self-seek u.h.f. tuning with automatic sequential programming of station memory bank. Luminance comb filter. Switch-mode power supply. Seven microcomputers and extensive use of LSI.

The C9 uses a lot of advanced technology, both mechanical and electronic, to achieve the highest specification to date for a domestic VCR – its performance is very good indeed, and every review I have read is full of praise.

Toshiba

V5250B: This is identical to the Sony Model SL8000UB.

V5470B: Piano-key operated with TV-video switch. A little smaller than its Sanyo and Sony contemporaries, and unusual for its vintage and type in having three motors, one for direct drive of the head drum. Several other features not usually associated with piano-key machines are also incorporated. One-week three-event timer. Soft-touch station tuning. Still frame in colour with the noise bars shunted out of the picture. Colour picture search. Trick speed replay in colour, continuously variable from still to double speed. Digital capstan and head servos. "Programme quick select" facility, similar to the automatic tape search system used in the Sony SL8080UB.

The capstan motor can be a weak spot in this machine, the usual symptom being wow or flutter on sound – bad cases will also give rise to lateral picture instability. Before condemning the motor it's worth checking the machanical alignment of the tape path and the condition of the play idler. Intermittent shutdown during a timed recording can occur: to cure this, change R619 (servo logic panel) to 330kΩ. Intermittent shutdown of the deck functions may be due to IC501 or the stop microswitch – the latter can cause full stop regardless of which keys are pressed! The record/playback switch S101 can cause intermittent noise and picture breakup if it's dirty, maladjusted or worn.

V8600B: Fairly bulky touch-controlled VCR with four video heads. One-week three-event timer. BNR sound system. TV/video switch. Programme quick select feature. Comprehensive wired remote control. Picture search at seven times normal speed. Excellent colour pictures in the still and slow-motion modes due to the four-head system. Double-speed playback. Auto rewind at tape end.

Reliability is good, and stock faults are mainly confined to solenoid trouble and the failure of Q661 (servo/logic panel). The latter fault removes the u.h.f. output on replay.

V9600B: Toshiba's first front loader, with radically restyled presentation. Aimed at the lower-price end of the market. This machine has something of a VHS look about it! Three-day one-event timer. Mechanical mode switching by loading ring, similar to the Sanyo VTC5000. Provision for wired remote pause control (optional extra). Simple still frame, slow motion and picture search, all in colour. Touch-button sequential channel selection.

Who's Cognizant?

Les Lawry-Johns

I used to be, but it seems I no longer am. This makes even the most simple job long and tedious.

For example I spent a lot of time trying to find the cause of horizontal black lines appearing intermittently across the picture of a Bush set fitted with the T20 chassis. At last I gave up and sent the chap off to Geoff for a second opinion. Within an hour Geoff phoned to ask me if I was all there as he'd put it right in minutes. It was the tube base arcing at the focus pin of course. We all know that one – I keep a dozen tube bases in stock for just this reason, and often lend one out to the simple souls who omit to do so. But I didn't recognise the symptoms myself (cries of "retire, retire!").

No Sound

Then look at last Sunday morning. We are around for only an hour or so while we make up (cook says Mr. Lord) the books and clear up the mess left over from the Saturday madness, before we make ourselves presentable to go and collect the sea food and play our Sunday card game. Just as Honeybunch and I were playing an innocent game of truth or dare however this chap came in with a Thorn 1590 portable (Ferguson Model 3816). He said it had no sound or picture.

Without further ado I whipped off the cover shell and checked the l.t. fuse. It was o.k. So I checked the mains input fuse, which was also o.k. Next I plugged in and switched on. The tube lit up and so did the screen. With an aerial connected it produced a good picture.

"Fancy that" said the chap, but I was already on the track of the no sound condition. Check the speaker and headphone socket. Check the voltages in the audio output stage, then in the bias, driver and audio amplifier stages. I injected an audio signal at the base of the audio amplifier transistor. Loud and clear . . . So I began to think dark thoughts about the preceding chip. Before going further I injected the signal at the centre tag of the volume control. No sound. Turn up the volume control and the sound is loud and clear. "Had to make sure" I explained, "why don't you take it to an expert next time instead of a moron like me?"

The G11

Now everyone knows their G11s. I mean everyone. A lady phoned to say that her Philips CTV had broken down with a white line across the screen and that she couldn't bring it in because it was too heavy. So I arrived with a complete case of G8 and G11 spares. It was a 26in. G11. Now any fool knows that field collapse is due to the TDA2600 i.c., with perhaps the 800mA fuse gone as well, and that the 470μF h.t. reservoir capacitor is possibly responsible for the chip and maybe the BU208A failing.

I whipped open the spares box and rummaged around for a TDA2600. Looked here and there until she picked one up and asked "is this what you're looking for?" Oh dear, but I took it from her gratefully. Next unsolder the heatsink and remove the faulty chip. The solder hadn't been disturbed, so I presumed it was the original one. I was surprised to find one pin folded upon itself: it had obviously made contact, so I fitted the new chip and checked the fuse which was intact. The 470μF reservoir capacitor was a red one and had been sparking at the rivet. In went a new one. "This would have caused you trouble later" said I, "so it's better out than in." "Of course" she agreed. As all seemed to be in order I switched on. The raster came up with incomplete field scan and collapsed, tried to build up again and collapsed. I checked the voltages: the 40V supply was smooth, but the voltages around the chip rose and fell together. Tried this and that to no avail. "I'll pop it back to the shop where I can check it more thoroughly" said I.

Off came the frame and I lugged the set out to the car, trying not to huff and blow. Back on the bench I checked the associated components, having fitted another TDA2600 just in case. Everything checked out o.k., though the voltages were all over the place of course. The new chip then went short-circuit and blew the fuse. I checked the voltages with no chip in: all were as expected and steady. Another chip was fitted and the comedy continued. The evening shadows fell, my spirits with them. At last I gave up.

In a dream I saw someone holding a TDA2600 with one leg folded up, and wondered what this foretold. Next morning I paid a visit to my friends Don and Raymondo. I told them how upset I was and why. "It's the holder" said Don. "It's the holder" said Ray. What wise boys they are. Of course it was the quil to dil chip holder. The folded up leg on the old chip had opened up the clip so that a new, unfolded leg couldn't make proper contact. All was well when a new holder and a new chip were fitted.

I rushed the set back to its owner. She saw me puffing up the path with it and opened the front door. There she stood, making it difficult to enter. I tried to get past but the set, and she, got sort of jammed in such a way that I felt embarrassed. "Awfully sorry" I gasped. "Don't worry about me, just push through." If it had been a bloke I'd have told him to . . off out of the way, but I didn't like to as she was a lady. So I pushed back on her to make way for the set. It was now obvious to me that she was a lady, but I didn't linger long. In went the set, pulling me with it, while she still stood against the door jamb as though nailed there. I think the edge of the frame just ran down her backbone and she was frightened to move in case she broke in half.

So ended another right muck up. Anyone else would have thought about that folded up pin, but all I could do was to dream about it.

A Right Pair

Then look what happened when I went to fix a set that wouldn't tune properly. I got it tuned all right, but when I came to leave she asked me (another lady, who's a friend of ours) how much. Didn't want to charge her at all, but I didn't want to offend her either. So I said a pound. She gave me this, commenting that it was obviously not enough for the call, and went out to the kitchen to get something else for me.

She came back with two large pears and suggested I put them in my box. There wasn't room for a peanut, so I put one in each trouser pocket. I felt a bit uncomfortable whilst driving back, but soldiered on. When I got back and went into the shop both legs were soaking wet and my trousers had changed colour. Ever helpful, Honeybunch said "couldn't you wait?" "Margaret sent us some pears" I tried to explain, showing her what was left.

Birds

In came this pretty young girl with a radio cassette. So I thought I'd show off a bit and do it whilst she waited. It was used on mains only, so I checked across the plug pins and found that the transformer's primary circuit was intact. Off came the back to check the fuses. Both the mains and the l.t. fuses were intact, so I plugged in to see what we had or didn't have.

There was a.c. from the transformer to the bridge rectifier. There was about 10V d.c. across the reservoir capacitor. A lead went from this point to the mains socket for switching purposes, and there was no output from the switch. "Simple" said I, "got it now." Since battery operation was never used, and indeed there was no sign of a negative lead from the battery compartment, I shorted the switch contacts across, expecting the set to burst into life. It gave a grunt and the 10V reading dropped to zero. "There's probably a short and it's probably blown the fuse" I said, with a sickly smile. The fuse was intact. I removed the screwdriver from the switch contacts and the 10V reappeared across the reservoir. I removed the mains plug and prepared to look for shorts. There were no shorts and the 10V remained across the reservoir. Since the voltage was still present I thought that the bridge had charged the reservoir and that all was well in this department. I again shorted the switch contacts and the 10V fell to zero. "I'll leave it with you then" said the girl, "and call back later. Perhaps you'll have got someone else to see to it in the meantime."

I stared at the set and called it a nasty name, like I call the bird when it goes to bite me. Once again I plugged it in and the 10V appeared at the reservoir. It remained there until I shorted the switch, this time with a permanent soldered connection. There was no voltage at the reservoir capacitor but there was at the output from the bridge rectifier, half a millimetre away. I applied the iron to the seemingly perfect joint and the radio burst into life. How the bridge had charged the reservoir capacitor across a high-resistance gap had once more fooled me.

I mentioned a bird just now. It's taught me the meaning of the term "bird brain" you see. A while ago one of Honeybunch's relatives was posted to Northern Ireland – he's in the army. Anyway, he thought the bird wouldn't be safe, so he gave it to HB who he knew would be crackers about it (true). It's not very old, about six months, so HB says we've got to be patient with it. It's a very handsome cockatiel. HB calls it Crystal and I call in Grumpy, and because of our cat we have to keep him upstairs. So for the best part of the day he's on his own though he gets plenty of attention from six o'clock onwards. HB talks to him continually. "Who's a clever boy then?", "there's a pretty boy" and all that sort of thing. He's yellow and white with orange patches on his cheeks. I add my terms of endearment – "who's a made up ponce then?"

In spite of all this loving attention he remains wary, suspicious and downright spiteful. He pecks through his millet at a great rate then squawks for more. When HB tries to give him more he attempts to bite her. I've told her to put him on iron rations for a week to teach him to be grateful but she'll have none of it.

All right, so he's mentally disturbed. Something nasty must have happened to him when he was younger. Yes. He was hatched.

Service Bureau

Requests for advice in dealing with servicing problems must be accompanied by a £1·00 postal order (made out to IPC Magazines Ltd.), the query coupon on page 97 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 KV1820

The fault is no sound or raster. On initial investigation the chopper transistor and its driver, also the surge limiting resistor R602, were found to be faulty and were replaced. This restored the h.t. supply, but at only 45V instead of 135V. The start-up diode D612 then went open-circuit. The h.t. rose to 135V after this, but kick-starting the line oscillator with an 18V battery reduces it to 45V again.

Since the power supply seems to be able to produce 135V off load, it's likely that the fault is in the line output stage. On occasions we've found that the trouble was due to a defective efficiency diode (D806). The best course would be to supply the set via a variac, measuring the h.t. current as the mains input is increased. With the h.t. at 60V there should be a small picture and the current, monitored at pin 1 of connector CNF3, should be around 200mA. If it's more, check the line output stage by disconnecting items in turn, starting with the tripler and yoke. If the current is much less than 200mA, concentrate on the power supply unit, if necessary disconnecting the over-voltage and excess-current circuits while monitoring the h.t. current as before.

PHILIPS N1501

This VCR produced sharp, steady pictures on my 19 and 12in. Bush monochrome sets until recently. Now there's a flickering effect – on the 19in. screen the whole picture fluctuates sideways by some quarter of an inch, affecting all verticals. The tape path has been checked and cleaned.

There seems to be a variation in either the head or the tape speed. If the fault is present in still frame, check for wear in the head lower bearing and lubricate this. If the movement of the picture is regular, the head servo ripple preset R214 on the servo panel needs adjustment – a scope is required for this. If the fault is not present in still frame, check whether the movement corresponds with the pinch wheel revolutions: if so, replace it. The tape servo ripple preset R252 may need adjustment. Failing this, check that both the head and capstan motors are absolutely free – the bottom bearings tend to become tight.

THORN 8000 CHASSIS

A brilliant white line appears about three quarters of an inch below the top of the screen – it's some ⅛in. deep. Adjusting the height control reduces the brightness of the line and moves it to near the top, where it appears as foldover. The set operates correctly in every other way.

This sort of problem is usually caused by trouble in the top half of the field output stage. Check the 2N6178 output transistor VT401, diode W413 in series with its base, and the flyback clamp diode W414. If necessary, check the bootstrap capacitor C438 (10μF) and the bias diodes W411/2.

KÖRTING HYBRID COLOUR CHASSIS

The problem is lack of width — the picture is only five inches wide. The resistors in the width circuit are all o.k. and the line timebase valves and the electrolytics in this area have been replaced. The line output stage derived voltages are all low, and the PL509's screen grid voltage is only 140V instead of 225V.

The low screen grid voltage suggests that either the feed resistor R424 (2·7kΩ) has gone high in value or the decoupling electrolytic C422 (25μF), which is mounted off the board, is leaky. In this case the PL509 will be running cool. If the valve is running hot, the drive waveform could be incorrect. Check C419 (220pF) in the shaping network for open-circuit and the line oscillator's anode circuit resistors R416 (47kΩ) and R417 (8·2kΩ) for changed value.

DECCA 80 CHASSIS

The line shift control VR403 won't move the picture left. Despite the control being at one end of its range, there's a quarter inch gap down the left-hand side of the screen. I've tried replacing the control and the two diodes which produce the shift voltage.

The shift control should provide correction in either direction and despite your problem is probably working correctly. First check the purity, then set up the line hold control VR321. This is done by shorting the test pins adjacent to R306, then adjusting VR321 for vertical bars. Remove the link and the problem should be resolved, with adjustment of VR403 as necessary.

GEC HYBRID COLOUR CHASSIS

The picture is sharp and the geometry good, but there's smearing and streaking across the screen, the effect varying with picture content. Reducing the setting of the contrast control removes the smearing but leaves a green tint over the whole screen. When the contrast control is turned up there are usually two faint, broad blue bands which vary with picture content.

This sort of thing is usually due to clamping problems at the c.r.t. grids, and is aggravated by grid current in a soft, gassy tube. Try three new PCL84 colour-difference output/clamp valves, and check the three 8·2MΩ triode clamp anode load resistors. If there's no improvement, reactivating the tube may well make a big difference. If the tube is past it, the only viable solution is to fit a regunned replacement.

SONY KV2000

I initially found that the chopper transistor Q607 was short-circuit. After replacing this there was a quick rush of e.h.t. and sound (e.h.t. top cap disconnected), then the protection circuit came into operation. Overriding the excess current trip by temporarily shorting out C610 produces an h.t. of 100V instead of 135V — this cannot be controlled by the preset. With no load the power supply trips about once a second. All the semiconductor devices in the power supply and the line output stage appear to be o.k., checked with a meter out of circuit. It's difficult to know whether the power supply is faulty or overloaded.

Check the current flowing on load at pin 1 of power supply connector F3. If it's in excess of 400mA, the line timebase is in trouble. Unload the line output transformer gradually — start by disconnecting plug E to isolate the e.h.t. transformer. If the current consumption is less than 400mA, concentrate on the power supply. We've known thermistor Th602 and zener diode D605 in the error amplifier circuit, and the chopper transistor's emitter resistor R628 (1Ω, 1W), cause trouble in this department.

THORN 9800 CHASSIS

There's an intermittent fault on this set. At switch on the picture is normal, but after a time that varies between three quarters of an hour to an hour and a half the height reduces to about three inches. Sometimes the fault doesn't appear for two or three days. If the set is left switched on the fault goes after a time that also varies. Switching the set off and allowing it to cool makes no difference.

We've seen the fault on this and other chassis — it's usually due to dry-joints around the pincushion correction transductor. Carefully check the connections to T501 and the phase coil L505.

TEST CASE

252

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

There are many traps for the unwary in television servicing, as most of our readers will know! What appears to be something obvious can turn out to be obscure, while conversely sometimes the most difficult looking faults can be caused by something simple. In much modern domestic electronic equipment several diverse faults can produce the same symptom as far as the user is concerned – examples include the "no deck functions" condition with a VCR and the "dead set" condition with a TV set.

As an illustration, we were recently confronted by a Bang and Olufsen set fitted with the 5000 chassis. The symptom was a pumping effect, the power supply switching on and off at about one second intervals. When this sort of thing happens, it's important to observe all the symptoms carefully so that the fault area can be narrowed down as far as possible. The technician dealing with the set noted that once the picture tube had warmed up a contracting raster was visible on each pump cycle, and that a corresponding burst of sound was present each time the h.t. line perked up. This suggested that the receiver and timebase sections of the set were in working order, and that the problem lay in the power supply itself.

It was known that the power supply incorporates over-current and over-voltage protection, designed to pulse the h.t. supply in the presence of abnormal conditions. If the e.h.t. or l.t. line voltages rise significantly, tripping will occur: a likely cause is excessive h.t. voltage. An AVO 8 was accordingly hooked on to the main 172V h.t. line as a check. The meter needle peaked at just 94V at each pump cycle, so the possibility of excessive h.t. voltage was discounted and other avenues were explored. No abnormal current was flowing through the sensing resistor 6R27, and shorting it out experimentally had no effect on the symptom.

Pursuing the possibility of a protection circuit fault, the technician next warily turned off 6TR6 by linking its base and emitter leadouts, whereupon the pumping action at once stopped. This confirmed that the tripping action was being initiated by this transistor, and now that a stable picture was present it could be seen to be considerably overscanned in both the horizontal and vertical directions. Suddenly everything fell into place in the technician's mind and a diagnosis was made with little more ado. What fundamental error had been committed during the investigation, and what was the true cause of the fault?

ANSWER TO TEST CASE 251
— page 41 last month —

Last month's "confessions from a workshop" described an elusive and spasmodic line whistle coming from within a new Hitachi Model CPT2028, and the heroic attempts to track it down by component substitution. The whistle was still present after replacing the chopper, line drive and line output transformers, leaving us at something of a loss.

The culprit was finally traced by resorting to something very similar to a feather with which, believe it or not, we gently brushed relevant areas of the chassis. Full marks to the feather, for it discovered that the offending whistle was coming from FB701, a ferrite bead on the cathode lead of the 12V rectifier D703. Its factory-applied blob of sealment had missed the target, and the bead was actually vibrating on the diode's leadout wire. A blob of silicone rubber compound silenced it forever!

We were a little wide of the mark last month in saying that this Hitachi set doesn't have a line linearity coil. In fact L704 performs this function. It's a fixed and sealed device however, with no means of adjustment and, so far as we can see, not propensity to whistle.

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TELEVISION DECEMBER 1983

Published on approximately the 22nd of each month by IPC Magazines Limited, King's Reach Tower, Stamford Street, London SE1 9LS. Filmsetting by Trutape Setting Systems, 220-228 Northdown Road, Margate, Kent. Printed in England by The Riverside Press Ltd., Thanet Way, Whitstable, Kent. Distributed by IPC Magazines Ltd., Lavington House, 25 Lavington Street, London SE1 0PF. Sole Agents for Australia and New Zealand – Gordon and Gotch (A/sia) Ltd.; South Africa – Central News Agency Ltd. Subscriptions: Inland £11, overseas (surface mail) £12 per annum, payable to Quadrant Subscription Services Ltd., Oakfield House, Perrymount Road, Haywards Heath, Sussex RH16 3DH. "Television" is sold subject to the following conditions, namely that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed by way of Trade at more than the recommended selling price shown on the cover, excluding Eire where the selling price is subject to currency exchange fluctuations and VAT, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.

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BC107B	.14	BD132	.33	BF362	.38	TIP31C	.46
BC108B	.14	BD201	.80	BF458	.30	TIP32C	.47
BC109B	.14	BD202	.70	BF459	.36	TIP33B	.80
BC139	.24	BD203	.70	BFR90	1.60	TIP41C	.48
BC140	.26	BD204	.83	BFT42	.30	TIP42C	.48
BC141	.26	BD222	.50	BFT43	.30	TIP2955	.70
BC142	.23	BD232	.50	BFX85	.30	TIP3055	.55
BC143	.25	BD233	.37	BFY51	.22	TV106/02	1.60
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BC107	0.070
BC108	0.070
BC109	0.070
BC115	0.100
BC118	0.110
BC140	0.190
BC141	0.190
BC142	0.190
BC143	0.190
BC147	0.055
BC148	0.055
BC149	0.055

BC157	0.055
BC159	0.055
BC182	0.060
BC182L	0.060
BC183	0.060
BC183L	0.060
BC184	0.060
BC184L	0.060
BC212	0.060
BC212L	0.060
BC213	0.060
BC213L	0.060
BC214	0.060
BC214L	0.060
BC237	0.070
BC238	0.070
BC300	0.160
BC301	0.180
BC302	0.180
BC303	0.180
BC327	0.060
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MJ3000	1.150
MJ3001	1.150
MJE29A	0.300
MJE30A	0.300
MJE340	0.250
MJE350	0.800
MJE520	0.300
MJE2955K	0.900
OA47	0.060
OA90	0.040
AO91	0.040
OA200	0.070
OA202	0.070
OC28	1.000
OC29	0.800
OC35	1.000
OC45	0.500
OC71	0.300

OC72	0.500
OC200	1.800
OCP71	1.000
ORP12	1.000
ORP60	1.000
ORP61	1.000
R2008B	0.800
R2010B	0.800
SAS560	1.100
SAS570	1.100
SN76003N	1.400
SN76013N	1.400
SN76023N	1.400
SN76033N	1.500
SN76110N	0.700
SN76115	0.700
SN76226	0.900
SN76227	0.800
T2800D	0.520
TAG06-60	0.420
TAG521-200	0.720
TAG4443	0.760
TAG4444	0.760
TAA550	0.160
TBA120S	0.450
TBA395	0.600
TBA396	0.600
TBA520	0.750
TBA530	0.750
TBA540	0.750
TBA560	0.700
TBA800	0.350
TBA810S	0.600
TBA820	0.750
TBA920	0.800
TBA950	0.800
TBA990	0.800
TCA800	0.800
TCA940	0.850
TDA1170	0.900
TDA1412	0.600
TDA2002	0.800
TDA2003	1.500
TDA2020	1.400
TDA2030	1.400
TDA2522	0.800
TDA2530	0.800
TDA2532	0.750
TDA2540	0.700
TDA2560	0.700
TDA2593	0.800
TDA2640	0.800
TDA2690	0.700
TIP29	0.150
TIP29A	0.220

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

3N.128	0.550
3N.143	0.650
IN.914	0.020
IN.4001	0.040
IN.4002	0.040
IN.4003	0.040
IN.4004	0.040
IN.4005	0.040
IN.4006	0.040
IN.4007	0.050
IN.4148	0.020
IN.5400	0.090
IN.5401	0.100
IN.5402	0.100
IN.5403	0.110
IN.5404	0.110
IN.5405	0.120
IN.5406	0.130
IN.5407	0.130
IN.5408	0.130

VOLTAGE REGULATORS

7805	0.350
7812	0.350
7815	0.350
7818	0.350
7824	0.350
7905	0.350
7912	0.400
7915	0.400
7918	0.400
7924	0.400
78L05	0.280
78L12	0.280
78L15	0.280
74L18	0.280
74L24	0.280
LM309K	1.000
LM317K	2.200
LM317T	1.800
LM323K	4.200
LM723	0.320
78HGKC	5.700
78HD5KC	5.200
78GU1C	1.900
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2SA104	0.320
2SA198	0.220
2SA203	0.300
2SA473	0.370
2SB54	0.250
2SB77	0.320
2SB337	1.200
2SB405	0.220
2SC460	0.210
2SC495	0.600
2SC733	0.400
2SC1161	1.100
2SC1172Y	1.500
2SC1279	0.240
2SC1306	1.000
2SC1307	1.000
2SC1520	0.250
2SC1969	1.300
2SC2029	1.200
2SC2078	1.200
2SC2122A	2.000
2SC2952	0.270
2SD234	0.370
2SK135	4.000
MB3712	1.500
TA7205	1.500
UPC575	1.000

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14 pin	0.080
16 pin	0.090
18 pin	0.120
20 pin	0.140
22 pin	0.160
24 pin	0.180
28 pin	0.200
40 pin	0.250

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DY87	0.530
DY802	0.450
ECC82	0.400
ECC83	0.430
ECC84	0.400
ECC85	0.400
ECH81	0.490
ECH84	0.520
ECL80	0.570
ECL82	0.590
ECL84	0.570
ECL85	0.570
ECL86	0.490
EF80	0.310
EF85	0.340
EF89	0.430
EF183	0.450
EF184	0.530
EL34	1.900
EY86	0.310
EY87	0.310
PC97	1.000
PCC85	0.420
PCF80	0.580
PCF200	1.350
PCF801	1.100
PCF802	0.570
PCF806	1.150
PCH200	1.000
PCL81	0.540
PCL82	0.630
PCL84	0.500
PCL85	0.550
PCL86	0.550
PCL805	0.550
PFL200	0.850
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LM380	0.600
LM381	1.000
LM709 Dil	0.300
LM723	0.320
LM741 Dil	0.150
LM741 Met	0.450
LM3900	0.250
NE555	0.150
NE556	0.400
BYX55/350	0.300
BYX55/600	0.300
BYX55/600	0.300
BYX55/800	0.320
BYX70/500	0.290
BYX70/500	0.310
BYX70/800	0.360
BYX71/600	0.800

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2A/200V	0.360
2A/400V	0.420
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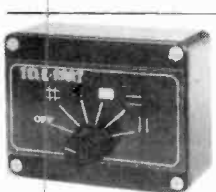

Telepart Pattern Generator

* Exceptionally light and durable
* Pocket size for outside service
* PP3 battery power source
* Five different test patterns for colour and mono TV
* Cross hatch grid
* Dot matrix
* White raster
* Horizontals
* Verticles

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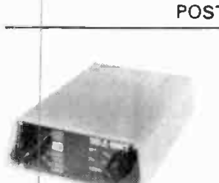
POST & PACKING £1.15



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* Exceptionally light & durable
* Compact 13×17.5×5.5 cms
* Battery powered for mobility
* Cross hatch grid
* White raster
* Grey scale
* Colour bars
* Sound

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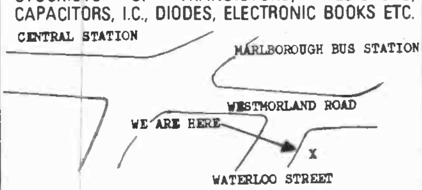

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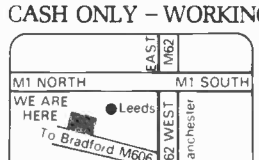

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Transducer Hand Set insert, crysta, tranducer, 11C SAA 1124 & lead £3.50
THORN 4000 ultra sonic hand set insert with 7 buttons (no case) £5
4.000 Thorn thick film.
00S1 012 E002 £1.00
00S1 012 010B £1.00
00S1 018D £1.00
Rank Toshiba preh unit 0354 £9.50
2 banks of 3 PB unit. Pye 731 £2
4 Push button unit preh £1.00
6 Push button VHF/UHF for v/cap. GEC-Decca type £7.00
7 Push button for CVC5 ITT £8.00
KT3 12 Push button unit £3.00
6 Push button Unit Thorn £1.00
6 Push button unit for GEC 2040 and ELC 1043/05 £6.00
6 Push button unit PYE 713 £7.00
7 Lamps for P.B./Unit 10p

Mains Droppers

Pye 731 3+56+27R 50p
3500 Thorn 6/1/100 60p
Thorn 50/17/1K5 £1.00
120/20/20/48/117 £1.00
270/.0/6 for Thorn 4000 50p
18/320/70/39 £1.10
Thorn 50-40R-1K5 50p
Aerial Socket and Lead 35p
Pye. Thorn. ITT. Thyristor. Philips G11 122 60p
Rank Toshiba Tube Bases 30p

Speakers

6×4G11	25 ohm	£1.00
5½×2½	3 ohm	£1.00
5×3½	80 ohm	70p
5×3	50 ohm	50p
5×3	35 ohm	70p
5×3	15 ohm	80p
6×4	15 ohm	£1.00
7×3	70 ohm	£1.00
5×3	8 ohm	70p
7×3	16 ohm	£1.00
5" dia	16 ohm	£1.00
5" dia	8 ohm	£1.50
6½" dia	4 ohm	£1.50
6½" dia	3 ohm	£1.50
2¾" dia	8 ohm	75p
3" dia	8 ohm	75p

Metal Wire Ends

TD 15 boost diode 1500V 20p

Diodes

BY 127	10p
BY 133	10p
BY 134	10p
BY 176	25p
BY 179	40p
BY 184	25p
BY 187	10p
BY 190	40p
BY 196	30p
BY 198	10p
BY 204/4	8p
BY 206	8p
BY 210/400	5p
BY 210/600	8p
BY 210/800	10p
BY 223	80p
BY 224/600	50p
BY 226	15p
BY 227	15p
BY 228	20p
BY 229/400	30p
BY 234	10p
BY 237	5p
BY 254	10p
BY 255	10p
BY 298	10p
BY 299	10p
BY 406	8p
BY 527	20p
BY 407a	10p
BY 602	10p
F 247	10p
XK 3102	50p
XK 3123	50p
Thorn A1	10p

Hitachi 2A/1500V metal case wire end 20p

Line Transformers

G8 Trans. Philips £7.50
G11 Split Diode £12.00
CVC820 Split Diode ITT £10.00
CVC40 Split Diode ITT £10.00

GEC 2040 £5.00
GEC 2110 £7.00
Pye mono £3.00
Rank mono T704A £3.50
CVC32 ITT £7.50
EHT Split Diode Leads £1.00

Triplers

Universal £6.00
11 TEZ Rank £3.00
9000 Thorn £5.00
KT3 £4.00
G9 Philips £4.00
GEC 2110 £4.00
9500 Thorn £4.50
2040 GEC £3.50
GEC TVM25 Tripler £2.00
G8 Philips £4.50
Decca 80 100 £4.50
LP1194 Pye 731 £3.50
Grundig TVK 52 £2.50
11TBQ £3.00
11THY £4.00
D22 for Pye 18" colour portable £4.00
LP 1193/63 £4.00
BG 100/41 £3.25
BG 100/61 £3.25
New Philips Infra Red Transmitter 9ch & Vol. & brightness change £7.00
GEC Portable Line Trans. £3.00
THORN 9000 tube base & panel £1.50
9000 front panel £5.00
9000 front panel (remote) £8.00
THORN 8800/9000 Remote Unit U705 £6.00
THORN 9000 Frame Panel £8.00
G8 Convergence Panel £12.00
T/text ultrasonic rec'r panel £14.00
Philips Handset (2 button unit) £8.00
THORN 9000 Syclops panel £1.50
THORN 8000/8500 timebase panel £8.00
THORN 8000/8500/8800 chroma panel £15.00
THORN 8500 convergence panel £6.00
Philips Infra-Red (full remote transmitter)
Philips KT3 16C928/20C934
Pye KT3 7228/7324 K12 26C
797/1ST 66K 1826 £12
G11 handset. Full remote top £12.00
Video cassette lamps on lead. 12-14V. 50p or 3 for £1.00
GEC 8 touch unit assy complete with all I.C.'s + pots £6.00
9000 Frame Panel £7.00
Transmitter Decca RC11 £14
Transmitter Decca RC12 £14
G11 E.W. coils £1.00
G11 Tuner Unit/U321 £6.00
G11 6 Button Key Switch £2.00
G11 Transient Suppressors 245V 10 for £1.00
G11 Scan Coils £5.00
KT3 AE Sockets 25p
4000 Thorn Frame Panel £5.00
4000 Thorn Power Supply £3.00
4000 Thorn Line OP Panel £20.00
NPN PNP 80V 6 Amp TO66 O.P. Trans. pair 25p
GEC IC CBF16848. SN16861. SN1682 each 50p
Thorn Tuner Panel 6-100K Pots & Components NEW No Tuner £2.00
6 button 100K pots + cursors on panel for varicap tuning £1.50
THORN 1600 mains lead: switch: 3 slider assy. £2.00
5 button touch tuner BBC1/2 ITV1/2 video with ic SAS 560T/570T £7.00
Control panel 5 sliders + mains lead £1.50
Thorn 8800 remote receiver unit U705 £6
G11 8 touch button unit replaces old 6 P.B.U. £20

International Rectifier EHT Diodes G770/HV34 6KV 3 for 8p
6A/600V Stud Diodes 20p
6A/1000V Stud Diodes 20p
EHT Rectifier wire ends 16Kv 10p
25A473 PNP C/P 10p

GEC portable chassis + LOPT £6
Thorn 1613/1713 chassis £9.75
Full remote G11 hand set, repaired £12 exchange
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60.CP2605 Philips infra red hand set. Full remote
9 C.H. £6.00
12 C.H. £12.00

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Decoder Panel (VM6230) £15.00
G8 T/Unit Panel £12.00 each
G8 IF Panel £12.00 each
G8 Line O/P Panel £12.00 each
G8 Power Supply £12.00 each
G8 IF & Chroma £15

Tube base + base unit for 820 Euro chassis £4.00
GEC Line O/P Trans. & Rec Stick for Portable £3.00
CVC 20/25/30/35/40 decoder panel £10
CVC 20/25/30/35/40 decoder panel (untested) £5
CVC 40/45 1F panel £5
Thorn 3500 6 push button unit & cable form £1.50

Rec & Trans

G11 Ultrasonic t/text transmitter
G26C 674/02
G22 C66/02 £16
Handset Rank Infra Red £10.00
Infra Red (full ramote transmitter) Dynatron TV CTV 62, 63, 64 £19
40K Transducer 50p
PHILIPS NE511N £1.20
LM337M Reg. 30p
Thorn T605 1V NPN TO66 80V 6A 10p
20 GEC Black Spark Gaps £1.00
G11 Line Driver Transformer 35p
G11 IF Detector £3.00
Complete CVC 825 Chassis (both panels) £40.00
G11 Teletext Transmitter £19.00
BG200/43 Tripler £3.00
DECCA IF 80-100 £3.50
AEC V/Cap Resistor Unit UHF with IC SAS660 SAS670 £3.00
Thorn 900 Sound OP Panel NEW £1.00
U321 T/Unit on Panel Cum 40 ITT £6.00
Z714 RANK IF Panels 6MHz 1 I.C. SL437F £3.00
Z909B RANK IF Panels Export 5.5MHz 2 I.C.'s TBA1205B TCA2705Q £2.50
Z743 RANK IF Panel Export 5.5MHz 3 I.C.'s TBA750+SC9504P+SC9503P £1.50
Tuner Unit VHF Sylvania GTR Videon MTS900 B1P VHF £2.50
G11 dynamic correction panel £6
CVC 20 Front panel with sliders + mains input panel £4
THORN 3500 Tuner panel (ELC 1043/05 + pots) £7
CVC 40 PUSH BUTTON ASSY with sliders: complete with lamp assy + pots £14
CVC 5 Mains on/off + 5 pots £2
GEC Convergence panel TO CLEAR £1
Universal Focus. Fits Pye, Thorn and Decca Units.
Large Type 75p
Decca Small 75p
KT3 Focus Unit 75p
ITT Small for use with Split Diode 50p

Thorn 3500 Focus Unit £1.50
TV11 50p
Remo TV12SP 50p
TV13 50p
TV14 50p
TV18 60p
TV20 £1.00
TV45 50p
16 Button Key Pad 1 to 0 + * + # + 4 blank £3.00

Condensers

470/16	6p
1500/16	20p
3300/16	20p
10000/16	25p
15000/16	50p
3300/18	20p
470/25	5p
680/25	5p
1000/25 Radial	10p
1250/25	10p
1500/25	10p
2200/25	10p
3300/25	20p
4700/25	25p
5000/25	25p
10000/25	50p
1500/30	20p
3300/30	30p
1500/35	10p
2200/35	25p
50/40	5p
220/40	5p
400/40	20p
680/40	5p
1250/40	20p
1500/40	20p
200/40	25p
2000/40	25p
2200/40	25p
2500/40	25p
3300/40	25p
6800/40	35p
750/50	10p
1000/50	20p
1250/50	25p
2000/50	20p
3000/50	25p
15/63	5p
47/63 Bipolar	15p
2200/63	50p
250/64	10p
3300/70	50p
.1/100	5p
4.7M/100	5p
140/100	25p
470/100	20p
470/160	20p
800/160	50p
G11 0.91/210 scan coil correction	25p
.1/250 Pulse	5p
G11 0.47/250	10p
2,2 250v	10p
3n3/250 A.C.	10p
.39/250V	15p
4n7/250 tested 5KV	25p
22/250	15p
47/250	10p
100/250	20p
G11 470/250V	£1.75
500/250	50p
GEC600/250	60p
800/250	40p
4/350	5p
8/350	8p
12/300	10p
600/300V	£1.50
4.7M/350v	10p
16/350	25p
50/350	10p
220/350	30p
300/350	40p
700/350	50p
22/375	15p
330/385 CVC 820HT	60p
0.1/400	15p
.56K/400v	20p
8/400	15p
33/400	20p
220/400	50p
400/400	40p
2×10,000Pf/400 in box	40p
394K/400V	20p
33/450	15p
220/450	40p
0.1/600	15p
.047/600	15p
0.1/800	15p
0.047/1000	10p
0.01/1000	10p
0.1/1000	10p
.15/1000	20p
.47/250V A.C.	10p
.47/1000	50p
.001K/1250	10p
0.0047/1500	10p
.005/1500	10p
.0105/1500	10p
1n8/1500	15p
2n2/1500	15p
G11.11000/1500	15p
G11.8200/2KV	15p
0.1/2KV	20p
10n/2KV	15p
3n9/2KV	15p
210/8KV	10p
0.0015/2KV	10p
5n2/2KV	10p
6n2/2KV	15p
7500pf/2KV	10p
4n7/2KV	15p
8n2/2KV	15p
0.0082/2500	15p
150/3500	10p
1800/4KV	5p
4.7nf/5KV	10p
170/8KV	10p
180/8KV	10p
210/8KV	10p
270/8KV	10p
1000/10KV	10p
210/12KV	10p
1000/12KV	10p
1200/12KV	10p

Multi-Caps

Thorn 3500	
175/100/100/350v	£2.50
KT3/200/25/25/385v	£1.00
47/220/350v	60p
150/150/100/100/100/320v	£2.00
2500/2500/63v	50p
470/470/250v	50p
150/200/200/300v	70p
400/400/200v	£1.70
300/100/100/16/275v	£1.50
100/200/325v	40p
150/150/100/375v	£1.50
200/350v + 300/100/32/300v	£2.00
200/200/100/32/350v	£1.50
200/47/350v	60p
100/300/200/100/16/350v	£2.00
200/100/100/375v	£2.00
100/100/35v	60p
1000/1000/35v	60p
150/150/100/100/320v	£2.00
100/350 + 300/200/100/16/275v	£2.00
300+300/300	£1.00
225+25/380	70p

Infra Red and Ultrasonic G11 Teletext Decoder Panel £30
RANK & ITT Mains Remote On-Off Switch (720R) £1.50
RANK & ITT Mains Remote Switch 2865 ohm £1.50
G11 Mains Switch 40p
ITT Mains Switch 4 amp 30p
GEC Mains Switch 4 amp 30p
Petrick Mains Switch 4 amp 30p
THORN Rotary Mains Switch 50p
G8 Mains Switch 75p
Mains Dropper PYE 3R5+15R+45R 50p
Thyristor 600/4 amp C106/2 24p
G11 Preh Red LED P/Button for C.H. Change 20p
2SC2073 on Heat Sink 150 NPN 1.5 Amps 7p
RANK TOSHIBA Transductors TPC-2011 50p
Remote Unit THORN 11 I.C. Mains Transformers Relay & 5 volt Reg & Component Unit £2.25
Thorn I.C. board with 11 various sn 74 I.C.'s £1
CVC 5 Mains on/off +250K+100K+500K+50K+500K Pot on Panel £2.00
Thorn Thermal Cut Out 75p

ITT Panels

CMA 10	£2.00
CMA 11	£2.00
CMA 30	£2.00
CMA 40	£1.50
CMC 10/2	£5.00
CMC 16	£4.00
CMC 38	
CMC 45	£1.50
CMC 47	£1.00
CMC 58	£8.00
CMC 59	£8.00
CMC 67	£3.75
CMC 67/2	£4.00
CMC 68	£4.00
CMD 12	£10
CMD 40	£5.00
CMF 25	£2.00
CMF 31	£1.50
CMF 40	£2.00
CMH 10	£1.50
CMH 31	£1.00
CMK 12 (untested)	£4.00
CMN 20	£1.50
CMN 40	£1.00
CMP 10	£2.00
CMP 11	£2.00
CMP 40	£2.00
CMS 11	£2.00
CMS 40	£2.00
CMU 14	£8.00
CMU 30	£7.00
CMU 40	£7.00
CMU 45	£5.00
VCA 20	£10
VCA 21	£10.00
VMC 34	£5.00
VMC 44 + 45	£4.00

SENDZ COMPONENTS

63 Bishopsteignton, Shoeburyness, ESSEX SS3 8AF

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Callers: To shop at 212 London Rd., Southend. Tel. 0702-332992

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ELC1043/05 Mullard	£6.00
ELC1043 (Ex Panel)	£3.75
ELC1042 ..	£5.00
ELC2000 ..	£7.00
ELC2004	£10.00
EL2006	£10.00
EL2060 ..	£7.00
ELC2060 on panel NEW	£5.00
Mullard 1043/05 on panel	£5.00
U321 (UHF) Mullard	£7.00
U322 (UHF) ..	£4.00
V314 (VHF) ..	£5.00
U341 UHF	£7.00
ELC1043/05 Thorn	£5.90
Small V/Cap Mitsumi UHF ..	£4.00
VHF ..	£3.00
Portable & rotary Tuners Sanyo & Mitsumi UHF	£5.00
NSF-UHF-VHF	£8.00
Mullard	£10.00
Video Modulator. Application, video tape recorders, TV cameras, video games, closed circuit T/V. C.C.I.R. system. Data supplied.	
Berec Battery SB1142 2 amp discharge current 8.4 volts with magnet switch made for emergency lighting. Nickel cadmium battery	£4.00
Sylvania UHF VHF F6013 (Fits Rank)	£6.00
Sylvania UHF F4720B	£6.00
Sylvania VHF 900	£6.00
Decca Bradford Tuner 5 Button	£4.00
Small Tuner DX 175-220MHz Auto Changeover	£5.00
9000 Thorn Tuner on Panel	£7.00
D.P.D.T. switch Black knob: Chassis or PCB mount	4p each or 40 for £1.00
THORN 1400 4P.B. Mech. Tuner	
THORN 1500 4P.B. Mech. Tuner	
THORN 1590 4P.B. Mech. Tuner	
THORN 3500 4P.B. Mech. Tuner	
THORN 8000 4P.B. Mech. Tuner	
THORN 8500 4P.B. Mech. Tuner	
All new & boxed	£4 each + £1 postage each

Diodes

1 Amp 1600v	7p
3 Amp 100v	7p
3 Amp 1200v	10p
7 Seg Display, Led Red	50p
Delay Lines	

TAU80	£1.00
DL11	50p
DL20A	80p
DL70	£1.00
DL600	£1.00
DL700	£1.00
UDL11	30p
KT 3 Luminence	75p
Luminance Delay Line	
MDL-CBL Min.	50p
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Co-Ax Joint	12p
Co-Ax Belling Lee Plug	12p
Co-As Splitter	£1.00
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Infra Red Emitting Diode	20p
NE286H Small Neon Lamps	
GEC	5p
Mullard 5 Watt Amps. LP1162 New	75p

T.V. Tubes

12" A31/300 Hitachi	£12
15" A38/170W Hitachi	£8
Add £2 P&P each	

Integrated Circuits

AC76003	£1.50
AM25LS23PC	10p
BAV40	40p
BRC-M-200	50p
BRC-M-300	60p
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CA270CE	50p
CA270CW	50p
CA3065	50p
CA3089Q	50p
CA3094AE	50p
CA3146	£1.00
CA920AE	£1.00
CA1310	50p
CD4510	30p
CBF16848	50p
DM7492	50p
HEF4001	10p
HBF4011AF	10p
HEF4016	15p
HEF4053B	30p
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M1024	£2.00
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MC1327	£1.25
MC1330	75p
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MC1352	£1.00
MC1358	£1.00
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MC14002	15p
MC14013	25p
MC14016	25p
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MC14069	15p
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MEM4956PT	£1.00
MM5387	£1.00
MM5611	£1.00
MM5840	50p
N64100	£1.00
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NE555P	60p
NE555	60p
IL-1	30p
OPT600	30p
OPT601	30p
SAA611	£1.00
SAA661	£1.75
SAA1020	£4.00
SAA1021	£4.00
SAA1024	£2.50
SAA1025	£2.50
SAA1073	£3.00
SAA1074	£3.00
SAA1075	£3.00
SAA1124	£2.00
SAA1130	£2.50
SAA1174	£3.00
SAA1176	£3.00
SAA1250	£3.00
SAA1272	£3.00
SAA1276	£3.00
SAA5000	£1.50
SAA5000A	£1.50
SAA5010	£3.50
SAA5012	£3.50
SAA5012A	£4.00
SAA5020	£3.50
SAA5030	£5.00
SAA5040	£3.50
SAA5040A	£4.40
SAA5050	£3.50
SAF1039	£2.00
SAS560	£1.00
SAS570	£1.00
SA5660	£1.00
SAS670	£1.00
SL901B	£4.40
SL918- SL917 MOD	£6.00
TAA320A	50p
TAA470	£1.50
TAA550	25p
TAA570	75p
TAA611	£1.50
TAA621	£2.00
TAA661	£1.75
TAA641	£1.50
TA7117	50p
TA7315AP	50p
TA7607AP	40p
TA7609P	50p
TBA120A	40p
TBA120AS	50p
TBA120SA	40p
TBA120B	40p
TBA120SB	40p
TBA120SQ	£1.00
TBA120U	50p
TBA120C	40p
TBA1441	£1.00
TBA231	75p
TBA395Q	50p
TBA396Q	£1.00
TBA396	75p
TBA440P	£1.00
TBA1440C	£1.00
TBA480Q	£1.00
TBA510	£1.00
TBA510Q	£1.00
TBA520	£1.00
TBA530	£1.00
TBA540	£1.00
TBA540Q	£1.00
TBA550Q	£2.50
TBA560CQ	£1.00
TBA560C	£1.00
TBA570	£1.00
TBA625	£50p
TBA641BX1	£2.00
TBA651	£1.00
TBA673	£3.50
TBA720A	£1.00
TBA750Q	£1.20
TBA780	£1.50
TBA800	40p
TBA810S	70p
TBA820	70p
TBA890	£1.00
TBA900	£1.20
TBA920	£1.50
TBA920Q	£1.50
TBA950	£1.00
TBA990Q	£1.00
TBA1440	£1.00
TMS1000NL	£4.00
TMS1943NL	£2.00
TMS9980	£4.00
TMS9901	£2.00
TMS2716	£2.00
TMS3529	£2.00
TMS4014	£1.50
TX012	£5.00
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SN74107	£1.00
SN7472N	20p
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SN76001	£1.00
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SN76018	£1.00
SN76008	£1.00
SN76023N	£1.50
SN76033	£1.50
SN76115	50p
SN76131	50p
SN76226	£1.00
SN76227	60p
SN76228N	£1.00
SN76532N	50p
SN76544N	£2.00
SN76545	£3.50
SN76546	£1.00
SN76550	30p
SN76552	30p
SN76650	50p
SN76660	40p
SN76620AN	50p
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SN76707N	75p
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SN76720	£1.00
ML231	£2.50
ML232R	£1.20
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ML236E	£1.50
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ML238B	£3.50
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BTT6018- ML237B	£1.50
BTT8124	£1.00
BTT8224	£1.00
UA783P3C	40p

Semiconductors

BT100A/02	40p
BT106	£1.20
BT106 Plastic	50p
BT109	£1.00
BT138/10A	70p
BT146	30p
TCA270	£1.00
TCA270Q	£1.00
TCA940	£1.00
TCA4500A	£1.00
TCA640	£1.00
TCA660	£1.00
TCA270S	£1.00
TCA270SQ	£1.00
TCA740	£1.00
TCA800	£1.00
TCA830	£1.00
TCA940	£1.00
TCA4500A	£1.00
TCEP100	£2.25
TCE120CQ	£1.00
TDA440Q	£1.00
TDA1003A	£1.00
TDA1010	£1.00
TDA1060A	£1.50
TDA1151	30p
TDA1170	£1.00
TDA1190	£1.00
TDA1327A	£1.00
TDA1412	30p
TDA2010	£1.00
TDA2140	£3.50
TDA2522	£1.00
TDA2532	£1.00
TDA2540	80p
TDA2541	£1.00
TDA2575A	£1.00
TDA2581	£4.00
TDA2590	£1.00
TDA2593	£1.00
TDA2560	50p
TDA2600	£5.00
TDA2653	£1.00
TDA2002	£1.00
TDA2640	80p
TDA2680	£1.00
TDA2690	£1.00
TDA2593	£1.00
TDA3190	£1.00
TDA3500	£2.00
TDA3560	£3.50
TDA3571Q	£1.50
TDA3950	£1.50
TDA9403	£3.00
SN74LS 125AN	30p
SN74LS32	15p
SIL4516	50p
SN16861	50p
SN16862AN	£1.00
SN16964AN	50p
SN29764	£1.00
SN297728N	50p
RGP30G	10p
MPSA43	10p
MJ13005	30p
MJE51T	25p
MJE340	28p
MJE660	25p
MJE661	25p
MJE3055	£1.00
MJE2801	30p
MJE2955	50p
MJE13005	30p
Sanikron Diode SKE2G2/04	30p

Transistors

A1222	15p
A1223	15p
AC121	15p
AC128	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
ACY18	20p
ACY21	25p
AD143	50p
AD149	50p
AD161/162 pair	40p
AF139	25p
AF181	£1.00
AF239	25p
AF367	25p
AL102	£1.75
AU113	£2.50
BC161	30p
BD138	30p
BD229	20p
BD437/438 on heat sink	60p
BD507	50p
BD509	30p
BD510	30p
BD517	30p
BD519	30p
BD534	30p
BD535	30p
BD544D	30p
BD562	30p
BD595	35p
BD610	40p
BD646	50p
BD676A	30p
BD678	50p
BD681	25p
BD807	20p
BD948	30p
BDX32	£1.25
BF115	20p
BF121	20p
BF127	20p
BF137	20p
BF157	20p
BF160	20p
BF161	20p
BF164	60p
BF178	25p
BF179	30p
BF180	20p
BF181	20p
BF182	20p
BF184	20p
BF194	10p
BF195	10p
BF196	10p
BF197	12p
BF198	10p
BF199	10p
BF200	20p
BF222	10p
BF224	15p
BF238	20p
BF240	16p
BF244	40p
BF245b	20p
BF256	10p
BF257	20p
BF258	25p
BF259	25p
BF262	15p
BF263p	25p
BF264	15p
BF271	10p
BF273	10p
BF274	10p
BF324	25p
BF355	30p
BF362	20p
BF363	15p
BF367	15p
BF391	15p
BF394	10p
BF419	30p
BF423	15p
BF448	30p
BF450	20p
BF458	30p
BF459	30p
BF468	30p
BF469	30p
BF470	20p
BF480	50p
BF594	10p
BF597	10p
BF694	10p
BF757	30p
BF758	30p
BF760	30p
BF761	30p
BF858	30p
BF871	30p
BFR79	15p
BFR39	15p
BFR52	7p
BFR61	25p
BFR81	15p
BFR87	10p
BFS60	10p
BFT34	15p

BFT43	10p	2SC2122A	£1.00	BC347	10p
BFT84	8p	2SC2229	15p	BC349b	10p
BFW11	20p	2SC7350	15p	BC350	20p
BFX29	30p	2SD180 TO3 80v/6A	15p	BC365	10p
BFX84	25p	2SD200	£2.00	BC384	10p
BFY50	15p	2SK30A	10p	BC394	10p
BFY52	20p	2SN30A	8p	BC413	10p
BFY90	25p	BC107	10p	BC414	10p
BRC116	40p	BC108	10p	BC416	10p
BRX43	15p	BC109/2N930	5p	BC440	30p
BRX48X	10p	BC113	10p	BC454	10p
BSY95a	10p	BC114	10p	BC455	10p
BTY80	20p	BC115	10p	BC456	10p
BSX19	17p	BC116	10p	BC460	25p
BSX20	17p	BC117	20p	BC462	10p
FT3055	30p	BC125	10p	BC463	10p
TCE82	30p	BC139	10p	BC478	10p
2N930	5p	BC141	25p	BC527	10p
2N2221	8p	BC142	25p	BC532	10p
2N2222	8p	BC143	25p	BC546	10p
2N3055	40p	BC147	10p	BC547	10p
2N3702	10p	BC148	10p	BC548	10p
2N3703	10p	BC149	10p	BC556	10p
2N3705	10p	BC153	10p	BC557	10p
2N3711	10p	BC154	10p	BC558	10p
2N3583	50p	BC157a	10p	BC559	10p
2N3904	15p	BC159	10p	BC635	10p
2N3906	15p	BC160	25p	BCX31	25p
2N4355	10p	BC171	10p	BCX32/36 pair	50p
2N4442	£1.00	BC172	10p	BD116	25p
2N4444	£1.00	BC173	10p	BD124	50p
2N5296	40p	BC174	10p	BD124 (metal)	60p
2N5496	50p	BC182L	10p	BD130Y	25p
2N5983	30p	BC183	10p	BD131	30p
2N6099	40p	BC184	10p	BD132/676a	30p
2N6109	40p	BC187	10p	BD135	25p
2N6130	50p	BC204	10p	BD136	30p
2N6133	20p	BC207	10p	BD176	25p
2N6348	20p	BC212	10p	BD182	£1.00
2N6399A	20p	BC213	10p	BD202	60p
2X 2N6099 on heat sink	50p	BC214	10p	BD203/204 pair	£1.25
2SB407 Sanyo		BC237	10p	BD204	60p
TO3	10p	BC238	8p	BD207	30p
2SB474	30p	BC239	10p	BD221	20p
2SB566	10p	BC250	8p	BD222	30p
2SC381	10p	BC251	10p	BD226	20p
2SC458	50p	BC252	10p	BD233	30p
2SC515	10p	BC262	10p	BD235	30p
2SC732	10p	BC263b	20p	BD238	30p
2SC733	10p	BC294	30p	BD239	15p
2SC828	10p	BC298	10p	BD243a	30p
2SC1030	£1.00	BC300	30p	BD250a	30p
2SC1172A	10p	BC301	30p	BD252	20p
2SC1173	10p	BC303	30p	BD253B	50p
2SC1311	20p	BC307	7p	BD331	20p
2SC1419	20p	BC308	7p	BD332	20p
2SC1546	20p	BC309	10p	BD416	25p
2SC1617	£1.00	BC327	10p	BD433	25p
2SC1684	20p	BC328	10p	BD437	25p
2SC1725	20p	BC328/338 pair	15p		
2SC2068	20p	BC337	10p		
2SC2073	8p	BC338	10p		

Filters

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

Thyristors

BT119	£1.00
BT120	£1.00
BRC4443	75p
G11 Thyristor	60p
Decca 80-100	60p

Thermistors

VA1104	35p
ITTP7266312	15p
PTH451 AOR	15p
PT37P Fits Pye & Bush	25p
PT34	20p
Degausing Thermistor (fits most sets)	20p
GEC Double Thermistor	75p

3 Pin Blue Thermistor (fits most sets)	20p
BLY49	50p
I.C. Heat Sink	20 for £1
20×TO5 Heat Sink	£1.00
T4040 Clock Display	£1.00
CVC 9 power supply board	£1.50
CVC 20/2 mains panel	£2.00
FED4/1220/4 3 pin ITT 1. MFD 4 Amp Mains Filters	50p
ITT Mains Filter .1/250v/	
CVC 20 to 45 chassis	50p
Pots 10 k with Switch	25p
Pots 47 k with Switch	25p
Mullard Surface Wave Filter RW 153P Colour TV Filter	40p
Mullard Surface Wave Filter RW 154 Colour TV Filter	40p
G11 Line Scan P.C.B.	£1.00
ELC 1042 P.C.B.	30p

Crystal T/V

T/V 4.433-619KHz	50p
6 MHX Crystal	50p
8.8867-238KHz Min	50p
Miniature ITT 6meg	75p

I.C. Holders

DIL – DIL	
42 Pin × 5	£1.00
28 Pin × 5	80p
16 Pin × 10	70p
24 Pin × 5	75p
14 Pin × 10	70p
18 Pin × 10	80p
DIL – QIL	
16 Pin × 10	£1.00
18 Pin × 10	£1.00
28 Pin × 4	£1.00
QUIL – QUIL	
16 Pin × 10	£1.00