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Published by
Radio & Electronics World Magazines
Sovereign House
Brentwood
Essex CM14 4SE
England
Tel: (0277) 219876

ISSN
0262-2572

Printed
In Great Britain

Newstrade sales
Seymour Press Ltd
334 Brixton Road
London SW9 7AG
Tel: 01-733 4444

Subscriptions
Tel: 01-760 0409

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Radio & Electronics World Magazines

Safety in the shack

Some of the constructional projects featured refer to additions or modifications to equipment; please note that such alterations may prevent the item from being used in its intended role, and also that its guarantee may be invalidated.

When building any constructional project, bear in mind that sometimes high voltages are involved. Avoid even the slightest risk – safety in the shack please, at all times.

Whilst every care is taken when accepting advertisements we cannot accept responsibility for unsatisfactory transactions. We will, however, thoroughly investigate any complaints.

The views expressed by contributors are not necessarily those of the publishers.

Every care is taken to ensure that the contents of this magazine are accurate, we assume no responsibility for any effect from errors or omissions.

Cover Photographs

Top — Olivetti's latest offering in its line of IBM-compatibles (p11)

Bottom — At last! Sinclair's 128K Spectrum (p10)

SPECIAL FEATURES

REGULARS

READER SERVICES

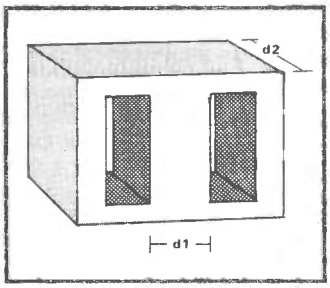
NEXT MONTH

☐ **Next Issue**
Cover date June 1986 on sale Thursday, 8 May

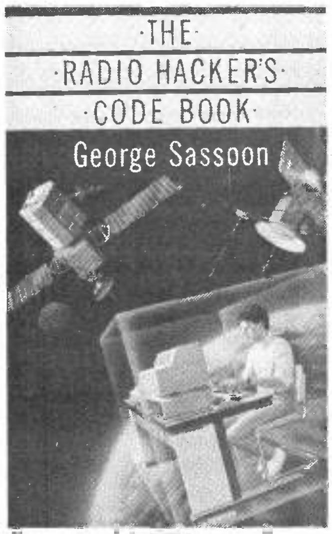
☐ **Publication Date**
Second Thursday of the month preceding cover date

Olivetti rules, OK? – page 11

Bend me, shake me – page 12



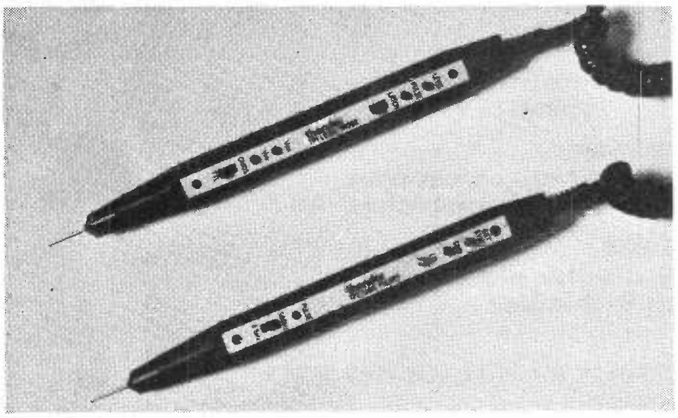
Core of the problem – page 25



007 of the airwaves – page 55

PRODUCT NEWS

Featured on these pages are details of the latest products in communications, electronics and computers. Manufacturers, distributors and dealers are invited to supply information on new products for inclusion in Product News.
Readers, don't forget to mention *Radio & Electronics World* when making enquiries



LOGIC PROBE

The Thandar TP1 logic probe and TP2 logic pulsar are tools for checking both TTL and CMOS circuits.

The TP1 can show fourteen different circuit conditions and can detect pulses down to typically 10ns.

The TP2 can inject a signal directly into a circuit without damaging sensitive components. Together they can stimulate and monitor responses of components in circuit, greatly aiding fault finding.

They retail at a price of £23.00 each plus VAT.

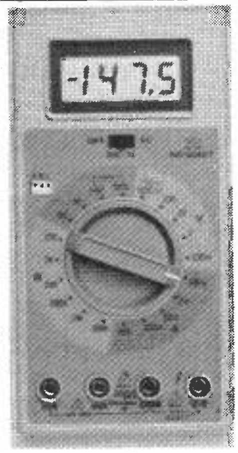
Thandar Electronics Limited,
London Road,
St Ives,
Huntingdon,
Cambs PE17 4HJ.
Tel: (0480) 64646.

DIGITAL MULTIMETERS

Levell Electronics Ltd have added two digital multimeters to their product range, the 540 and the 540T. These instruments permit accurate measurements to be made at low cost. Leading features are 2,000 hour battery life, and clear 3½-digit liquid crystal displays with 0.5in high characters.

The ranges covered are 200mV to 750V ac or 1,000V dc, 200μA to 10A ac and dc, and 20 ohms (or 200 ohms) to 20MΩ. The instruments also have a continuity buzzer test and a diode test range. The dc voltage accuracy is $\pm$0.25% of reading +1 digit and input impedance is 10Mohms. A transistor gain range is also incorporated in the 'T' version.

Cases are moulded in high impact ABS plastic, 170 $\times$ 87 $\times$ 42mm, weighing only 343gm. A



tilt stand is provided for bench use.

The multimeters are priced at £37 + VAT for the 540 and £39 + VAT for the 540T.

Levell Electronics Ltd,
Moxon Street,
Barnet,
Herts EN5 5SD.
Tel: (01) 449 5028.

HIGH-RES MULTIMETER

A new high-resolution 4¾-digit multimeter from MS Components offers a basic accuracy of 0.03% and a total of 28 ranges. dc voltage and current up to $\pm$1200V and 10A respectively, ac up to 750V and 10A, and resistance up to 32Ω cover the majority of application requirements.

Two additional functions provide frequency measurement, accurate to better than 0.008% from dc to 4kHz, and a diode testing facility.

Powered by six 'C' cells, the unit has an input impedance of 10Mohms, switchable to 100Mohms to reduce circuit loading below 3.2V.

Measurements are displayed on a 9mm high LC display with over-range and low battery warning indication and automatic zero and polarity functions.

MS Components Ltd,
Zephyr House,
Waring Street,
West Norwood,
London SE27 9LH.
Tel: (01) 670 4466.

MEASUREMENT KIT

Accurate and reliable electricity supply measurement has now been made possible using the new three-phase power measurement kit from the Response Company.

The kit comprises a three-phase solid state power meter, 3 clip-round 1000A current transformers and 4 quick-fit voltage leads. The Responder 3 meter, together with all fixing leads and operating manual, fits neatly into a specially designed shoulder-strap carrying case. The kit weighs barely 5.00kgs.

The measurement kit provides comprehensive analysis display and registration of kW, kVA, kVAR, kWH, kVAH and kVARH, all to 1% resolution and with a range of 1000A down to 2A per phase.

The Response Company Limited,
77 Wales Street,
Winchester,
Hampshire SO23 8EY.
Tel: (0962) 67287.

VDU-SCOPE

Electronic & Computer Workshop Ltd claim that service engineers working with CCTV and a wide range of computerised equipment can significantly reduce the number of instruments and items of test equipment necessary by using a new combined instrument, the VDU-oscilloscope.

The Crotech 3339 combines a dual-trace 30MHz oscilloscope with a component tester and a fully 625-line compatible VDU.

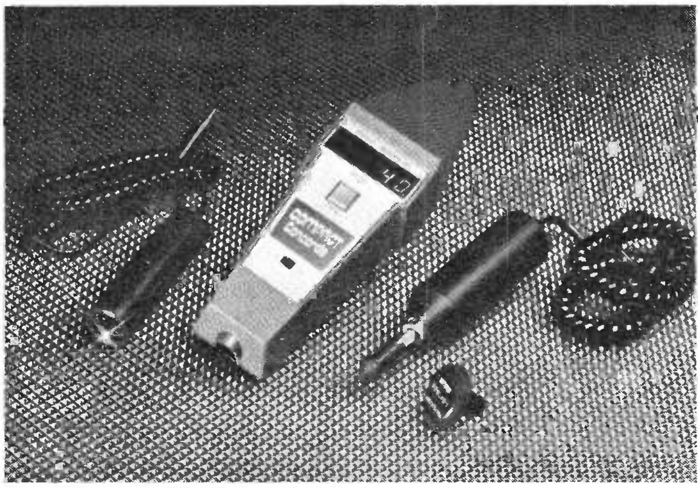
The VDU function allows the test engineer to monitor all types of standard composite video lines (1V p-p) and its built-in zoom facility can be adjusted to give resolutions of up to 15 division horizontally and 20 division vertically. This gives a screen of up to 64 characters wide.

Using this capability the engineer can test a range of CCTV circuits and video output lines. Another application is with computerised equipment, where the 'scope can be used to test a range of digital and analogue lines.

The instrument offers two 30MHz channels, with a sensitivity of 5mV per division and sweep speeds to 0.2μs per division. A range of display modes is available, including X-Y, and trigger facilities are sufficiently versatile for many types of measurement application.

The Crotech 3339 VDU-oscilloscope is available from ECW at a price of £669.30, including post-packaging.

Electronic & Computer Workshop Ltd,
171 Broomfield Road,
Chelmsford,
Essex CM1 1RY.
Tel: (0245) 262149.



TACHOMETER

Both contact and non-contact measurements of rotary and linear speed can be taken with the new digital tachometer from MS Components.

This compact, battery powered, hand-held instrument covers speeds from 50 to 20,000rpm in two switched ranges. Indication is by means of a 4½-digit LED display and is accurate to ±1 digit.

Non-contact readings can be taken at up to 1 metre using the basic instrument or the optional optical sensor where visual access is limited. Contact readings can be taken using an optional extension sensor, which can be fitted with an rpm cone or a choice of two linear speed conversion discs, giving readings in feet or metres per minute.

The instrument is supplied complete with reflective tape, batteries and carrying purse.

MS Components Ltd,
Zephyr House,
Waring Street, W Norwood,
London SE27 9LH.
Tel: (01) 670 4466.

DATA LOGGING

A new data logger, Vela, from the Data Harvest Group can achieve a high degree of speed, accuracy and convenience in scientific measurements, while eliminating the need for numerous cumbersome instruments.

At the heart of Vela is a powerful microprocessor, equipped with fifteen permanently stored, EPROM-based programs which cover transient recording, data logging, timing, pulse counting and waveform generation. More than 60 additional programs for measurement and monitoring are also available.

Vela's abilities include: the analysis of stress in structural members; the logging of breaking point/plastic point; the monitoring of growth of fractures; the measurement of operational life of emergency lighting systems; the analysis of engine exhaust; and a host of other general monitoring and transient recording tasks.

The user simply types the appropriate two-digit program number onto the integral keyboard, then enters a parameter and runs the program.

Vela can be used as a portable instrument (with the assistance of an external power source) and as an 'intelligent' fixed interface to computers.

Vela can be powered from a wide range of supplies including rechargeable cells. Battery-backed CMOS memory ensures data retention in the event of power down. The introductory cost of the system is £375.00.

Data Harvest Group,
28 Lake Street,
Leighton Buzzard,
Beds LU7 8RX.
Tel: (0525) 373666.

AC TEST STATION

An ac-to-ac power supply which enables simulation of power supplies anywhere in the world is the latest addition to the range of power conversion units offered by Systron Donner.

The model ACTS500 is an ac test station providing up to 500VA of output power which may be infinitely varied in any combination of frequency and voltage over the ranges 40Hz to 1500Hz and 80 to 280V.

The ACTS500 will find many applications among design and production engineers needing to test products designed for military and export markets. It will also be invaluable for all electrical and electronic facilities needing to check line regulation and tolerances on ac line powered devices.

The unit is protected against overload, short circuit and inductive surges on the output, and also against over-temperature conditions and failure of supply rails.

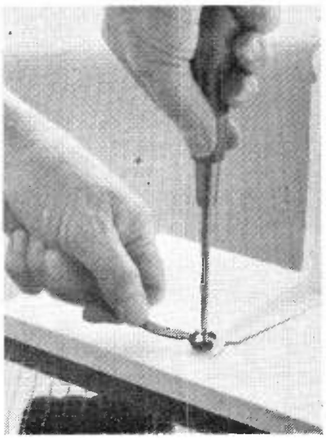
Thorn EMI Measurement Ltd,
Systron Donner Division,
Archcliffe Road, Dover,
Kent CT17 9EN.
Tel: (0304) 202620.

HANDIGRIP

A device designed to take the frustration out of positioning and using screws and nails, known as Handigrip, has been introduced by Display Tiling Services Ltd.

Handigrip is a small plastic handle which holds the nail or screw in a patented jaw. This allows the fastener to be accurately positioned before driving into any horizontal or vertical surface.

Handigrip is available in three sizes to suit a wide range of screws and nails, from the smallest panel pin through to heavy duty wood screws.



Handigrip is available through hardware stores, DIY outlets and garage shops. A pack containing a pair of each size and retailing at a recommended price of 69p including VAT will be the standard unit.

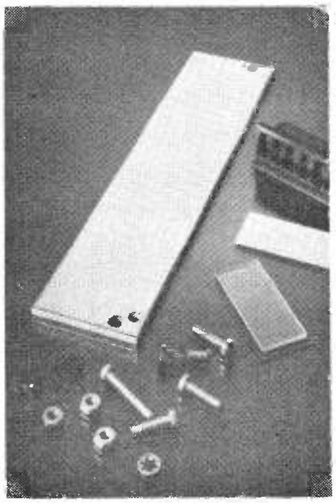
Display Tiling Services Ltd,
Level Street,
Brierley Hill,
West Midlands DY5 1TZ.
Tel: (0384) 263123/4/5.

FRONT PANEL KIT

Most products based on standard Eurocard housings require a small degree of front panel customisation to house the system's controls and user interface. To facilitate the development of this, a new prototyping front panel is now available from BICC-Vero Electronics.

The prototyping front panels are from the KM6 range, and are supplied in a basic unfinished state with only the triple 'Dee' panel-fixing holes and the normal ident sight hole. The kit contains ten panels and a full complement of handles, idents and screws, together with drilling details for the normal handle positions.

BICC-Vero Electronics,
Unit 5,
Industrial Estate,
Flanders Road, Hedge End,
Southampton SO3 3LG.
Tel: (04892) 5824.



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2SC3153	£5.26
2SC372	£1.40
2SC373	£1.16
2SC383	£1.33
2SC388	£0.50
2SC394V	£0.81
2SC403C	£0.39
2SC41	£2.19
2SC458	£0.39
2SC495	£0.92
2SC515A	£1.85
2SC535	£0.79
2SC536	£0.29
2SC537	£0.54
2SC605L	£1.16
2SC620	£1.46
2SC643A	£1.54
2SC668	£0.67
2SC681	£4.40
2SC682	£1.88
2SC684	£1.65
2SC693	£0.63
2SC710	£0.69
2SC711A	£0.50
2SC717	£1.28
2SC734	£1.43
2SC761-Y	£0.95
2SC783	£3.98
2SC790Y	£1.64
2SC828	£0.28
2SC867A	£3.05
2SC876	£0.96
2SC930	£0.54
2SC935	£4.13
2SC936	£8.66
2SC940	£4.68
2SD1128	£2.90
2SD1138	£0.99
2SD1273	£1.25
2SD1453	£0.75

2SD152K	£2.64
2SD198	£3.87
2SD234	£0.49
2SD235	£0.60
2SD24	£2.29
2SD257	£2.94
2SD292	£2.59
2SD313	£2.59
2SD325D	£1.95
2SD348	£16.13
2SD350	£5.20
2SD350A	£2.80
2SD353	£7.50
2SD389	£2.41
2SD401	£2.55
2SD414	£1.98
2SD471	£2.13
2SD560	£2.95
2SD588A	£1.99
2SD600	£3.25
2SD601R	£0.65
2SD613	£1.03
2SD621	£12.67
2SD636	£0.55
2SD639-R	£0.85
2SD655	£0.98
2SD657	£2.85
2SD661A	£0.80
2SD731	£2.45
2SD773	£0.33
2SD811	£5.54
2SD823	£1.98
2SD837	£1.20
2SD841	£3.65
2SD856	£2.25
2SD857Q	£1.84
2SD882	£1.50
2SD894	£1.50
2SD898	£5.45
2SK105H	£2.15
2SK152	£2.95
2SK34	£0.76
2SK41	£1.07
2SK79	£2.98
40408	£0.50
40594	£1.53
40636	£1.43
4EX581	£0.80
741	£0.30
7805-TO22	£0.63
7806	£0.73
7808	£2.39
7812-TO22	£1.16
7815	£0.64
7818	£0.92
7824	£0.64
7905	£0.80
9368	£10.70
NAT	£8.00
TELETON	£4.50
AA133	£0.12
AC123K	£0.43
AC127	£0.27
AC128	£0.34
AC138	£0.24
AC141	£0.29
AC142K	£0.43
AC151	£0.28
AC176	£0.30
AC179	£0.28
AC183	£0.72
AC187	£0.39
AC187K	£0.43
AC188	£0.25
AC188-01	£0.49
AC188K	£0.43
AC193K	£0.65
AC194K	£0.65
AD140	£1.06
AD143	£1.25
AD145	£1.60
AD161	£0.56
AD162	£0.45
AD262	£1.25
AF114	£2.47
AF115	£1.24
AF118	£1.20
Af127	£0.50
AF139	£0.53
AF178	£1.45
AF179	£0.55
AF180	£0.55
AF181	£0.53
AF186	£0.53
AF239	£0.43
AF279	£0.88
AL113	£1.36
AN115	£3.98
AN155	£1.89
AN206	£2.58
AN208	£3.55
AN210	£2.28
AN211	£3.25
AN214Q	£2.75
AN231	£14.43
AN234	£5.92
AN236	£3.78
AN239	£5.88
AN240P	£1.52
AN241	£1.71
AN245	£4.49
AN253	£2.97
AN260	£3.85
AN262	£1.98
AN272	£7.92
AN281	£6.65
AN295	£5.52
AN301	£5.55
AN302	£3.99
AN303	£4.39
AN305	£9.47
AN315	£2.46
AN316	£5.53
AN318	£6.27
AN320	£5.47
AN321	£2.25
AN322	£5.85
AN331	£4.59
AN337	£5.37
AN340P	£1.17
AN355	£5.98
AN362	£1.75
AN370	£3.95
AN5010	£5.70

AN5111	£2.92
AN5120N	£4.50
AN5132	£4.39
AN5250	£2.89
AN5435	£3.08
AN5610	£7.43
AN5612	£3.81
AN5613	£3.80
AN5630	£3.95
AN5701N	£1.66
AN6250	£2.95
AN6300	£7.00
AN6310	£8.74
AN6320N	£4.28
AN6340	£6.46
AN6341	£4.00
AN6342	£1.61
AN6363	£16.00
AN6371	£2.00
AN6387	£7.95
AN6531	£1.95
AN6551	£1.35
AN6552	£0.68
AN6610	£2.40
AN6677	£6.60
AN7111	£1.45
AN7114E	£5.94
AN7115	£1.75
AN7120	£4.65
AN7145	£2.80
AN7146	£4.35
AN7151	£2.26
AN7156	£2.85
AN7158	£6.75
AN7218	£1.84
AN7223	£4.25
AU107	£3.50
AU110	£2.25
AU113	£5.25
AY105K	£2.08
AY106	£1.09
BA524	£8.21
B250	£2.65
B40	£1.55
BA130	£0.14
BA1310	£1.98
BA1320	£1.38
BA1322	£3.95
BA1330	£2.75
BA145	£0.19
BA148	£0.33
BA154	£0.40
BA155	£0.12
BA156	£0.05
BA159	£0.12
BA182	£0.24
BA222	£1.66
BA302	£1.24
BA311	£1.32
BA312	£0.97
BA313	£0.76
BA317	£0.05
BA318	£0.09
BA328	£4.77
BA333	£1.37
BA335	£6.27
BA5102A	£3.78
BA511	£2.92
BA514	£2.25
BA521	£2.02
BA524	£8.94
BA526	£7.98
BA527	£2.98
BA532	£2.67
BA536	£2.95
BA6209	£4.75
BA656	£8.99
BA7100	£10.85
BA841A	£16.72
BA843	£3.96
BA854	£5.76
BAV18	£0.21
BAV19	£0.11
BAV20	£0.31
BAV21	£0.34
BAW62	£0.19
BAX12	£0.44
BAX13	£0.11
BAX16	£0.11
BC107	£0.13
BC107A	£0.11
BC107B	£0.18
BC108	£0.15
BC108B	£0.15
BC109	£0.12
BC109B	£0.15
BC109C	£0.12
BC113	£0.14
BC119	£0.36
BC126	£0.20
BC132	£0.14
BC135	£0.14
BC137	£0.18
BC138	£0.34
BC139	£0.28
BC140	£0.45
BC141	£0.34
BC142	£0.34
BC143	£0.33
BC147	£0.08
BC148A	£0.10
BC148B	£0.13
BC148C	£0.11
BC149	£0.11
BC149B	£0.13
BC153	£0.14
BC154	£0.14
BC159	£0.16
BC160	£0.40
BC161	£0.28
BC168	£0.36
BC169C	£0.16
BC170	£0.16
BC171	£0.11
BC172	£0.13
BC172B	£0.27
BC173	£0.17
BC174B	£0.27
BC177	£0.20
BC178	£0.26
BC179	£0.26
BC182	£0.09
BC182L	£0.10
BC182LB	£0.14

BC183L	£0.11
BC183LB	£0.26
BC184	£0.13
BC184L	£0.14
BC184LB	£0.26
BC186	£0.27
BC187	£0.28
BC204	£0.16
BC207	£0.14
BC212	£0.11
BC212B	£0.26
BC213L	£0.10
BC213LB	£0.15
BC214	£0.10
BC214LB	£0.26
BC225	£0.40
BC237	£0.10
BC237BJ	£0.12
BC238	£0.10
BC238A	£0.13
BC238B	£0.13
BC239	£0.12
BC239B	£0.25
BC251A	£0.12
BC294	£0.50
BC300	£0.35
BC301	£0.45
BC302	£0.53
BC303	£1.04
BC307	£0.18
BC307A	£0.14
BC308	£0.18
BC308A	£0.11
BC309	£0.17
BC317A	£0.13
BC327	£0.15
BC328	£0.11
BC337	£0.09
BC338	£0.12
BC360	£0.34
BC368	£0.24
BC440	£1.09
BC441	£0.44
BC454	£0.36
BC460	£0.42
BC461	£0.47
BC462	£1.15
BC463	£0.84
BC477	£0.37
BC478	£0.32
BC479	£0.41
BC532	£0.28
BC546	£0.17
BC547	£0.10
BC548	£0.10
BC549	£0.10
BC550	£0.40
BC556	£0.16
BC557	£0.10
BC558	£0.10
BC559	£0.10
BC559B	£0.11
BC560C	£0.14
BC635	£0.36
BC636	£0.42
BC637	£0.24
BC639	£0.20
BC640	£0.24
BC879	£0.39
BC880	£0.31
BCX34	£0.40
BCY70	£0.30
BCY71	£0.21
BCY72	£0.20
BD115	£0.36
BD116	£0.70
BD124	£1.31
BD124P+KIT	£0.69
BD131	£0.42
BD132	£0.42
BD133	£0.53
BD135	£0.36
BD136	£0.26
BD137	£0.36
BD138	£0.46
BD139	£0.34
BD140	£0.37
BD144	£1.70
BD150	£0.75
BD157	£0.67
BD160	£1.60
BD163	£0.71
BD165	£0.62
BD166	£0.42
BD168	£0.73
BD175	£0.60
BD179	£0.49
BD181	£0.99
BD182	£0.99
BD183	£0.99
BD184	£1.21
BD187	£0.53
BD189	£0.69
BD190	£0.69
BD201	£0.53
BD202	£0.60
BD203	£0.50
BD204	£0.40
BD207	£1.79
BD208	£1.23
BD222	£0.49
BD225	£0.49
BS228	£0.63
BD229	£1.05
BD232	£0.50
BD234	£0.42
BD237	£0.47
BD238	£0.45
BD239	£0.45
BD240	£0.37
BD241	£0.39
BD242	£0.39
BD243A	£0.37
BD243C	£0.79
BD244	£0.51
BD244C	£0.79
BD245C	£0.99
BD246C	£0.89
BD253	£1.05
BD278A	£0.80
BD317	£2.60
BD318	£2.85
BD375	£0.42

BD380	£0.76
BD410	£0.52
BD433	£0.47
BD434	£0.49
BD435	£0.49
BD436	£0.60
BD437	£0.49
BD438	£0.40
BD441	£1.42
BD442	£0.66
BD509	£1.42
BD510	£1.07
BD519	£1.50
BD529	£1.32
BD530	£1.10
BD533	£0.67
BD534	£0.53
BD535	£0.77
BD536	£0.61
BD537	£0.74
BD538	£0.67
BD544B	£0.83
BD598	£1.25
BD677	£0.53
BD679	£0.57
BD680	£0.76
BD681	£1.48
BD696	£2.47
BD699	£3.49
BD700	£3.70
BD707	£1.06
BD709	£1.12
BD710	£0.80
BD809	£0.75
BD810	£0.69
BD879	£0.74
BD880	£0.79
BD895	£2.31
BD899	£2.48
BD901	£0.79
BD902	£0.84
BDW83C	£1.56
BDW84C	£1.56
BDX32	£1.75
BDX53A	£4.93
BDX53B	£3.35
BDX54B	£2.61
BDX62A	£2.15
BDX63A	£1.96
BDY20	£1.21
BDY81	£1.18
BF115	£0.40
BF117	£0.66
BF118	£0.67
BF121	£0.25
BF123	£0.13
BF127	£0.13
BF137	£0.28
BF153	£0.58
BF154	£0.26
BF157	£0.33
BF158	£0.18
BF159	£0.18
BF160	£0.31
BF167	£0.38
BF173	£0.34
BF177	£0.55
BF178	£0.40
BF179	£0.36
BF180	£0.36
BF181	£0.32
BF182	£0.34
BF183	£0.39
BF184	£0.43
BF185	£0.39
BF194	£0.14
BF195	£0.14
BF196	£0.17
BF197	£0.16
BF198	£0.17
BF199	£0.17
BF200	£0.37
BF218	£0.36
BF224	£0.17
BF237	£0.65
BF240	£0.17
BF241	£0.17
BF245	£0.50
BF245A	£0.37
BF245B	£0.49
BF246A	£2.52
BF255	£0.20
BF256	£0.28
BF256LB	£0.42
BF256LC	£0.42
BF257	£0.34
BF258	£0.36
BF259	£0.34
BF262	£0.57
BF263	£0.57
BF271	£0.34
BF273	£0.20
BF274	£0.20
BF324	£0.23
BF336	£0.33
BF337	£0.40
BF338	£0.40
BF335	£0.49
BF362	£0.66
BF363	£0.60
BF371	£0.50
BF391	£0.25
BF417	£0.84
BF418	£1.87
BF422	£0.29
BF423	£0.52
BF450	£0.35
BF451	£0.29
BF457	£0.41
BF458	£0.39
BF459	£0.52
BF460	£1.56
BF469	£0.31
BF470	£0.55
BF471	£0.31
BF472	£0.33
BF479	£0.61
BF480	£0.60
BF491	£0.32
BF495	£0.64
BF506	£0.43
BF509	£0.41
BF523	£0.20
BF532	£0.45

BF596	£0.18
BF597	£0.27
BF694	£0.22
BF757	£0.59
BF759	£0.47
BF761	£1.05
BF762	£0.75
BF869	£0.65
BF870	£0.30
BF959	£0.42
BF960	£0.69
BF970	£0.69
BFR39	£0.44
BFR61	£0.50
BFR62	£0.50
BFR79	£0.29
BFR81	£1.65
BFR86	£1.08
BFR89	£1.63
BFR90A	£1.30
BFT42	£0.43
BFT43	£0.43
BFT84	£0.40
BFW10	£0.60
BFX29	£0.34
BFX84	£0.37
BFX85	£0.41
BFX86	£0.36
BFX87	£0.55
BFX88	£0.34
BFX89	£0.44
BFY50	£0.32
BFY51	£0.50
BFY52	£0.27
BFY79	£0.49
BFY90	£0.61
BLY49	£2.20
BR100	£0.22
BR101	£0.75
BR103	£0.75
BR303	£1.26
BRC116	£0.67
BRC300	£2.01
BRC5296	£0.77
BRC6109	£0.83
BRC82	£1.08
BRC83	£2.19
BRC84	£2.08
BRX44	£0.60
BRX49	£0.53
BRY39	£0.69
BSS38	£0.64
BSTB0140G	£5.25
BSTC0246	£7.25
BSTC0233	£7.25
BSTC0143	£3.07
BSTD1043	£2.85
BSV57B	£3.49
BSW68	£0.60
BSX19	£0.34
BSX20	£0.34
BSY52	£0.50
BSY79	£0.51
BT100A	£1.61
BT106	£1.55
BT108	£1.45
BT119	£1.76
BT120	£2.17
BT121	£2.48
BT123	£1.98
TBA970	£3.06
BT151-800R	£1.15
BTT6018	£2.42
BTT6218	£2.51
BTT8124	£4.89
BU106	£2.48
BU108	£1.50
BU109	£2.25
BU110	£5.69
BU111Y	£4.16
BU125	£2.48
BU126	£1.55
BU137	£9.25
BU205	£1.08
BU206	£1.27
BU207	£1.65
BU208	£1.12
BU208/02	£1.97
BU208A	£1.12
BU208D	£1.95
BU209	£1.93
BU226	£2.95
BU326	£2.00
BU326A	£2.20
BU326S	£2.20
BU406	£1.49
BU406D	£1.79
BU407	£0.82
BU407D	£1.00
BU412	£5.29
BU426A	£1.67
BU500	£1.95
BU508A	£1.89
BU536	£5.80
BU608	£2.65
BU705	£3.81
BU806	£1.79
BU807	£0.80
BU826A	£2.15
BUW84	£1.39
BUX84	£1.00
BUX85	£1.10
BUY69A	£2.04
BY126	£0.13
BY127	£0.13
BY133	£0.11
BY164	£0.47
BY176	£1.52
BY179	£0.62
BY182	£1.05
BY184	£0.47
BY187	£0.77
BY189	£1.76
BY198	£1.62
BY201/2	£1.50
BY203/20	£0.41
BY207	£0.22
BY208	£0.46
BY210-400	£0.18
BY210-600	£0.27
BY210-800	£0.34
BY218	£1.64
BY223	£1.23
BY224-600	£1.88

BY225-100	£1.13
BY226	£0.25
BY227	£0.49
BY228	£0.60
BY229-1000	£1.12
BY229-600	£0.92
BY225	£0.69
BY295-600	£0.81
BY298	£0.20
BY299	£0.60
BY407	£0.84
BY409	£1.49
BY448	£0.69
BY713	£1.10
BYW19/1000	£0.69
BYW56	£0.34
BYX10	£0.29
BYX55-600	£0.15
BYX71-600	£1.25
BYX71-350	£0.72
BYX94	£0.14
BYY56	£1.20
BZY93C30	£1.86
BZY88 RANGE	£0.10
BZX61 RANGE	£0.18
BZX79 RANGE	£0.10
C106D	£0.46
C106M	£0.76
C1129	£0.58
CA3046	£2.06
CA3089	£0.83
CA3090AQ	£3.25
CA3094	£2.20
CA3131EM	£3.12
CBF16848N-07	£1.56
CD4001	£0.38
CD4002	£0.27
CD4008	£1.35
CD4011	£0.29
CD4012	£0.24
CD4013	£0.47
CD4016	£0.46
CD4017	£0.82
CD4020	£1.23
CD4021	£0.39
CD4023	£0.28
CD4025	£0.64
CD4028	£0.84
CD4040B	£0.85
CD4047	£1.06
CD4049	£0.46
CD4052	£0.75
CD4066	£0.38
CD4069	£0.29
CD4070	£0.66
CD4081	£0.35
CD4093	£0.72
CD4511	£1.10
CD4528	£2.04
CD4556	£3.47
CR02AM-8	£1.55
CV12E	£3.07
CX095D	£3.14
CX104	£9.64
CX108	£10.50
CX109	£7.86
CX130	£8.76
CX134	£11.04
CX136	£11.49
CX139	£11.83
CX157	£4.84
CX158	£4.10
CX177	£6.75
CX187	£5.26
CX755	£12.95
CX885A	£6.85
DEC1	£2.20
DEC2	£2.20
DS3486N	£4.33
DS3487N	£4.33
E1222	£0.40
E5024	£0.28
E5386	£0.25
E9003	£0.46
E9005	£0.50
ESM310BP	£4.15
FND500	£5.78
GC374	£1.65
GD243	£4.95
GF758	£0.84
GH3F	£1.82
HA11215	£5.06
HA11211	£2.53
HA11225	£4.29
HA11226	£8.71
HA11229	£2.88
HA11235	£2.48
HA1124	£5.25
HA11244	£2.82
HA11251	£4.47
HA1125	£4.29
HA1137W	£2.87
HA1138	£5.03
HA11414	£5.65
HA1144	£7.87
HA1156	£1.16
HA1160	£4.78
HA1166	£5.25
HA1166X	£5.36
HA1167	£5.36
HA11702	£6.50
HA11706	£9.50
HA11705	£8.00
HA11703	£9.56
HA11701	£9.56
HA11710	£9.50
HA11713	£8.13
HA11711	£20.16
HA11715	£8.13
HA11714	£7.76
HA11716	£13.10
HA11725	£18.26
HA11725MP	£16.00
HA117555P	£6.23
HA11781	£8.90
HA1180	£5.15
HA1196	£7.43
HA13001	£6.25

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HA1306	£2.26
HA1338	£7.50
HA1339	£2.33
HA13402	£7.87
HA1342	£2.65
HA1365	£4.02
HA1366WR	£1.88
HA1367	£4.32
HA1368R	£2.45
HA1368	£1.90
HA1370	£3.71
HA1374	£4.80
HA1377	£3.96
HA1389R	£2.05
HA1389	£2.39
HA1392	£3.90
HA1394	£3.95
HA1397	£3.76
HA1398	£3.98
HA1406	£2.07
HA1452	£1.63
HBF4030AF	£2.48
HD14538	£2.07
HD38702-A2	£7.45
HD38750A53	£8.71
HD38750A-7	£7.25
HD38800A50	£14.09
HD44801A05	£17.49
HEF4001BP	£0.67
HISH1010	£8.59
HISH1004	£6.00
HISH1002	£9.50
HM6231	£9.81
HM6232	£8.89
HM6251	£5.70
HM7103	£2.46
HM9032	£3.22
HM9102	£3.22
HM9105	£3.24
HT4207	£17.16
HT4208	£18.25
IN5401	£0.11
IR2403	£4.25
IR2C05	£4.25
IR3P06	£2.25
IR3P08	£4.95
IR94558	£6.25
IS751	£2.85
ITT425	£0.18
IZ0003GE	£5.37
IZ0020GE	£5.93
K174YP	£3.46
KA2101	£2.92
KC581C	£6.32
KC582C	£3.97
KC583C	£5.54
L200CV	£1.89
LA1201	£1.02
LA1210	£1.56
LA1230	£2.87
LA1320	£2.87
LA1352	£1.75
LA1357N	£11.07
LA1363	£7.25
LA1364	£3.02
LA1365J	£3.44
LA1385	£1.94
LA1387	£7.60
LA3155	£1.25
LA3301	£1.41
LA3350	£1.43
LA3361	£1.23
LA3365	£3.98
LA3390	£4.25
LA4030P	£4.20
LA4031P	£3.20
LA4032P	£2.35
LA4100	£1.25
LA4101	£1.30
LA4102	£2.81
LA4112	£4.83
LA4125	£2.25
LA4138	£3.38
LA4140	£1.15
LA4192	£3.65
LA4220	£1.62
LA4250	£6.75
LA4400	£2.25
LA4420	£1.72
LA4422	£1.72
LA4430	£1.47
LA4440	£4.95
LA4445	£7.25
LA4460	£2.32
LA4461	£2.95
LA4505	£5.94
LA5112N	£2.65
LA7020	£7.33
LA7025	£8.05
LA7027	£9.35
LA7040	£9.20
LA7042	£4.25
LA7800	£2.65
LA7801	£4.15
LB1274	£3.08
LC7800	£9.20
LD3120	£1.13
LD3150	£2.25
LM1017N	£4.29
LM1877	£10.92
LM224	£1.75
LM2808	£5.94
LM2877	£4.93
LM317CKC	£1.38
LM324N	£0.75
LM339N	£0.80
LM340K	£11.85
LM342P	£1.62
LM342P	£1.62
LM342P	£1.62
LM348N	£2.15
LM380N	£2.80
LM384N01	£3.25

LM567CN	£1.71
LM6402/011	£10.23
LM6402A093	£10.15
LM748	£1.82
LM8360	£3.22
LM8361	£3.57
LR2612	£11.95
LR3419	£9.37
LR3471	£9.37
LU1141	£7.27
LU52012	£5.95
LU52011	£4.95
LUO3112	£12.37
M193	£12.75
M21C	£1.00
M23C	£0.83
M293	£9.15
M51102L	£8.35
M5115P	£5.24
M51203L	£3.15
M51231P	£3.04
M5134-9341	£4.13
M51353P	£5.25
M51381P	£4.50
M51393AP	£7.78
M51394P	£11.97
M5142P	£5.49
M5144P	£4.25
M51513L	£2.55
M51515BL	£3.23
M51517L	£3.71
M5192	£2.20
M5194AP	£5.74
M5231L	£1.95
M53274P	£1.33
M54532P	£2.15
M54544L	£4.75
M58478P	£6.75
M58485P	£10.74
MA06	£1.07
MA8001	£0.82
MA8003	£1.16
MB3705	£1.98
MB3712	£1.85
MB3713	£1.69
MB3730	£3.25
MC13002	£4.50
MC1310P	£2.25
MC1327P	£1.33
MC1330P	£1.69
MC1350P	£1.61
MC1351P	£3.96
MC1352P	£1.98
MC1357P	£2.15
MC1358P	£1.30
MC14001	£2.40
MC14013	£0.41
MC14493P	£3.44
MC14494P	£2.15
MC14497	£14.99
MC14510BAL	£3.75
MC14511BCP	£1.10
MC14528BCP	£2.70
MC1712	£3.88
MC5192	£13.50
MC7724CP	£3.49
MC7818C	£2.18
MCR100/7	£1.65
MCR106-5/6	£0.85
MCR220/7	£2.28
ME0402	£0.17
ME0404/2	£0.47
ME0411	£0.28
ME6002	£0.26
ME6102	£0.28
ME8001	£0.34
ME0411	£0.75
MJ2501	£3.30
MJ3001	£1.69
MJ481	£1.53
MJ802	£5.45
MJE2955	£1.89
MJE3055	£1.65
MJE340	£0.49
MJE520	£0.49
ML231	£3.33
ML232B	£2.15
ML237B	£2.51
ML238	£5.77
ML923	£3.30
ML926	£3.58
MM5314N	£4.02
MM5316N	£4.25
MM5318N	£3.11
MM5369N	£2.01
MM5387AA/N	£6.20
MM5841N	£6.49
MN1400VL	£9.96
MN1405	£9.52
MN1435VX	£10.62
MN601A	£20.56
MP1192	£5.07
MP2794	£4.00
MP2812	£5.07
MP8512	£1.57
MPC596	£2.13
MPF256C	£0.60
MPS6570	£0.48
MPSA42	£0.65
MPSA56	£0.27
MPSA92	£0.45
MPSU05	£0.86
MPSU10	£1.56
MPSU56	£0.60
MPSU60	£1.33
MR818	£0.33
MR854	£0.72
MR914	£1.20
MSM5816RS	£17.35

MSM5840H	£9.15
MVS460-02	£0.61
NE542	£2.35
NE545B	£4.33
NE555	£0.38
NE556	£0.95
NE565N	£1.33
NE645BN	£3.35
NP1106	£5.81
OA202	£0.11
OA47	£0.14
OA91	£0.09
OA95	£0.09
OC28	£2.95
OC29	£2.15
OC36	£1.28
OC44	£0.35
OC45	£0.18
OC72	£0.44
OC75	£0.44
ON236	£1.06
ON782	£1.98
OT121	£1.45
PT6042	£2.45
PT8504	£4.95
R1038	£2.19
R1039	£2.19
R2008B	£1.33
R2009	£1.98
R2010B	£1.33
R2029	£1.33
R2030	£1.33
R2257	£2.38
R2265	£1.49
R2305	£1.18
R2322	£0.59
R2323	£0.76
R2354A	£2.01
R2354B	£2.01
R2443	£0.88
R2461	£1.50
R2540	£2.31
R2540X	£3.30
R2615	£0.67
RCA16029	£2.01
RCA16600	£1.38
RCA16802	£1.08
RCA17074	£6.60
RCA17376	£1.58
RCA17524	£0.83
RCA17523	£0.83
RCA2060	£2.00
RGP01-15	£0.70
RGP10	£0.50
RGP30M	£0.59
RT402	£1.19
RT905A	£2.38
S1299	£5.74
S175	£31.48
S2062D	£2.07
S2800D	£5.54
S2802	£3.47
S2818	£4.05
S3702S	£6.15
S40W	£10.89
S6080B	£8.80
SA8063	£5.17
SAA1006	£1.75
SAA1020	£4.76
SAA1025	£4.40
SAA1024	£2.81
SAA1075	£6.25
SAA1121	£4.43
SAA1124	£3.25
SAA1130	£4.99
SAA1174	£7.77
SAA1250	£3.96
SAA1251	£9.85
SAA1351	£4.95
SAA3027P	£10.03
SAA5000	£2.95
SAA5010	£5.39
SAA5012	£4.15
SAA5020	£5.78
SAA5030	£8.25
SAA5050	£7.74
SAB1009B	£6.81
SAB3011	£7.34
SAB3013	£5.61
SAB3021	£7.90
SAB3024	£6.36
SAB3209	£5.82
SAB3210	£3.49
SAF1032P	£6.50
SAF1039	£3.35
SAS5010	£8.39
SAS560S	£2.26
SAS560T	£5.42
SAS570T	£5.42
SAS570S	£2.61
SAS580	£2.85
SAS6600	£1.33
SAS660	£2.97
SAS6700	£1.33
SAS670	£3.96
SAS6710	£1.33
SBA750	£1.61
SC84203	£18.98
SC9504P	£1.95
SDA2006	£18.95
SDA2112/2	£12.50
SG264A	£5.26
SG613	£8.75
SG629	£8.27
SG6533	£10.31
SI-1020H	£10.89
SI-1125HD	£17.63
SI1125H	£7.50
SI1225HD	£17.73
SI1630HD	£17.85
SI6900	£12.00
SKE1/02	£1.85
SKE2F1/04	£1.39
SKE2G3/04	£1.05
SKE4F1/06	£0.73
SKE4F2/08	£1.24
SKE4F2/06	£0.85

SKE4F2/10	£1.24
SKE4G2/02	£0.96
SKEF3/10	£1.60
SKS1/10	£2.15
SL1310	£3.14
SL1430T	£2.31
SL414	£3.69
SL432A	£3.44
SL439	£2.48
SL471	£3.28
SL480	£3.14
SL490	£2.37
SL901B	£8.32
SL918A	£9.07
SN16861ANO	£4.95
SN16862AN	£2.98
SN16966N	£10.25
SN29717N	£7.19
SN29716N	£3.88
SN29715N	£6.04
SN29722	£11.95
SN29723AN	£7.65
SN29764AN	£1.38
SN29767	£4.98
SN29770BN	£4.24
SN29772BN	£4.91
SN29771BN	£4.93
SN29791	£1.67
SN29798N	£5.58
SN72709	£0.44
SN7400N	£0.34
SN7401N	£0.38
SN7402N	£0.65
SN7404N	£0.24
SN7408N	£0.27
SN7410N	£0.27
SN74121	£1.60
SN7413N	£0.37
SN74141N	£2.65
SN74151AN	£1.51
SN74154N	£1.27
SN74190	£2.00
SN7420N	£0.34
SN7430	£0.49
SN7440N	£0.27
SN7472	£1.54
SN7474N	£0.44
SN7490AN	£0.93
SN74LS26N	£0.53
SN76001N	£1.65
SN76013N	£4.95
SN76013ND	£2.48
SN76013HDG	£8.88
SN76023N	£5.15
SN76023ND	£3.96
SN76033N	£4.15
SN76110N	£0.90
SN76115AN	£1.81
SN76131	£1.92
SN76227N	£1.33
SN76226DN	£1.98
SN76228N	£3.27
SN76242	£8.95
SN76243	£5.23
SN76396	£2.90
SN76533N	£2.47
SN76532N	£2.95
SN76545	£4.87
SN76546N	£3.47
SN76549	£2.59
SN76570	£3.08
SN76611	£2.59
SN76620	£2.59
SN76660N	£2.48
SN76666N	£1.41
SN76708	£4.86
SN76709	£5.12
SN76709N	£5.45
SN76707N	£4.39
SN76705N	£1.34
SN76730	£5.36
SN76810N	£0.60
SN76832N	£3.25
SN94041	£5.54
SN94042	£4.35
SP8385	£0.55
SPS5384	£1.98
ST1702L	£0.99
STA401	£6.76
STA441C	£2.75
STA471C	£6.76
STK0029	£5.54
STK0039	£5.35
STK0040	£12.00
STK0050	£7.67
STK0080	£9.16
STK011	£3.96
STK013	£9.25
STK014	£9.80
STK015	£7.75
STK016	£6.91
STK022	£5.25
STK025	£12.50
STK031	£12.95
STK040	£8.70
STK043	£13.44
STK054	£7.13
STK058	£18.25
STK077	£7.67
STK078	£8.52
STK080	£16.50
STK082	£11.86
STK086	£13.59
STK1039	£5.75
STK2110	£7.33
STK2145	£16.25
STK2230	£7.70
STK2240	£14.40
STK2250	£18.95
STK3042	£11.05
STK3044	£5.75
STK4019	£4.50
STK430	£11.75
STK433	£5.45
STK4332	£8.25
STK435	£5.94

STK4352	£12.25
STK436	£7.21
STK437	£7.80
STK4372	£3.85
STK439	£8.31
STK441	£11.28
STK443	£10.29
STK457	£13.45
STK460	£10.75
STK461	£9.68
STK463	£11.53
STK466	£11.77
STK4833	£16.95
STK501	£6.32
STK502	£5.74
STK5314	£9.48
STK5730	£3.95
STK7216	£12.67
STK772	£6.95
STR1096	£4.50
STR4090	£11.75
STR440	£7.85
STR441	£9.45
STR451	£4.95
STR453	£8.16
STR454	£7.50
STR6020	£8.31
T6029V	£5.75
T6035V	£0.73
T6036	£0.67
T6037	£2.11
T6044V	£0.95
T6045	£1.20
T6049	£1.45
T6052V	£0.87
T6058	£0.59
T6059	£0.65
T9003V	£1.25
T9005V	£2.38
T9011V	£0.49
T9013V	£7.96
T9014V	£2.60
T9016	£1.02
T9019W	£1.98
T9034V	£1.38
T9035V	£1.39
T9051	£4.29
T9054V	£1.15
T9057V	£0.70
T9062V	£0.49
T9064	£1.51
TA6002	£4.35
TA7027	£4.80
TA7050	£1.74
TA7051	£1.74
TA7054	£2.55
TA7060AP	£0.71
TA7061AP	£1.27
TA7069	£3.13
TA7070P	£1.83
TA7072P	£2.57
TA7073P	£5.86
TA7074P	£1.98
TA7076P	£7.50
TA7089P	£1.50
TA7092P	£6.84
TA7093P	£3.99
TA7102P	£5.88
TA7108P	£1.61
TA7109	£4.90
TA7122B/P	£0.92
TA7124P	£2.34
TA7129P	£1.50
TA7130P	£1.27
TA7136AP	£1.27
TA7137P	£0.98
TA7141AP	£3.87
TA7146	£2.50
TA7146P	£4.23
TA7148P	£1.67
TA7149P	£3.26
TA7152P	£1.52
TA7153P	£7.47
TA7161P	£5.45
TA7162P	£2.98
TA7169	£9.54
TA7172P	£1.41
TA7176P	£2.48
TA7193AP	£6.67
TA7193P	£5.50
TA7201P	£2.71
TA7203P	£2.18
TA7204P	£2.16
TA7205P	£1.38
TA7206P	£6.25
TA7207P	£3.34
TA7208P	£2.15
TA7210P	£3.58
TA7214P	£3.63
TA7215P	£2.58
TA7217AP	£1.45
TA7222	£1.95
TA7226	£10.25
TA7227P	£2.81
TA7229P	£4.45
TA7230P	£4.98
TA7232P	£6.60
TA7233P	£5.32
TA7240AP	£7.83
TA7245P	£7.50
TA7270	£6.75
TA7310P	£2.15
TA7312P	£2.45
TA7313AP	£1.50
TA7314	£5.94
TA7323P	£3.15
TA7325P	£1.15
TA7339P	£1.35
TA7340P	£5.06
TA7607AP	£13.90
TA7609	£3.28
TA7611AP	£4.80
TA7616P	£5.25
TA7622AP	£8.94
TA7628P	£5.62
TA7629P	£7.50
TA7630P	£2.98
TA7640AP	£1.19

TA7672P	£1.75
TA7676P	£2.81
TA7726P	£10.25
TAA320A	£1.27
TAA350A	£0.80
TAA570	£1.74
TAA621AX1	£2.48
TAA621A12	£2.14
TAA661B	£1.00
TAA691	£8.58
TAA700	£3.75
TAA930	£4.87
TAA970	£2.83
TAD110	£2.52
TAG232-600	£0.73
TAG626-600	£1.06
TBA120AS	£1.24
TBA120SB	£1.05
TBA120T	£0.95
TBA120U	£2.50
TBA120A	£1.05
TBA1440	£2.03
TBA1441	£1.62
TBA1440G	£5.20
TBA1441	£1.75
TBA240A	£3.99
TBA395	£1.10
TBA395Q	£1.10
TBA396	£0.80
TBA400	£2.39
TBA440P	£2.45
TBA480Q	£1.30
TBA500P	£6.58
TBA510	£1.37
TBA520	£1.84
TBA520Q	£1.68
TBA530	£1.30
TBA530Q	£1.30
TBA540	£1.15
TBA540Q	£1.15
TBA560C	£1.40
TBA560CQ	£1.60
TBA570Q	£1.60
TBA570A	£1.71
TBA641A12	£4.13
TBA641B72	£3.03
TBA651	£1.76
TBA673	£2.60
TBA700	£1.85
TBA720	£1.55
TBA730	£2.55
TBA750Q	£2.90
TBA760	£1.71
TBA800	£1.08
TBA810S	£1.61
TBA810T	£1.50
TBA810AS	£1.00
TBA820	£1.52
TBA820M	£0.82
TBA890	£2.50
TBA920	£1.89
TBA920Q	£2.31
TBA940	£1.87
TBA950	£1.55
TBA970	£1.79
TBA990	£1.82
TBA990Q	£1.88
TC4001BP	£3.25
TC4011BP	£3.50
TC4013BP	£3.75
TC4016BP	£3.15
TC4053BP	£4.34
TC4069	£1.52
TC4071BP	£2.76
TC4081BP	£3.25
TC40H000	£1.98
TC4514BP	£4.15
TC9002BP	£11.95
TCA270Q	£1.71
TCA270S	£2.15
TCA270SQ	£1.65
TCA290A	£2.39
TCA420A	£2.16
TCA440	£1.93
TCA530	£2.16
TCA640	£10.26
TCA650	£2.04
TCA660B	£3.30
TCA730	£3.81
TCA750	£2.25
TCA800Q	£6.95
TCA830S	£2.38
TCA890	£5.44
TCA900	£2.04
TCA910	£1.65
TCA940	£1.60
TCA940E	£2.93
TCE330	£3.89
TCEP100Q	£10.25
TCEP100	£9.61
TD3406AP	£3.98
TD3F800R	£3.92
TD3F900H	£4.16
TD62105P	£2.50
TD62104P	£2.50
TD62706P	£4.50
TDA1001B	£2.31
TDA1003A	£2.25
TDA1005A	£2.22
TDA1006A	£2.11
TDA1010AF	£4.25
TDA1011	£2.40
TDA1010	£1.15
TDA1011A	£5.25
TDA102B	£2.45
TDA1034B	£2.42
TDA1035S	£2.95
TDA1035T	£2.55
TDA1037	£1.98
TDA1037D	£3.25
TDA1044	£2.62
TDA1047	£4.10
TDA1059B	£0.80
TDA1054M	£1.21
TDA1060	£2.60
TDA1082	£3.25
TDA1151	£1.22

TDA1170S	£2.25
TDA1190	£2.11
TDA1190Z	£3.96
TDA1200	£1.50
TDA1235	£3.88
TDA1236	£4.30
TDA1270	£3.76
TDA1327A	£1.33
TDA1412	£1.05
TDA1420	£1.55
TDA1440	£3.45
TDA1470	£3.16
TDA1470P	£4.25
TDA1506	£7.45
TDA1510	£5.90
TDA1512	£2.89
TDA1515	£16.60
TDA1559	£3.15
TDA1670	£4.48
TDA1770	£6.85
TDA1905	£1.76
TDA1908	£1.75
TDA1940	£1.95
TDA1950	£4.75
TDA2005	£5.08
TDA2006	£1.55
TDA2004	£2.27
TDA2002	£0.90
TDA2003	£1.75
TDA2010	£1.85
TDA2020	£2.77
TDA2030	£1.99
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TDA3540	£2.98
TDA3541	£3.80
TDA3560	£5.00
TDA3571Q	£2.83
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TDA3652	£5.44
TDA3651AQ	£4.35

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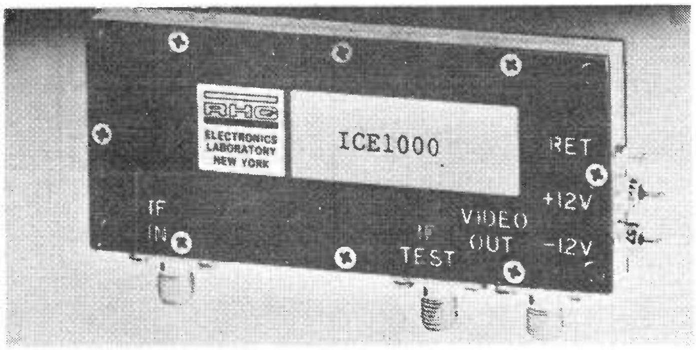


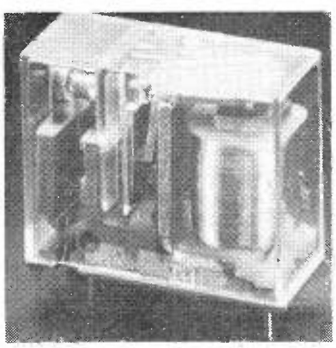
LINEAR AMP

Now available from Walmore Advanced Components Limited is a new 1GHz linear amplifier/detector with a 500MHz bandwidth and a 15ns rise time.

Manufactured by RHG Electronics Laboratory Inc, the model ICE1000 is designed primarily for radar and other applications requiring high speed IF processing. This new device, which incorporates a built-in 20dB dynamic range ac coupled video detector, offers 60dB of gain. The video output is capable of driving 93 ohm loads to 2.2 volts nominal.

Walmore Electronics Ltd,
Laser House,
132/140 Goswell Road,
London EC1V 7LE.
Tel: (01) 251 5115.

AC DRIVEN RELAY



A new miniature ac driven relay has been introduced by Italian manufacturer Feme and is available in the UK from Quiller.

The Feme relay is intended to provide a low cost alternative to the present dc driven devices, and eliminates the need for design and layout of rectifier circuits. Space saving without the dc power source is quite considerable.

Switching up to 16 amps, the ac relay can be supplied in a c/o, n/o or n/c configuration and can operate over a voltage range of 6-240V ac.

Quiller Ltd,
85 Stanley Road,
Bournemouth BH1 4SD.
Tel: (0202) 303424.

934MHz GEAR

Selectronic has now introduced a new 934MHz hand-held transceiver, the MT370, which features 20 channels, 10 memory channels, full scan facility, a high performance RF output, good audio quality, a high capacity battery pack and a half-wave whip antenna. It is available for £459 including VAT.

The company also has a new range of 934MHz accessories.

Selectronic,
203 High Street,
Canvey Island, Essex.
Tel: (0268) 691481.

SHARP CUT-OFF FILTER

In broadcasting applications there is often a need for a filter which provides a sharply defined frequency range, yet is virtually transparent to the baseband signal itself. A new filter from BAL Components Ltd claims to achieve this.

The LPC filter family exhibits a transition sharpness of 1.17, ie stopband-start to end of passband, while the group delay ripple is controlled to 10ns peak-to-peak up to within 97% of the 0.10dB ripple bandwidth. This sharpness compares with, typically, 1.30 to 1.50 for other delay line types.

BAL Components Ltd,
Bermuda Road,
Nuneaton,
Warwickshire CV10 7QF.

ANTENNA COUPLER

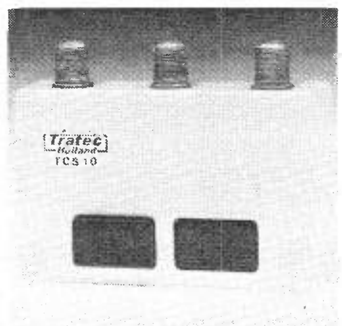
The Amcomm 9000 antenna coupler is a development of the Amtech 300, now incorporating a 1:4 toroidal balun to permit connection of a transmitter to an antenna via 300 ohm balanced feeder.

The antenna coupler utilises a capacitively tuned T network for matching high impedance (300 - 600 ohms) or low impedance (50 - 75 ohms) antennas to low impedance transmitter outputs. It is general coverage and will tune over the range 1.7MHz to 30MHz. Selection of frequency range is by means of the inductor switch.

In operation the tune and load capacitors are adjusted to obtain minimum VSWR at the transmitter. The components in the antenna coupler are rated for operation with power outputs of 100 watts.

Low impedance connections are made via PL259 sockets. High impedance balanced feeder connections are made via insulated screw terminals (red and white).

Amcomm/ARE,
373 Uxbridge Road, Acton,
London W3 9RN.
Tel: (01) 992 5765/6.



SWITCHED ON!

Tratec, the Dutch satellite product manufacturer, has introduced the TCS-10, a coaxial switch to be used in the 950-1750MHz satellite IF frequency.

The upgraded switch includes what the company call 'spectacular features'. Specifications include a return loss of better than 20dB, an insertion loss of 0.3dB and isolation of 90dB.

Tratec BV,
POb 385,
3900 AJ Veenendaal,
Holland.

ANTENNA BRACKET

A bracket to support an antenna mast above the rotator, has been designed by Brian Lee of West Yorkshire.

Made in one welded piece, the bracket is extremely rigid and stable. It uses two nylon bearings, which fit snugly round the antenna mast and take the strain which the rotator normally takes, hence prolonging the rotator's life.

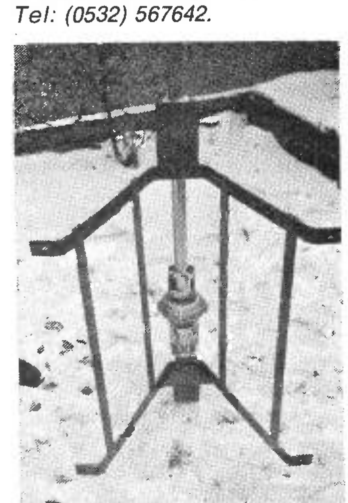
The overall length of the bracket is 3 feet, 2 feet of which make up the main bracket, with a 6 inch projection at the top for bearing supports and 6 inches at the bottom for the rotator fixing point, which has a sturdy stiffening rib at the back. It is easily attached by connecting the U/bolts to the mast stub.

The bracket is supplied with U/bolts and wall fixing bolts and is finished in hammer type paint. 10mm holes are drilled in each of its four corners for wall fixings.

The amount of projection from the wall is fixed according to the customer's specifications, to allow for any obstruction. This is done at no extra cost.

The price for the antenna bracket is £23.50 plus £6.50 postage and packing.

Brian Lee,
31 Merton Avenue,
Farsley,
Pudsey,
West Yorkshire LS28 5DX.
Tel: (0532) 567642.



NEW KENPRO MODEL

Hi-Tech Worldwide Ltd have introduced a new Kenpro model to complement the KT200/400 series.

The unit has the following features built in as standard: 24 hour LCD clock, CTCSS sub-audible tone encode (decode optional) DTME touch-tone with 2 autodial memories, battery economiser on receive (in standby mode), 4 scanning mode/functions, channel spacing steps programmable from 5kHz to 100kHz, 5 watts RF output with 12.8V Nicad, 10 memories with scanning and lockout facility, 144-148MHz coverage expandable for export versions, direct frequency access with programmable switch-on call channel.

The unit incorporates the latest receiver front-end JFET low noise devices with a good sensitivity and blocking performance, quality recovered audio, clear Tx audio from the built-in electret microphone and easy to fit optional accessories such as speaker mic. It also has a built in dc jack for operation without the Nicad pack.

The KT220EE costs £209 (prices may vary owing to fluctuating exchange rates).

Hi-Tech Worldwide Ltd,
584 Hagley Road West,
Oldbury,
Quinton,
Birmingham B68 0BS.
Tel: (021) 421 6001.

LOWE-DOWN

New products from Lowe Electronics include the Trio TS440S HF transceiver (£950 inc VAT): the Trio TM2550E 2m FM mobile rig (£399 inc VAT); the Trio TR751E 2m multi-mode mobile transceiver; the JRC NRD525 general coverage receiver; and the Trio SWC3 remote head for the SW200 meter (£30.20 inc VAT).

Lowe Electronics Ltd,
Chesterfield Road,
Matlock,
Derbyshire DE4 5LE.
Tel: (0629) 2817.

MOBILE TRANSCEIVER

ICS Electronics Ltd have announced the new ALR-206E 25/5 watt mobile transceiver.

This compact unit has an easy to read back-lit LCD frequency and S-meter readout with the same programmable features as the company's ALM-203E hand-held transceiver introduced at the end of 1985. These are accessed from a keypad on the rear of the microphone.

Programmable features include: band scan; 10 memory channels; and memory scan. Frequency selection is by means of a large front panel knob or from the microphone up/down buttons. A mobile mount is included as standard.

The price of the ALR-206E is £295.00 including VAT plus £3 post and packing.

Also available from ICS is a complete 30W 2m hand-held system, consisting of the ALM-203E and a separate 30W FM amplifier with a 10dB gain GaAsFET pre-amp. The price, including connecting cable, is £249.95 including VAT, plus £4 postage and packing.

ICS has also announced that the ISO144 2m isopole antenna is again available at a price of £39.95 including VAT, plus £2.50 postage and packing.

ICS Electronics Ltd,
PO Box 2, Arundel,
West Sussex BN18 0NX.
Tel: (024 365) 590.

RECEIVE SOFTWARE

Technical Software has announced that the RX-4 Multimode Receive Program, which can receive Morse, RTTY, Amtor and slow-scan TV without needing any expensive hardware, has now been completely revised, with improved performance and many new features added.

An advantage with this software is that all four modes are in the same program, only needing one key-press to change mode.

On CW there is a choice of software filters as well as a wideband decoder capable of reading at over 250wpm. The autotrack facility is controllable up to the maximum speed and can also be locked completely.

RTTY and Amtor have selectable unshift-on-space and switchable normal-reverse polarity. Tuning these signals is easy and accurate, as the on-screen frequency scale displays the tones directly. RTTY has four baud rates and decodes any shift automatically without switching. Amtor also reads many commercial TOR transmissions.

The SSTV can display 8, 16 or 32 second frames and good pictures are obtained even in the presence of some noise. The grey scale (picture brightness) can be adjusted from the keyboard and the picture storage allows you to over-write one stored frame with a better one, if required, thus making much more efficient use of the available memory space.

All received text is stored as well as printed on the screen. Stored text and pictures can be recalled to the screen, dumped to a printer or saved on tape or disc.

The Spectrum version needs no hardware at all, connecting directly to the Spectrum's Ear socket. The BBC-B, CBM64 and Vic 20 versions use the same interface as the RTTY/CW transceive program. For CW and RTTY they can also use a suitable terminal unit.

The program costs £25 on tape, £27 on BBC or CBM format disc, and the interface is £5 as a kit or £20 ready-made with all connections.

Technical Software,
Fron, Upper Llandwrog,
Caernarfon,
Gwynedd LL54 7RF.
Tel: (0286) 881886.

RX MODIFICATION

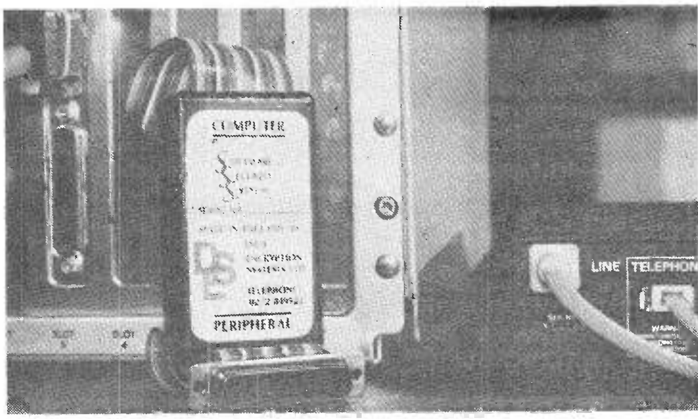
RWC Ltd have announced a modification for the Yaesu FRG9600 scanning receiver. The standard frequency range of 60-905MHz has been extended to cover up to 945MHz (940MHz guaranteed) with adequate sensitivity to cover the 934MHz range.

The modification also includes improved receiver sensitivity and 'S' meter recalibration.

Customers who purchase the FRG9600 at RWC can have the modification fitted at no cost, (including existing customers). Owners of the FRG9600 can have the modification and the other improvements fitted for £25 including VAT and return post. They are warned, however, that the warranty will be affected on sets not supplied by RWC.

Further developments are in progress, with a low frequency option under way to enable operation below 60MHz. It may also be possible to include additional bands to be fitted in 20MHz increments.

R Withers
Communications Ltd,
584 Hagley Road West,
Oldbury, Quinton,
Birmingham B68 0BS.
Tel: (021) 421 8201.



DONGLE DESIGN

Data Encryption Systems have launched their new low cost dongle, the SSS. Plugged into the serial port of the computer, the dongle is interrogated under instructions from the software package and transmits a decryption key, which can be millions of bits long, into the computer to enable the software to be decrypted. Unless the correct key is used the package will not run.

The serial port can still be used in the normal way, the dongle acting merely as a passive connection, once the software has been authorised.

The SSS is available for £22.50.

Data Encryption Systems Ltd, Nore Road, Portishead, Bristol BS20 8EY. Tel: (0272) 849522.

WILD VISION

Wild Vision, the Newcastle based electronic vision company, has launched the Hawk V8, a low cost, high performance real-time image processing system for the BBC microcomputer.

The Hawk V8 consists of a single PCB mounted inside the BBC micro and an image processing software package. Video images from a camera are digitised in real-time and stored directly into the graphics display memory of the computer.

The direct memory access method used provides a system with a performance comparable to high-speed framestores, yet at a fraction of the cost. Moreover, the use of the computer's internal memory means that much higher processing speeds can be achieved.

Wild Vision,
Mari House,
20-22 Jesmond Road,
Newcastle-upon-Tyne
NE2 4PQ.
Tel: (091) 281 7861.

SPECTRUM 128

As expected, Sinclair launched the new Spectrum 128 onto the UK market during February (a similar machine has been available in Spain since before Christmas). It features, of course, 128K of RAM, with 32K of ROM, and will retail at £179.99.

The most notable features of the Spectrum 128's hardware, apart from the added memory, are the RS232/MIDI-out port and the keypad interface (both software driven), and the RGB/composite video output. It retains the earlier Spectrum's cassette port, TV output and expansion bus. There is, somewhat surprisingly, no joystick port.

There is also a 3-channel sound chip, which means no more weedy beeping, and a RAM disc file system usable from Basic. This latter means that some of the on-chip memory can be used for data storage in the same way as a disc is used. Access to such data is virtually instantaneous (and therefore much faster than disc).

The built-in software ('firmware') includes 48 Basic for those who want it, but has in addition a new 128 Basic with a full screen editor and on-entry syntax checker. 'Tape Loader' and 'Tape Tester' facilities will help with loading programs from cassette.

The new Spectrum 128 is claimed to be fully compatible with earlier Spectrum software, so there is already a massive amount of software available for it.

ICS presents the brilliant ALINCO

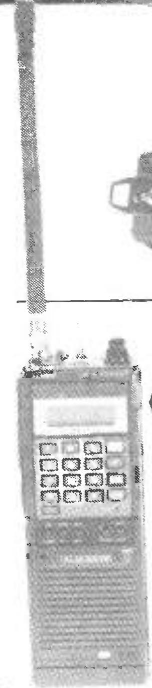
2 METRE TRANSCEIVERS

ALR-206E 25 WATTS 2 METRE MOBILE

- 144-146 MHz FM
- 25 watts output
- 10 memory channels, band scan
- All programming from key pad on microphone
- Back lit LCD frequency display with LCD 'S' metre
- Frequency selection from front panel or microphone
- Mobile mount included

The ALR-206E features micro processor controlled versatility and programming from the microphone in a compact package.

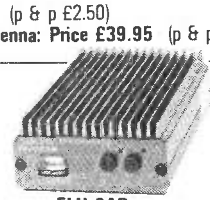
ALR-206E Price:£295 inc VAT. (p & p £2.50)
Isopole 144 omni-directional antenna: Price £39.95 (p & p £2.50)



ALM-203E
3/5 WATTS
2 METRE
HANDHELD

- 144-146 MHz FM
- 3 watts with NiCad, 5 watts with DC/DC converter
- 10 memory channels
- Programmable band scan
- Switchable 150-160 MHz Rx (marine band)
- 'S' metre
- Toneburst
- NiCad charger

ALM203E Price: £239 inc VAT (p & p £2.50)



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Olivetti's former flagship, the M24SP

OLIVETTI PCs

Olivetti is demonstrating an increased commitment to the business computer market with plans for the introduction of three new IBM-compatible computers. The M19, M22 and M28 are being launched during April, with availability being forecast for the second quarter (M19, M28) and the end of the third quarter (M22).P

Over the last two years Olivetti has seen its share of the European PC market double, so that it now stands at an estimated 11.7%, and the company is the foremost competitor to IBM in international terms, other companies competing only in their home markets.

The new machines will complement Olivetti's current range of M24 series models, which have gained an excellent reputation since they were introduced. When designing the M24 Olivetti sought to compete with the IBM PC on the grounds of performance, giving a higher specification for a roughly comparable price (not difficult, some would say, given the IBM PC's lacklustre design, its success in becoming a *de facto* standard being a result more of IBM's sheer size). Some other companies have taken a 'same performance, lower price' attitude, with Epson, for example, offering a basic IBM-compatible PC for £777. Lately such competition has resulted in companies like Olivetti reducing their prices as well.

Of the new machines, the M28 has the highest specification. Based on an 80286 processor running at 8MHz, it is claimed to be 30% faster and 25% smaller than the IBM PC AT. It is equipped with 512K of RAM as standard, expandable to 1MB on-board and to 7MB using the expansion slots, and uses a 20MB hard disc drive.

The M28 also caters for those requiring a multi-user system. A serial multiport board can be fitted, allowing the machine to support four extra workstations, and Olivetti has announced full Xenix V support.

The M22 is a full-function portable computer with 256K of RAM as standard, a single 360K 5¼ inch floppy disc drive, and an 80 column × 25 line LCD display. Serial, parallel and mouse ports are standard, and the machine is battery-powered.

The M19 compact PC is primarily intended for the workstation market, with the small business and education markets also seen as likely areas for sales. It is a very small 8088-based computer, with serial and parallel ports as standard and an integral graphic display controller which offers 640 × 200 pixel resolution (compared to the M28's 640 × 400) or 320 × 200 with 4 colours/shades.

In addition to the new hardware, Olivetti is to extend its range of third party software optimised to run on its PCs, and to offer further communications packages.

British Olivetti Ltd,
PO Box 89,
86/88 Upper Richmond Road,
London SW15 2UR.
Tel: (01) 785 6666.

SATELLITE SYSTEMS

Now available in the UK through Skidmore 4WD Ltd are the Superwinch satellite antenna control systems. Superwinch are known in the States for their good quality vehicle-mounted electric winches, and have applied this experience in building a robust actuator for satellite dishes.

The actuator employs a ⅛ horsepower motor to provide a 2000lb thrust rating through solid steel motor gears. Much attention has been given to weatherproofing.

Two indoor control systems are offered. The manual version provides a 3-digit readout of dish position, with two buttons to control movement. The programmable controller also has the 3-digit display and a manual facility, but also offers 16 preset positions. Both consoles have lock and key security so that the dish may be left pointing at a particular satellite or between satellites.

The outdoor actuator unit is available separately for those who might have requirements other than for a total system.

Skidmore 4WD Ltd,
60 Sandwell Street,
Walsall,
West Midlands WS1 3EB.
Tel: (0922) 613633.

MOUSE CONTROL

Nidd Valley Micro Products, whose Slomo speed controller generated a lot of interest last year, has now introduced new systems of mouse control.

The Anamouse is an analogue input device which uses a precision tracker ball and potentiometer system. It is designed for the professional and serious user to give outstanding positional accuracy for CAD, graphic art and tracing applications.

Anamouse connects directly into the analogue port of the BBC and costs £34.95 including VAT. A Spectrum Anamouse interface will be available soon which will feature a Centronics printer port, plus Nidd Valley's patented slow motion control. The price of the Spectrum interface has not yet been fixed but is expected to be around the £25 mark.

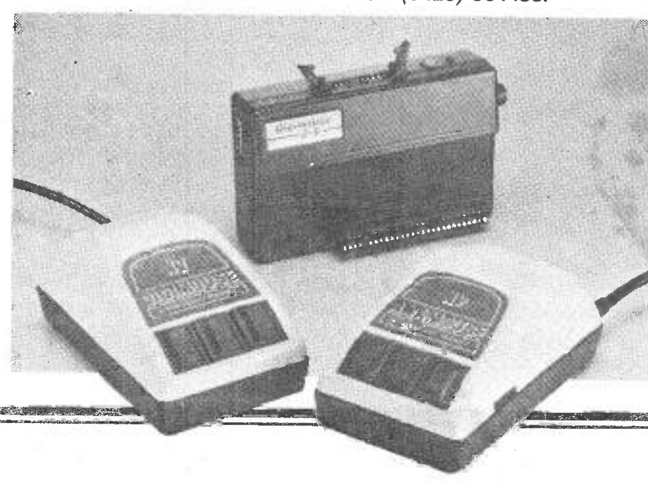
Digimouse uses a precision tracker ball and encoder system to give a highly accurate digital pulse output, and is compatible with many existing graphic art and word processing packages.

The BBC Digimouse connects directly into the user port and is priced at £34.95 including VAT. For Spectrum users, Nidd Valley has designed the Digimouse ZX and Digimouse JS interfaces to provide accurate mouse control to any program or game written for Kempston joystick protocol.

Spectrum Digimouse retails at £34.95 including VAT. The ZX interface is £14.95, and the JS with full Centronics printer port and software utility is £24.95. Both the Spectrum interfaces are fitted with Nidd Valley's patented Slomo device, which gives not only program speed control but also mouse sensitivity control.

Adaptations of Anamouse and Digimouse for other computers are planned, including the CBM64 and Amstrad, which will be released in June this year.

Nidd Valley Micro Products,
Stepping Stones House,
Thistle Hill,
Knaresborough,
North Yorkshire.
Tel: (0423) 864488.



NEWS DESK

Racing ahead

The RACE project (Research in Advanced Communications for Europe) has entered its Definition Phase, the first part of a major programme to establish a pan-European advanced wideband telecommunications network by 1995.

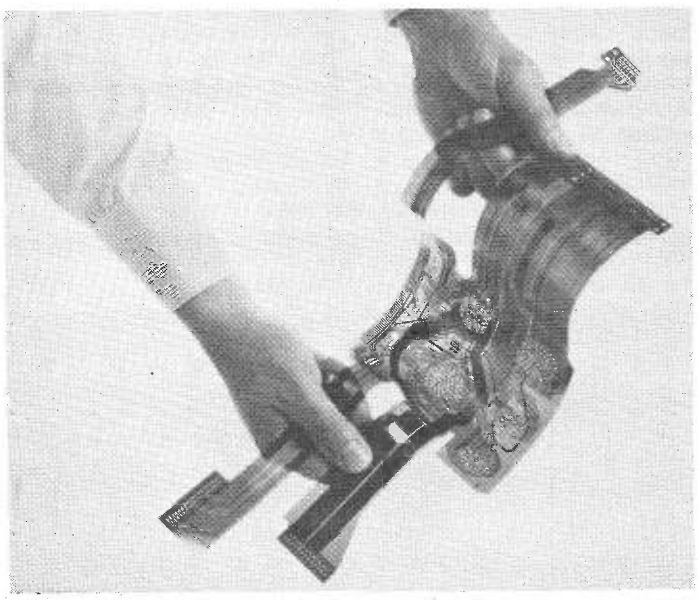
RACE is the second major project to be launched by the Information Technologies and Telecommunications Task Force, which was set up by the Commission of the European Communities in 1983, when ESPRIT was agreed. ESPRIT (European Strategic Programme of Research and Development in Information Technology) is a five year co-operative project in basic research involving industry, universities and research organisations.

The RACE Definition Phase involves the issuing of research contracts to a total of 109 different organisations, including telecommunications administrations, manufacturers, broadcasters and universities, who will work together through the Task Force and organisations such as ECTEL, the manufacturers' body, and CEPT.

Since the call for proposals last September the Task Force has moved at a breakneck pace, and all the contracts had been negotiated by the first week of March. Some had even been signed by the New Year, with work by now well under way.

The Definition Phase will run for 18 months, by which time the requirements of the Europe-wide telecommunications infrastructure will be established. The areas to be covered include the transmission of text, graphics and video as well as voice, and the digital technology involved means that control software will play a major part in the project. The ultimate goals include such services as videoconferencing and high quality flat screen television.

The speed and degree of co-operation achieved result from the appreciation by all concerned that only such a united effort can compete with the economic muscle available to the Americans and Japanese. A standardised European network would offer a home market of comparable size to that available to these foreign competitors, thus giving the cost benefits of community scale production.



A flexi-rigid circuit board produced by Flexible technology, a company recently acquired as part of further expansion by Cambridge Electronic Industries

New videotex standard

Prestel, British Telecom's public videotex service, is backing a new European protocol for data transfer on videotex systems.

The proposed standard has been developed by the European telecommunications technical standards organisation, CEPT, for inclusion in the new European videotex terminal standards.

While enabling information to be displayed on a videotex terminal, the new standard will allow data to be used for other purposes, for example the remote control of computer peripherals such as printers, and downloading of telesoftware with automatic error detection and correction.

The biter bit

It is unfortunately the case that adverts sometimes cause offence or indignation because of their wording, although this is usually unintentional. Hence the following extract from a letter sent in by J S Paton G6RAZ of B&J Telecommunications of Thornbury, near Bristol, referring to Scarab Systems' ad in the February issue:

"The opening paragraph of this reads 'Have you had your appetite whetted on cheap ineffective programs from part-time software writers . . .' I must defend my own part-time interest in B&J Telecommunications and point out that all software marketed by ourselves is written by professional software writers, eg Ham Tel, Grosvenor Software and Pearsons Computing, and that these programs were selected by ourselves as being the best available for each of the computers concerned.

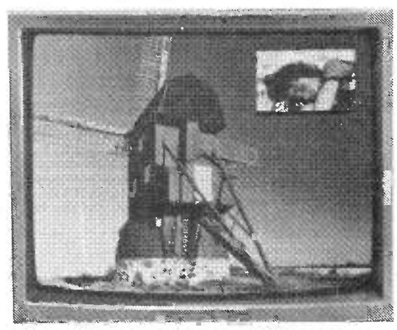
"B&J Telecommunications manufacture hardware to support these programs and were forerunners in the use of the XR2211 IC in the receive side of RTTY terminal units. As far as the Spectrum computer is concerned with audio input, our audio tone processor not only filters both tones but also buffers and amplifies to give up to 5V output from signals as low as 100mV. This has been designed around the G1FTU program but will greatly enhance the performance of any audio input system and must not be confused with cheap single tone filters. The logic of this (pun intended) is that you do not need 599 signals and can run audio input systems from the record output of many receivers."

I must agree with Mr Paton that 'part-time' does not necessarily mean 'unprofessional', and the software companies he mentions are known for the quality of their products. However, to be fair to Scarab Systems it must be pointed out that their criticism was directed at those purveyors of 'cheap and cheerful' software who offer utility programs which have not been thoroughly debugged or are rather inelegantly written.

While the quality of such offerings can vary from excellent to laughable, a prospective buyer has little chance of determining the quality before purchase. It is probably wise to rely on an established reputation (ie a company such as B&J Telecommunications or Scarab Systems), but, as the saying goes, you pays your money and you takes your choice.

Mobile radio

The DTI has announced that licences for nationwide private mobile radio networks in Band III will go to GEC and



The multicontrol TV from ITT (see News Desk in the March issue) has a revolutionary 'picture in picture' facility the consortium led by Pye Telecom. The two other contenders were Motorola and National Radiofone.

The Pye consortium intends to form a company to operate the network which will be jointly owned by Pye, Racal, Securicor, Investors in Industry (3i) and Digital Mobile Communications. It is interesting to note that Racal and Securicor are rivals in the field of cellular radio (Racal operate the Vodafone service and Securicor, in conjunction with BT, operate Cellnet).

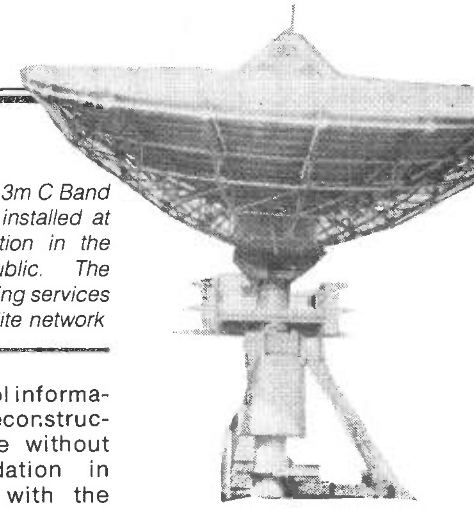
A common technical standard has yet to be agreed, but the provisional start-up is given as January 1987. The networks will use the technique of trunking (essentially, automatic allocation of channels) to give users quicker access than would otherwise be available.

The prime users of the networks will be truckers, coach and taxi firms, etc.

In addition to the two nationwide networks there will also be a number of regional networks, and in this area the relative lightweight National Radiofone will operate services in London, Birmingham, Merseyside and Scotland.

It seems to have attracted a lot of interest, and Maplin are consequently devoting greater resources to this area.

The MPS quarterly price list is sent free of charge to all customers, and is also available at the five Maplin retail stores. Further details are available from Doug Simmons on (0702) 552961.



Marconi Radar's new 13m C Band antenna is seen here installed at the Sana'a earth station in the Yemen Arab Republic. The antenna will be accessing services from the Arabsat satellite network

Digitally assisted television

Digitally assisted television (DATV) is a new concept proposed by BBC research engineers. DATV involves the transmission of analogue picture signals together with high data rate digital signals carrying control or supplementary information about the picture. One application of DATV might be to reduce the bandwidth of a high definition television (HDTV) signal so that it can be accommodated within a single DBS channel, previously planned for 625-line television services.

DATV is a bandwidth compression technique intended for use with high quality television signals. The essential role of the digital component in DATV is to provide the receiver with control information to assist in reconstruction of the picture without significant degradation in quality compared with the original.

One example of the use of the digital component of DATV is to carry information about which parts of the picture are moving and which are stationary; several bandwidth reduction techniques rely upon such information being available in the receiver. Another example is to carry data to help in the reconstruction of a sequentially scanned picture where, to save bandwidth in transmission, the signal has been converted from sequential scanning to interlaced scanning.

Early results from the experiments at the BBC's research department at Kingswood Warren indicate that the DATV concept can offer HDTV picture quality in the home, even when the bandwidth of the signal has been reduced by a factor of between two and four.

DATV can also be used to improve the performance of 625-line television systems which have associated digital capacity, such as the MAC/packet family of transmission standards. However, when used to improve 625-line systems, there would be less freedom to exploit the DATV technique compared with its use to facilitate the transmission of HDTV systems using more than 1000 lines.

Pretentious, moi?

Weather satellite enthusiasts would be well advised to get hold of the latest edition of *The Maplin Magazine*, which features a VHF receiver for use with a standard TV set. Aerial requirements are included, and Maplin will undoubtedly be making a kit of parts available.

The news release from Maplin publicising their magazine caused a little amusement in the office. Describing this issue as 'action-packed', it went on to say that 'Maplin Research Engineers have developed the world's first VHF Weather Satellite Receiver'. Just a shade pompous, *n'est-ce pas?*

More Maplin

More news from Maplin concerns their wholesale operation, Maplin Professional Supplies, set up in 1985 to cater for the professional, trade, industry and educational customer.

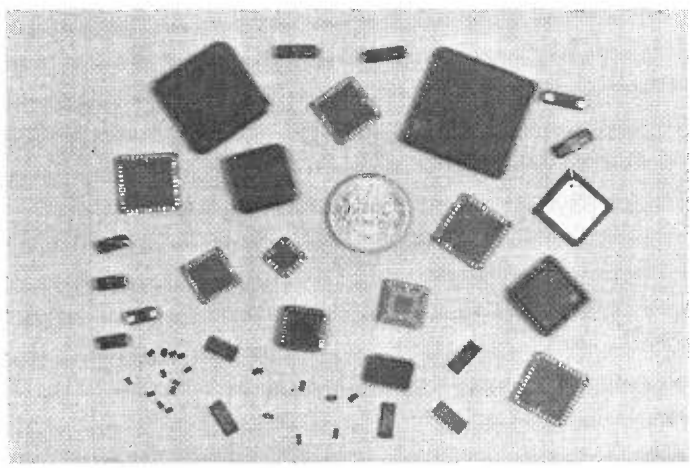
SMT service

Frazer-Nash Electronics, a design and development company based in Leatherhead, are now offering a surface mounting technology (SMT) prototype and preproduction service. Their aim is to provide a facility for proving runs in batches of between 5 and 500 before clients commit themselves to major investment.

Surface mounting technology, in case you're uncertain about it, involves soldering the components in a circuit onto a board without using leads which pass through holes in the board to be soldered on the other side. The devices are mounted on the same side as the copper tracks and soldered directly to them. This obviously means that connections are shorter, and using SMDs (surface mounted devices) results in a considerable reduction in board size for a given circuit. There is also, perhaps more importantly, a reduction in the cost of assembly (no holes to drill, a smaller area to plate, etc).

Boards using SMT are assembled fully automatically, with the devices usually being glued to the board to keep them in place before being wave-soldered.

The devices themselves look rather unusual to anyone used to the more conventional leaded components. Resistors and capacitors, for instance, look like tiny bricks, and transistors have a similar appearance but with the addition of short, stumpy leads. ICs can be packaged in plastic leaded chip carriers (PLCCs), resembling the familiar DIL packages but smaller, or leadless ceramic chip carriers (LCCCs), which have a series of metal contacts around their edges.



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Your monitor from its computer!! For only **£24.95** it becomes a **SUPERB HIGH QUALITY * COLOUR * TV SET**

The fabulous **TELEBOX**, an **INVALUABLE MUST** for the owner of **ANY** video monitor with a composite input, colour or monochrome. Made by a major UK Co. as a **TOP QUALITY**, stand alone **UHF** tuner and costing **OVER** £75 to manufacture, this opportunity to give your monitor a **DUAL FUNCTION** must not be missed!! The **TELEBOX** consists of a compact, stylish two tone charcoal moulded case, containing ALL electronics tuner, power supply etc to simply plug in and convert your previously dedicated computer monitor into a **HIGH QUALITY COLOUR* TV SET**, giving a real benefit to ALL the family!! Don't worry if your monitor doesn't have sound – **THE TELEBOX** even has an integral 4 watt audio amplifier for driving an external speaker, **PLUS** an auxiliary output for superb quality television sound via your headphones or **HI FI** system etc. Other features include: Compact dimensions of only 15.75" w x 7.5" d x 3.5" h, latest technology, **BRITISH** manufacture, fully tuneable 7 channel push button tuner, Auto **AGC** circuit, **SAW** filter, LED status indicator, fully isolated 240v AC power supply for total safety, Mains ON-OFF switch etc. Many other uses.

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ONLY £24.95 OR £19.95 if purchased with **ANY** of our video monitors. Supplied **BRAND NEW** with full instructions and 2 YEAR warranty. Post and packing £3.50 *When used with colour crt

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Made by the famous **REDIFFUSION Co.** for their own professional computer system this monitor has all the features to suit your immediate and future requirements. Two video inputs: **RGB** and **PAL** Composite Video, allow direct connection to **BBC/IBM** and most other makes of micro computers or **VCR's**, including our very own **TELEBOX**. An internal speaker and audio amp may be connected to computer or **VCR** for superior sound quality. Many other features: PIL tube, Matching **BBC** case colour, Major controls on front panel, Separate Contrast and Brightness – even in **RGB** mode. Separate Colour and audio controls for Composite Video input, **BNC** plug for composite input, 15 way 'D' plug for **RGB** input, modular construction etc etc.
This Must Be ONE OF THE YEAR'S BEST BUYS. PC USER
Supplied **BRAND NEW** and **BOXED**, complete with DATA and 90 day guarantee. **ONLY £149.00** as above **OR IBM PC** Version **£165.00**
15 Day 'D' skt **£1.00**, **BNC** skt **75p** BBC interface cable **£5.50**

DECCA 80 16" COLOUR monitor. RGB input.
Little or hardly used manufacturer's surplus enables us to offer this special converted **DECCA RGB** Colour Video TV Monitor at a super low price of **only £99.00**, a price for a colour monitor as yet unheard of!! Our own interface, safety modification and special 16" high definition PIL tube, coupled with the **DECCA 80** series TV chassis give 80 column definition and quality found only on monitors costing **3 TIMES OUR PRICE**. The quality for the price has to be seen to be believed!! Supplied complete and ready to plug direct to a **BBC MICRO computer** or any other system with a **TTL RGB** output. Other features are: internal speaker, modular construction, auto degaussing circuit, attractive **TEAK CASE**, compact dimensions only 52cm W x 34 H x 24 D, 90 day guarantee. Although used, units are supplied in **EXCELLENT condition.**
ONLY £99.00 + Carriage.

DECCA 80, 16" COLOUR monitor. Composite video input. Same as above model but fitted with Composite Video input and audio amp for **COMPUTER, VCR** or **AUDIO VISUAL** use. **ONLY £99.00** + Carr.

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Spare paper roll for AE11 **£4.50**
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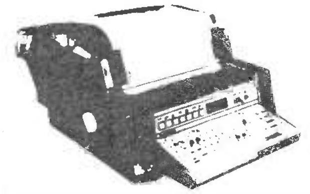
Carriage and Insurance £7.50

GE TERMIPRINTER



A massive purchase of these desk top printer terminals enables us to offer you these quality **30** or **120** cps printers at a **SUPER LOW PRICE** against their original cost of over £1000. Unit comprises of full **QWERTY**, electronic keyboard and printer mech with print face similar to correspondence quality typewriter. Variable forms tractor unit enables full width - up to 13.5" 120 column paper, upper - lower case, standard **RS232** serial interface, internal vertical and horizontal tab settings, standard ribbon, adjustable baud rates, quiet operation plus many other features. Supplied complete with manual. Guaranteed working **GE30 £130.00. GE1200 120 cps £175.00**
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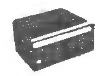
CALL FOR DETAILS

COMPUTER/SYSTEM CABINET & PSU



All in one quality computer cabinet with integral switched mode PSU, mains filtering, and twin fan cooling. Originally made for the famous **DEC PDP8** computer system costing thousands of pounds. Made to run 24 hours per day the psu is fully screened and will deliver a massive **+5v DC at 17** amps, **+15v DC at 1 amp** and **-15v DC at 5 amps**. The complete unit is fully enclosed with removable top lid, filtering, trip switch, **power** and **run** leds mounted on ali front panel, rear cable entries, etc. etc. Units are in good but used condition - supplied for 240v operation complete with full circuit and tech. man. Give your system that professional finish for only **£49.95** + carr. 19" wide 16" deep 10.5" high. Useable area 16" w 10.5"h 11.5"d.

Also available less psu, with fans etc. Internal dim. 19"w, 16"d, 10.5"h. **£19.95. Carriage £8.75**

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ONLY £195.00 + pp £2.50.
"GANG OF EIGHT" intelligent Z80 controlled 8 gang programmer for **ALL** single 5v rail **EPROMS** up to 27128. Will copy 8 27128 in **ONLY 3 MINUTES**. Internal **LCD** display and checking routines for **IDIOT PROOF** operation. Only **£395.00** + pp £3.00.
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Data sheets on request

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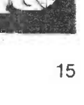
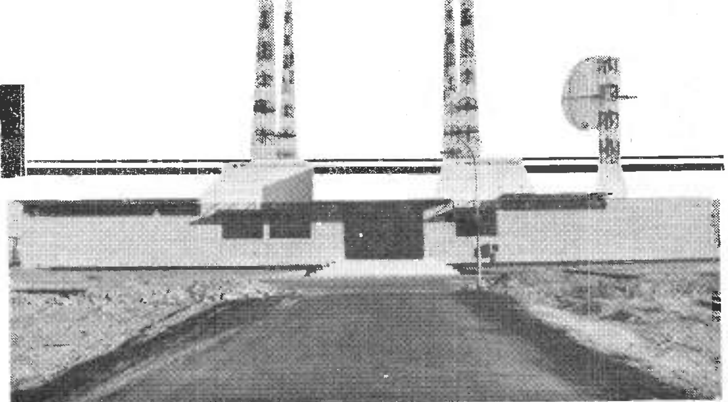
Don't forget, ALL TYPES and QUANTITIES of electronic surplus purchased for CASH



SPECTRUM WATCH



Brown Boveri's 2×1,000kW Abu Dhabi MW transmitter station

NIGEL CAWTHORNE G3TXF

By the end of 1985, the four country Scandinavian NMT-450 cellular network had a total of 218,000 subscribers. The country breakdown was Sweden 76,000, Norway 63,000, Denmark 46,000 and Finland 33,000. With a total population of only 22 million, the average number of cellular subscribers per 1,000 Scandinavians is now 9.7 (or just under 1%).

The highest cellular penetration is in Norway, where in December '85 there were 15.4 cellular subscribers for every 1,000 Norwegians (1.5% of the population).

The NMT-450 network first came into service in Norway and Sweden in late 1981. The annual sales growth for all four countries combined was: 1981 – 3,000; 1982 – 29,000; 1983 – 43,000; 1984 – 59,000; 1985 – 84,000.

Today's Scandinavian NMT network uses 6,900 channels, 903 cells and 9 mobile switches. Subscribers can roam freely within any of the four Scandinavian countries. A 900MHz expansion is being planned. This will relieve congestion in the major city areas. The first NMT-900 cells are scheduled to be operational by late 1986 in Helsinki, Stockholm and Oslo.

Cellular services will be extended to Greenland and the Faroe Islands during 1986/87.

No to 900MHz

The UK's two cellular network operators, Cellnet and Vodafone, have both been experiencing overload problems in the densely packed central London area. The UK's 900MHz TACS cellular network has been operational for just over a year and the subscriber total is now just on 55,000, many of these being in the London area.

The success of cellular radio has resulted in an overcrowding of the spectrum in London. At busy times of day it can be difficult to obtain a line and users can be cut off during calls.

More channels

The DTI were asked for an additional 400 channels in the 900MHz band. Each network operator currently has 300 25kHz duplex channels, which together occupy 890-905MHz and 935-950MHz. The remaining unallocated 400 channels (905-915MHz and 950-960MHz) have been reserved for the Pan-European digital network. The UK government is reluctant to allocate extra 900MHz frequencies because this would weaken efforts to involve the UK in the Pan-European digital cellular system.

Cellular subscriber growth (in percentage of population terms) has been faster in the UK than anywhere else. After just over one year's operation, the subscriber bases of the two operators are for 31,000 Cellnet and for 24,000 Vodafone.

Vodafone, which claims to cover over 50% of the UK population, has 4 mobile exchanges (London, Birmingham, Manchester and Glasgow) in operation, 125 sites, 250 cells and 1,500 voice channels.

New service

The DTI has reportedly issued a draft specification for trunked Personal Radio Services (PRS) to operate in a 1MHz slot alongside the current 934MHz CB allocation.

The UK's 934MHz CB segment is tucked in just below the 935-960MHz cellular base-station band. The 40 channels of the proposed trunked PRS would lie between 933 and 934MHz. Trunking means that communication is automatically set up on a clear channel. Frequency selection is dynamic (by the use of a calling frequency and a signalling procedure) and is not under the control of the user.

Switzerland already has operational PRS using the whole of the 933-935MHz band. PRS is seen by many as a reliable short range business communications medium for small local businesses that do not require and cannot afford the services offered by other mobile services. Being both trunked and at 900MHz, PRS is noise-free when compared to the clatter of 27MHz!

French revolution

Up until last year, TV broadcasting in France was relatively simple and easy to understand. There were three state-owned channels (TF1, Antenne 2 and FR3) which, after the closure of France's old 819-line VHF channels, reached their audiences via an entirely UHF transmission network, consisting of over 400 transmitters and 6,000 repeaters.

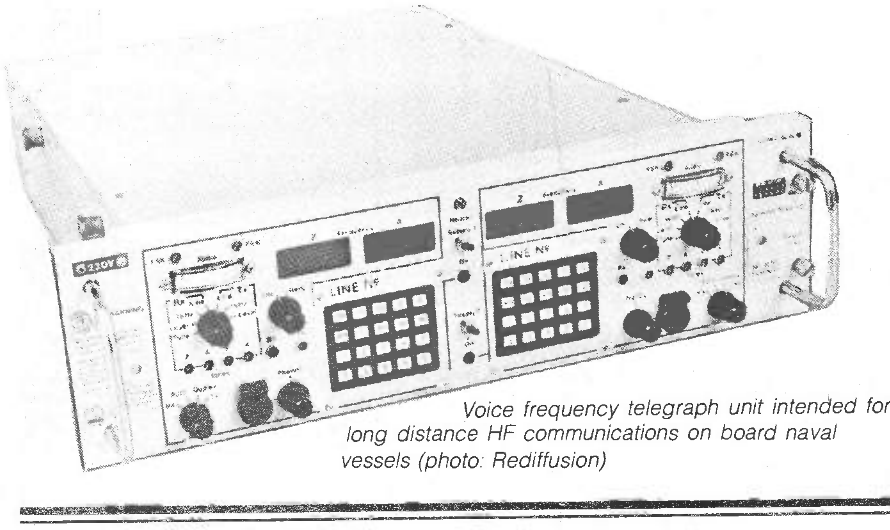
France's fourth channel, Canal Plus, is an over-the-air pay TV service. The French government has a major stake in Canal Plus through the state-owned publicity giant, Havas.

Canal Plus started transmissions in late 1984 on a mixed VHF and UHF network. Unlike the UK, where four channels could be squeezed into the UHF band, in France this did not prove possible, so Canal Plus has had to make do with a hybrid VHF/UHF network.

Canal Plus VHF transmissions use Band III frequencies liberated by the close down of the old 819-line black and white network. During its early months of operation, Canal Plus suffered a slower than projected subscriber take-up rate, but recently announced the signing up of its 800,000th subscriber. Canal Plus transmissions are encrypted.

Channels 5 and 6

However, apart from the four TV channels already in operation in France, there are now two other new national TV channels which planned to come on air in late February. There is also a project for a new cultural channel. All this is in addition to the forty new local TV stations



Voice frequency telegraph unit intended for long distance HF communications on board naval vessels (photo: Rediffusion) planned as part of the liberalisation of broadcasting in France.

It was just over a year ago that President Mitterand gave the green light for France's two national private TV channels. The announcement last November that the fifth channel, the first fully private channel after TF1, A2, FR3 and Canal Plus, was to be given to a group of investors which included the Italian private TV entrepreneur, Silvio Berlusconi, provoked a major political storm in France, with the opposition threatening to disband the new commercial channel if, as is widely expected, it gains a majority in the National Assembly in the March general elections.

The go-ahead for the second private channel (France's sixth TV channel) was given in late January. The sixth TV channel will concentrate on music programmes and, like the fifth channel, was due to come on air before the end of February.

Eiffel Tower dispute

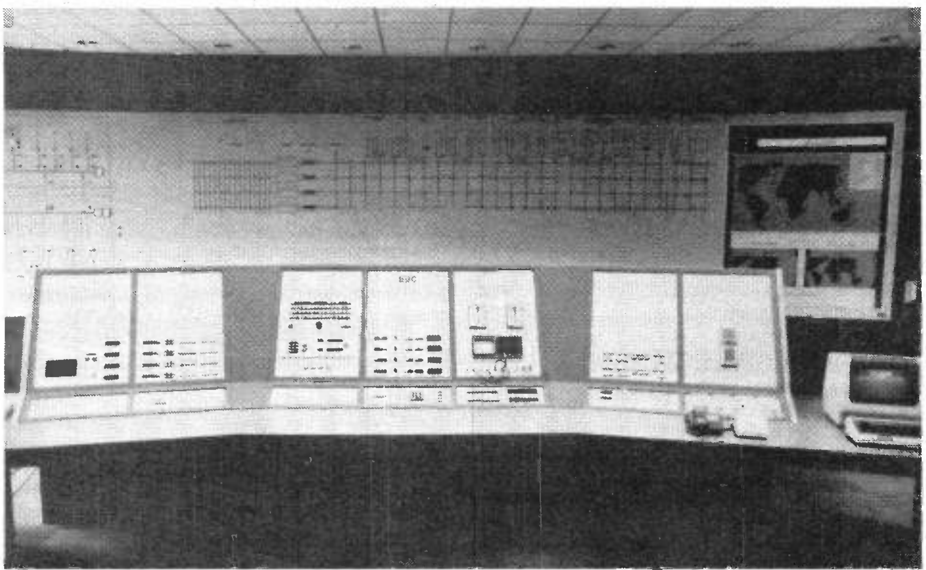
The political controversy surrounding the new TV channels is spilling over into broadcast engineering. The two new channels wanted to install transmitters on the Eiffel Tower to cover the Paris area. The four existing TV programmes each use Paris' famous landmark as their main transmitter site for the city (TF1 Ch25, Antenne 2 Ch22, FR3 Ch28, each with 700kW ERP at UHF and Canal Plus on VHF Ch06), but the bill that would allow the new channels to use the Eiffel Tower site was ruled as 'unconstitutional' by France's Constitutional Council.

Bitter arguments were still raging only weeks before the new channels were due to open. The operators of the new TV channels were complaining that if they were forced to use a site other than the Eiffel Tower, then their potential audience in the Paris area would be drastically reduced. TV antennas in the central Paris area all point towards the Eiffel Tower.

Channel Sept

Final decisions on how France's seventh (state-run) TV channel will be organised have still to be announced. A start up budget allocation of 300m francs has already been made. The seventh TV channel, which will be cultural, will use one of the four transponders on TDF-1, France's DBS satellite now scheduled for launch in November. The new seventh channel will also be transmitted over the FR3 terrestrial network while awaiting the launch of TDF-1.

France's DBS bird, TDF-1, has suffered further delays. Arianespace has again had to put back the launch date. The failure of Ariane flight V15 last September (which included the loss of what was to be Europe's third Eutelsat communications satellite) has delayed the launch by three to four months.



Control room of the 4×500kW Brown Boveri built SW transmitter station in Abu Dhabi

Within the last 18 months there have been many major and controversial changes to the whole framework of TV broadcasting in France. How broadcasting further develops, or even if it continues to develop in the same direction, will only become clearer after the elections in March.

Another chance

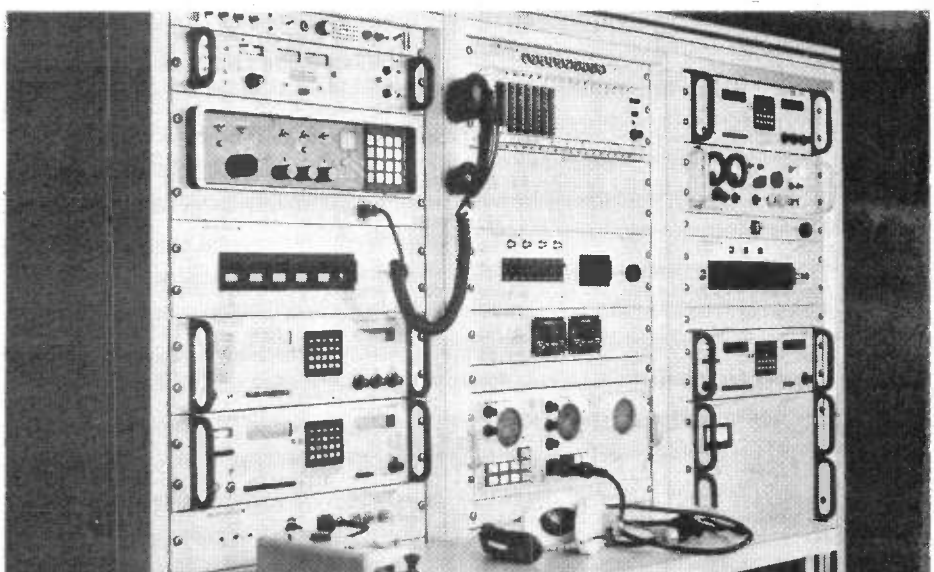
The Home Office, which is responsible for the broadcasting policy in the UK, plans to ask the IBA to advertise for operators for three new high-power DBS TV channels for the UK.

The IBA, which would be the regulatory body for the DBS project, is expected to advertise the franchises in the national press soon.

The UK's previous attempt to launch a DBS project collapsed last June, when the consortium (Club of 21) formed by the BBC, the Independent TV companies and five non-broadcasting bodies decided that the risks were too great. One reason then given for the collapse was the UK government's insistence on the use of a British satellite.

UK Home Secretary Douglas Hurd said in Parliament at the end of February that contractors planning to offer DBS services would not be precluded from buying a foreign satellite, if necessary.

Then we'll have a foreign satellite sending us foreign programmes interspersed, no doubt, with adverts for foreign goods. But at least it will still be called UK-DBS! REW



Modern integrated naval communications consoles such as this Rediffusion equipment still have a Morse key on the desk! *(Photo: Rediffusion)*

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2SD794 sim BD131 .... 4/£1 100/£20
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TIP35B £1.30 TIP35C £1.50
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Futaba 8 digit calculator, fluorescent display 9CT-01-3L £1.50
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FX2243 POT CORE & BOBBIN .... 5/£1
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12FR400 12A 400v small stud .... 4/£1.50
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BY254 800v 3A .... 8/£1.00
BY255 1300v 3A .... 6/£1.00
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MCR72-6 400v £1
35A 600v stud £2.00
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TRIACS diacs 25p

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Centronics 36way IDC plug .... £4 10+£3.50
Centronics 36way IDC skt £4.50
Centronics 36way plug (solder type) £4
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R47 1R0 2R0 2R7 3R9 5R0 10R 12R 15R 18R 20R 27R 33R 36R 47R 120R 180R 200R 330R 390R 470R 560R 680R 820R 910R
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AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

In our January contribution to this feature we drew attention to the efforts being made by David Dodds GM4WLL to get more activity going on the 4 metre band. It was proposed that Wednesday evening be made a special 70MHz activity night. This has now been changed to Tuesday evening to fit in with 70MHz activity organised by G4SEU.

Throughout 1986, the callsign GB4MTR will be used for operations from thirteen different stations, each in a different county. The callsign will be used on most amateur bands, depending on the equipment available at the operating station. It is hoped that these operations will include 70MHz operation and that 4 metre operators will make either two-way contacts, crossband contacts or send in SWL reports. An award will be available, details of which can be obtained by contacting G4SEU, 49 Lincoln Avenue, Nuneaton, Warks CV12 0HR (sae please).

So far the callsign has been operated from G4VOZ in Leicestershire in January, G4ENA in Gloucestershire during February, GW4HBK in Gwent during March and G4ENB in Bedfordshire during April. Further volunteers are required for the project and anyone interested should contact G4SEU.

Oscar 10

Having reached its most southerly orbital position at the beginning of March, the slow precession of Oscar 10's orbital plane is now bringing its apogee back to the north, when it will reach its most northerly latitude early in 1988. Its south to north passage takes about 22 months. It crosses the equator in January 1987.

The aurora

About a year ago we reported a dramatic 'fade-out' of radio signals which affected pretty well all of the HF amateur bands. At the time we commented that such sudden fade-outs are quite frequently associated with solar cycle minimum times – a state which we are experiencing at present.

Another such fade-out occurred over the first weekend in February. On the Sunday there was an almost total blackout of the HF amateur bands. The ionospheric disturbance was accompanied by outstanding auroral displays and excellent auroral propagation conditions. The latter gave the VHF DX enthusiasts a real field-day!

Contacts were made from this country with most other European countries on the two metre band and the new 50MHz (six metre) band provided some good DX conditions, producing much excitement among those who have just got going on this band.

Auroral propagation is an interesting form of VHF propagation, occurring when the ionosphere above the polar regions of the Earth becomes highly ionised through unusual solar activity. Streams of electrified particles are injected into space from the sun and travel towards the Earth, where they encounter the Earth's magnetic field. This directs the stream of particles towards the north and south poles.

In equatorial regions the Earth's magnetic fields run parallel to the surface of the planet, whereas at the magnetic poles they come down toward the poles and are thus vertical to the surface. Hence they have more influence on the ionospheric layers, and if severe enough produce such effects as the aurora.

There are two types of solar phenomena which produce these streams of particles. There are the so-called 'flares', which are related to sunspots, and 'coronal holes', which are areas of diminished solar magnetic field from which electrically charged particles escape in the form of jet streams. Both sunspots and coronal holes rotate with the sun, so their effects have a cyclic periodicity, provided of course they do not cease to exist before they are due to appear again, having gone all the way around the sun.

After major ionospheric storms it often takes about three weeks or so for conditions to improve, which is about the time it takes for the 27 day cycle of the sun's rotation. If the sunspots or coronal holes are still in existence then, poor propagation conditions will re-occur.

Beacons

Amateur radio beacons have been in existence for quite a long time now. The original idea was to provide a means, in the days of home-built receiving equipment for VHF use, for checking such gear out. Later on, with the advent of commercially produced VHF/UHF receiving equipment this requirement ceased, so they became a means for checking propagation conditions and for carrying out propagation research studies, particularly in the fields of sporadic-E, tropospheric and auroral propagation.

They were very useful too when provided for bands such as 10 metres, which became little used due to the vagaries of their characteristics, as indicators of whether the band was open or not.

The first beacon to be established was GB3IGY, which as its callsign suggests was operated for radio propagation studies during the International Geophysical Year, 1957/8. This was established for 144MHz band studies and was located in Kent.

As the value of these beacons became apparent more were established, both in this country and elsewhere. Those in this country are controlled by the RSGB and new ones will only be licensed if a genuine need and proof of their value to a sound scientific project can be put forward. An example of such a need was for investigations into the 50MHz band characteristics before it was released for amateur use.

Phase 3C

The next amateur radio satellite in the Phase 3 series is nearing completion, as teams in West Germany and the United States progress with the project. The anticipated launch is in August this year from an Ariane 4 launcher. However, slips in the Ariane 6 launch last January may push the actual launch of Phase 3C into September.

At the Phase 3C integration facility in Golden, Colorado, AMSAT technicians have carried out the all important thermal/vacuum tests. These tests are crucial in determining if the spacecraft is flight ready, the combination of heat and vacuum duplicating the environment in space in which the satellite will operate. Components in the spacecraft will thus be under as much pressure as they will be in space, and any suspect component can thus be replaced.

The two back-up battery packs have been mounted and the primary battery pack has been fitted with its cells. The individual cells in the main battery pack have yet to be wired together.

The helium bottle mounting bracket gave some problems. A couple of dimensional errors in the components of this bracket made it necessary to re-machine parts and move mounting holes, which had, to be done without disturbing other spacecraft systems.

The ionospheric 'F' layer

Long distance radio communication using frequencies below about 28 to 30MHz occurs as a result of bending of the radio waves in the ionosphere, a layer between about 50 to 200 miles above the Earth's surface, where free ions and electrons exist in numbers sufficient to affect the direction in which radio waves entering it will travel. This layer of ionisation is produced by the ultra-violet radiation from the sun.

In fact there are several layers, designated the 'E' layer, the 'D' layer and so on, but the one of most significance to radio amateurs is the 'F' layer. It is about 175 miles high at night, at which height the air is so thin that the recombination of the ions only takes place slowly. During daytime the layer splits into two, designated the 'F1' and the 'F2' layers at heights of 140 and 200 miles respectively. The maximum distance for single-hop propagation via the 'F' layer is around 2500 miles.

It is interesting to recall how these ionised layers became designated by letters of the alphabet in the way they are. Soon after Marconi had managed to send radio signals across the Atlantic in 1901, attempts were made to explain how it was that these electromagnetic waves, which were known to travel in straight lines like light waves, could have been bent round the surface of the Earth in their travels from one side of the Atlantic to the other.

A physicist named Heaviside in England and another in America named Kennelly almost simultaneously suggested that there must be some sort of reflector in the upper atmosphere which reflected the waves downward. Heaviside's name is usually given to this hypothetical reflector rather than Kennelly's for the reason that Heaviside wrote an article for the scientific journal *The Electrician*, but it was rejected! Later on, in 1912, a radio physicist called Eccles wrote a paper on the effects of the ionised upper atmospheric layer on radio signals, and knowing of Heaviside's rejected article went out of his way to call the layer the Heaviside Layer, the name which is still used today.

Still later, as knowledge of the structure of this reflecting layer developed, it was realised that there was not only one reflecting layer, but several. One of the investigators whose name became associated with the work was Appleton. He discovered that there was in fact another layer above the Heaviside Layer, and this layer became known as the Appleton Layer to start with.

A more objective way

However, supposing there were other layers? Would it be sensible to go on calling them by the name of the person who discovered them? It was decided to adopt a more objective way of naming them. The part of the atmosphere responsible for reflecting radio waves would be called the ionosphere, and the layers within it would be designated by letters of the alphabet, starting from the bottom. To leave room for possible undiscovered layers above and below the known ones, Appleton called the Heaviside Layer the 'E' layer and the one he had discovered the 'F' layer.

So far, apart from a vague region below the 'E' layer called the 'D' region, and dividing Appleton's layer into two layers, *viz* the 'F1' and the 'F2' layers, no further layers have been so designated. REW

HART

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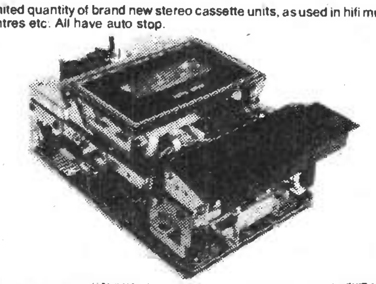

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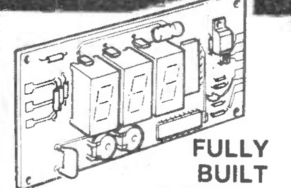

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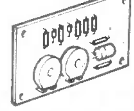

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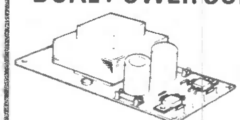

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VPS VIDEO TIMERS

James Fletcher looks at the new video recorder timing system now being used in Germany

Surveys show that the vast majority of video recorders are used mainly to 'time-shift' programmes that are recorded off-air, for playback at a more convenient time. The one thing that the new owner of a video recorder soon learns, however, is that it won't provide more hours in the day for TV watching, and I wonder how many of these timed recordings are in fact subsequently watched.

Also, how many people can actually understand the instructions that come with their recorders? Modern recorders offer very sophisticated timed-recording facilities, often allowing the viewer to record many different programmes at different times over a period of up to a fortnight, or to have individual episodes of a favourite soap opera recorded every night for a week.

Understand how it works

Unfortunately, most viewers never take the trouble to learn how to make full use of the timer facilities and restrict themselves to being able to record just one programme, finding this sufficient for their everyday purposes. Installation engineers say that the only people who make use of the full range of the timer facilities are teenage children, and many a return call to a customer with a new VCR can be avoided if the installer makes sure that the children of the family understand how it all works!

Another problem with timed recordings is that the broadcasters don't always keep to their published schedules, which can lead to great disappointment when the film doesn't start until later than the published time, and you find that you have recorded all but the last ten minutes of it and will never know who dunnit!

These problems are not restricted to our own backward shores, and to help overcome them the Germans have designed a much simpler system of controlling timed recording sessions. The VPS (Video Programme System) switching system has been developed by the West German broadcasting organisations, in conjunction with their version of BREMA, the ZVEI, and has been operational since the autumn of last year.

With VPS each programme carries a teletext-like coded label on line 16 of each picture, and when the information on the transmitted label matches the information that has previously been put into the recorder, and not before, the programme will be recorded. At the end of the programme the recorder will switch off until it recognises another label for a programme which it has been asked to record. Therefore, the actual time at which the programme is transmitted is unimportant, since the VCR will not start until it recognises the label at the beginning of the required transmission.

If the broadcasters would co-operate by putting 'off' and 'on' labels at the start and finish of advertisements, the VPS system could even allow films to be recorded without recording the so-called 'natural breaks', but I guess that sound commercial reasons will be found for preventing this!

For some years now the West German broadcasters have been carrying bi-phase coded data at a rate of 2.5Mbit/s on line 16 of each TV picture, one of the so-called Insertion Data lines. This data is used to provide source identification, remote control of the network, identification of stereophonic sound channels, and for the transmission of test measurement results. The VPS labels for each programme item are carried in four bytes of the data transmitted on line 16, which have up until recently been spare, these being bytes 11-14. The comparator in the home video recorder continuously checks to see if the label information decoded from bytes 11-14 of line 16 matches the information that has previously been programmed into it by the viewer.

Automatic selection

The system allows for the automatic selection of label-controlled or timer-controlled operation of the VCR, so as to cope with programmes that haven't been labelled. The use of the timer can allow the recorder to wait for a label only during a particular time slot, perhaps half an hour before and an hour after the expected transmission time, thus minimising power consumption.

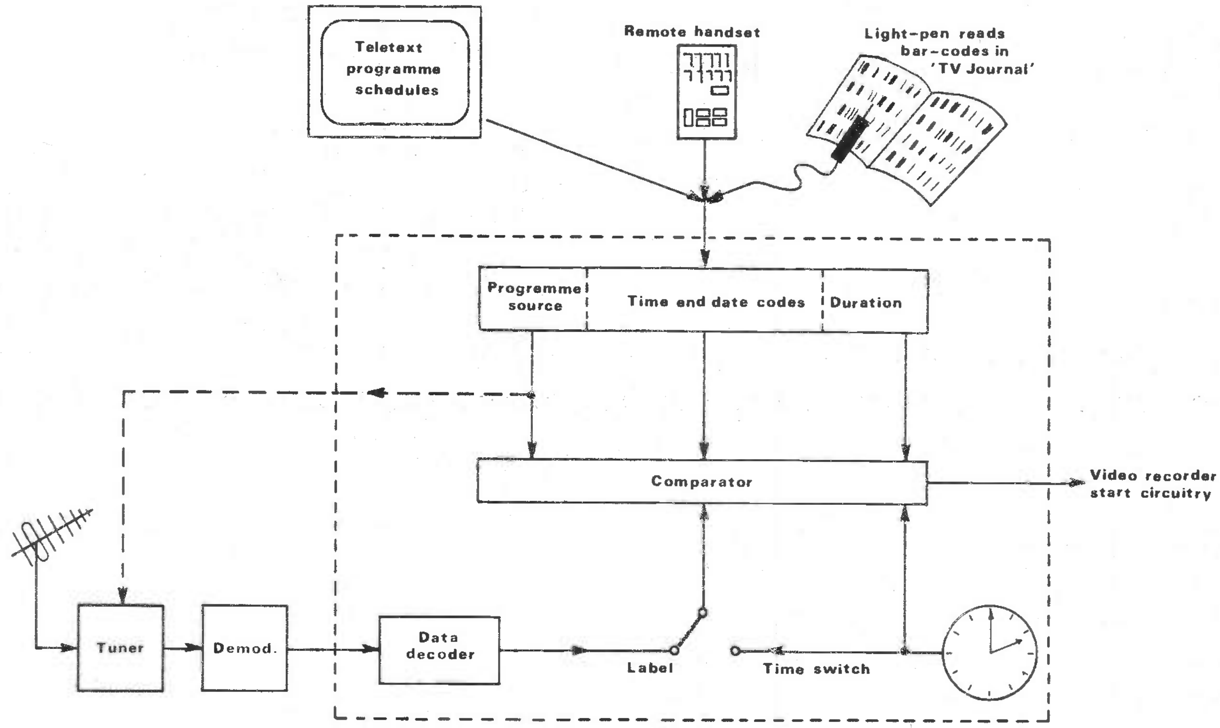
The actual inputting of instructions telling the recorder which programmes to record and when can be done in several ways. Since the labels contain the month, date, hour and minute of the programme's starting time, plus the code for the programme source, it is easy to use the remote control handset to insert the required information when prompted by a message on the television screen.

Even easier is to wipe a simple 'light-pen' over the bar-codes that are printed in the programme journals. Merely passing this pen over the codes for all the programmes you would like to record sets up the required labels without any further action on the viewer's part, and this is bound to make life much easier for the non-technical.

Many engineers will wonder why the Germans are not making use of the standard teletext transmissions for tape recorder switching purposes, since the IBA demonstrated that such a scheme was practicable back in the late 1970s. At that time the intention was to use

	Byte 11								Byte 12								Byte 13								Byte 14								
Data bit number →	1							8	1							8	1							8	1							8	
VPS bit number →	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Normal label →	Address Region		Day					Month				Hour					Minute						Country				Programme source						
			Special system codes																														
System status code →	A	A	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	N	.	.	N	P	.	.	.	.	P	
'No label' code →	A	A	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	N	.	.	N	P	.	.	.	.	P	Switches to 'timer' when this code received
Interrupt code →	A	A	0	0	0	0	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	N	.	.	N	P	.	.	.	.	P	Recorder pauses when this code received
	A – Address code																						N – Country code P – Programme code										

Format of VPS data in 4 bytes of line 16



Block diagram of the VPS system

automatic teletext-controlled switching to allow UK schools' broadcasts to be transmitted during the night. The UK teletext standard, on which the German teletext system is based, actually contains a pseudo row address in magazine 8 specifically for this purpose. When challenged with this, the German engineers say that the lower data rate of VPS, 2.5Mbit/s compared with 6.9375Mbit/s for teletext, leads to a better error rate, with simpler error detection and clock regeneration, resulting in a more reliable system.

Reliable transmissions

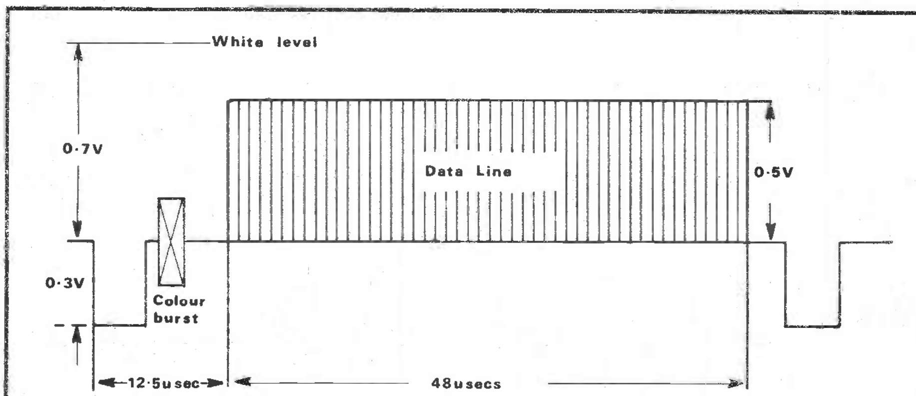
This all sounds theoretically fine until you remember that the teletext system was not adopted until large numbers of tests had shown that the 6.9Mbit/s transmissions was reliable over a whole range of different terrains, including that of Bavaria. It also seems strange to introduce yet another decoder circuit into the receiver, now that teletext is available on millions of receivers.

A more plausible reason for not adopting a teletext-based system, if you disregard commercial reasons of the 'not invented here' variety, is that the federalist structure of West Germany's broadcasting system has led to a system where each region has its own programming, but not necessarily its own teletext service. The Germans claim that if teletext signals from a centrally generated service had to be multiplexed with locally generated video-recorder switching signals, this would prove extremely expensive. All regions already make use of the existing data transmissions on line 16, and it would therefore be fairly simple to introduce the extra video recorder switching bytes in each region. UK broadcasters currently make use of line 16 for standard teletext transmissions.

Grundig are actually making recorders with VPS at the moment, several German networks are transmitting the labels, and Austria and Switzerland have announced that they too intend to introduce VPS shortly.

It looks as though this West German initiative is set for considerable success, thanks to manufacturers and broadcasters having worked hand in hand. Having seen what happened when the Germans introduced stereo sound with TV and how the UK has had to rush to catch up, a speedy agreement between UK manufacturers and broadcasters would seem to be required if the VPS system is not to become a *fait accompli* throughout Europe.

The forecast for the introduction of an alternative, teletext-based switching system doesn't look too good when you remember that the earlier IBA ideas were never taken up. The bar-code system of programming was demonstrated by the BBC for use in conjunction with radio recorders several years ago, but it was claimed that the printers couldn't print accurate bar codes on the paper used for the *Radio Times!* REW



Data timing and voltage levels on line 16

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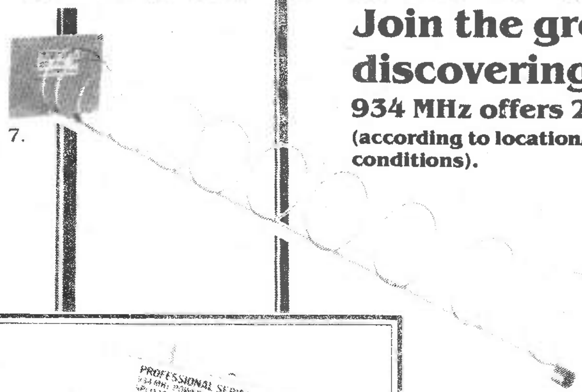

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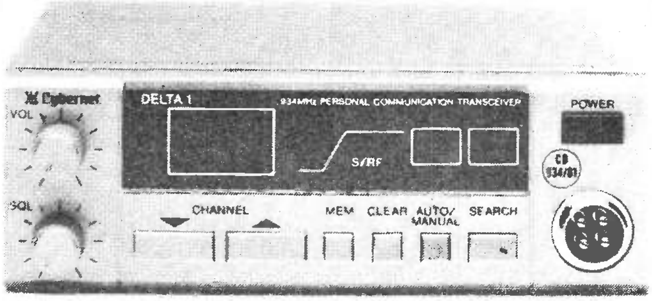

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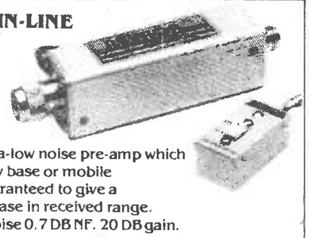

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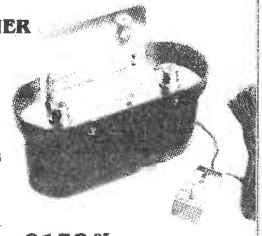

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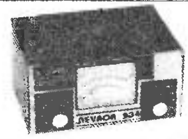

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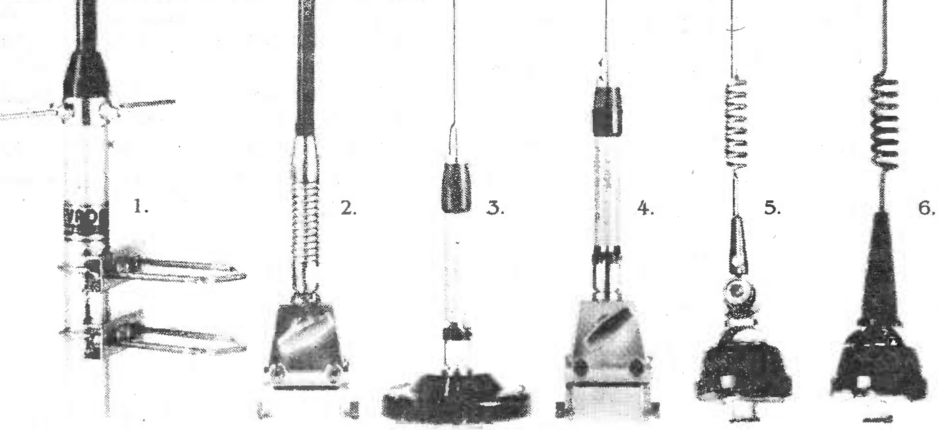

1. 2. 3. 4. 5. 6.

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COMPUTING TRANSFORMERS

An analysis program from BRIAN KENDAL and JEFF HOWELL

Every home constructor has learned from bitter experience that the cost of the power unit used for any project frequently exceeds the cost of the project itself, and very often the most expensive component in the power unit is the mains transformer.

For some projects – such as valve linear amplifiers – suitable new transformers are extremely difficult to obtain at reasonable cost, and in consequence recourse has to be made to those available from club junk sales, stalls at rallies, etc.

Unfortunately, the connections of these transformers are frequently unmarked and even when they are, except on ex-government transformers, the power ratings are rarely given. Of course, it is possible to make a 'guesstimation' of the rating from the physical appearance of the transformer, but its inability to cope with the intended load may not be found out until too late, and replacement requires a complete rebuild of the power unit.

This program has been written to overcome this problem; by taking a few simple physical and electrical measurements and then applying these in the program, it is possible to calculate the capability of the transformer.

Within the program a number of assumptions have been made, but as these are based on standard design practice we feel they are acceptable.

Unfortunately, the program is only appropriate to conventional transformers and will not cope with high-power (over 5kVA), ferrite cored or toroidal transformers, or with variacs or auto-transformers. Despite the length of this list, most surplus transformers will fall within the scope of the program.

As with all our previous programs, this is written in standard Microsoft Basic and has been tested on both Sanyo and BBC B (32K) machines. It should also run with little or no modification on many other machines such as the Dragon or TRS80, although we have not tested the program on these.

Using the program

The power capability of any conventional transformer depends on several factors, the first of which is the cross-sectional area of the core. The first requirement is therefore to measure the width and height of the centre core lamination stack (d1, d2).

This complete, the dc resistance of each winding should be carefully measured, and it should then be possible to determine which is the primary winding. If this is not possible, choose one of the higher resistance windings as primary, because if the wrong selection has been made it does not matter at this stage as the error will become evident later.

It is likely that the resistance of the low voltage secondary windings will be too low to be accurately determined by most multimeters. If this is the case, resort to passing a current from a low voltage source through the winding, measuring the current through, and the voltage drop across the winding and calculate the resistance by Ohm's law. The more accurate the resistance measurements can be made, the more accurate will be the final result.

Many transformers have tapped secondary windings. Treat each tap as the beginning of another winding, unless you are confident that the tapped winding uses the same wire gauge throughout.

It is now time to apply some voltage to the primary winding of the transformer. The value of this voltage is not important provided that it is sufficient for the transformer to give adequate output from its low voltage secondary windings for reasonably accurate measurement. For this, bearing safety in mind, probably 24-48 volts ac (*not* dc) would be suitable, although mains voltage could be applied if the primary winding is marked as such. If mains voltage is used, a low value fuse (not exceeding 3 amps) should be placed in series with the supply.

Wire a resistor of suitable value (typically 10 to 15 ohms) in series with the selected primary winding and apply the test voltage. Measure the voltage across the resistor and across the primary winding. It should be noted that the sum of the voltage across the resistor and that across the winding will not equal the supply voltage, for the inductance of the winding will cause a phase difference. Finally, measure the output voltage for each secondary winding in turn.

It then only remains to run the program, inserting the measured figures as requested. The program will then print out a set of operating conditions, together with power losses, for which the transformer may have been originally designed. These figures are a valuable guide to the capabilities of the device, but nevertheless will rarely coincide with the intended application. For example, the calculated output may be 20 volts at 5 amps, but 8 amps is required and a slightly lower output voltage acceptable. Equally, the estimated input voltage may vary considerably from that supplied.

At the end of the printed table, therefore, the user is invited to insert the desired primary input voltage and the anticipated load on each secondary winding.

The table is then reprinted with due allowance for the differing operating conditions. Should the anticipated primary voltage be excessive and lead to core saturation, this will be indicated to allow the requirements to be modified – or alternatively another transformer to be located in the station operational stores department (ie junk box).

Assumptions

In order to derive the characteristics from the physical and electrical measurements described, certain assumptions must be made. These, however, are based on standard design practice and in consequence may be assumed to be in agreement with the figures used in the original design of the transformer.

The first of these is that the transformer is designed for 50Hz operation. Almost certainly all mains transformers of European origin meet this criterion, while most American transformers with a

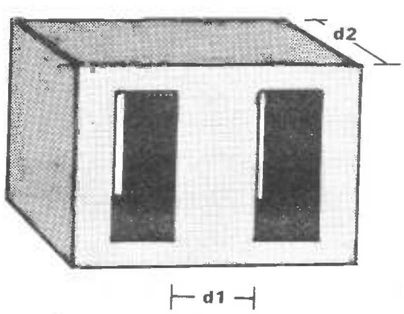

Fig 1 Dimensions required for the calculations

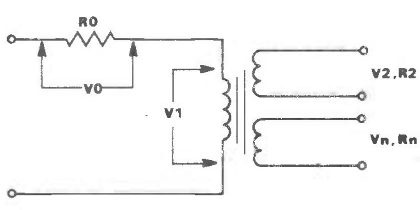

Fig 2 Measurements to be entered

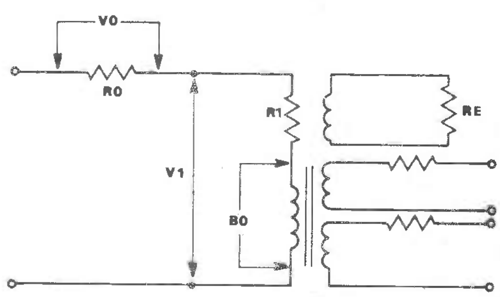

Fig 3 Allowance for internal resistance of the winding and eddy losses

240 volt primary are also suitable for this frequency. Care has to be taken with American transformers with 110 volt primaries, for these are usually designed for domestic use on their 60Hz mains.

Take care

Care should also be taken if the transformer originated in wartime air-borne or shipborne equipment, for many of these were designed for 400 or 500Hz operation and are not suitable for use on 50Hz mains. Being ex-government, these are normally marked with both the output voltages and the frequency of operation. More modern high frequency transformers normally use a ferrite core and thus can be readily identified.

Signal transformers, such as valve audio output types, will give unexpected results, but these may still be applicable provided that the insulation is adequate for the voltages concerned.

The second assumption is that the design flux for the transformer is 0.55 Tesla (50,000 lines/square inch) while the flux level at core saturation is 0.825 Tesla (75,000 lines/square inch). It has also been assumed that the iron loss at design flux will be 0.75 watts/kg (0.34 watts/lb) and that the copper loss in the secondary windings at design flux will be 4%.

The third assumption is that the load on the transformer will be resistive. If a capacitively smoothed rectified output is required, then the surge current must be used to find the actual output voltages.

A 'rule of thumb' has been used in the calculation of the total load on the transformer. This is that the square root of the input power (volts × amps) divided by 5.6 equals the area of the core in square inches.

The program

As may be expected, the early part of the program is devoted to the insertion of the static (lines 50 to 70) and ac (lines 80 to 260) measurements. Thereafter the program may be divided into 4 parts.

The first of these is devoted to estimating the internal construction, ie the turns ratio of the transformer. For this, it is first necessary to calculate the magnetising voltage. This may be thought to be the measured voltage across the primary winding. However, correction must be made to allow for the internal resistance of the winding (R1 in *Figure 3*), and as inductance effects cause the current and voltage to be out of phase, recourse must be made to vector arithmetic. This figure (Bo) is calculated in lines 270-310.

Since the secondary windings are not loaded in the test, the induced is equal to the measured voltage and in consequence the turns ratio for all secondary windings is equal to the voltage ratio Vn/Bo (lines 330 to 360).

The second part of the program is devoted to estimating the original design operating voltages and currents. Here the rule of thumb formula referred to previously, which derives the total input load of the transformer from the central core area, has been used. Knowing that 4% of this will be dissipated in resistance, the design load on each secondary winding can be calculated (lines 390 to 410) and, from this, the design primary magnetising voltage (lines 420 to 450).

As the iron losses are almost entirely due to eddy currents, these have been represented by an additional secondary load Re (line 370).

From these derived figures it is now possible to calculate the primary current, vectorially add the voltage drop across the internal resistance of the primary winding (R1) to the magnetising current, and from this derive the design primary voltage, V1, at lines 460 and 470 and calculate the output voltages of the secondary windings (V2...Vn) at lines 480 to 500.

The third part of the program is concerned with estimating losses, this being a summation of those from all individual sources. At line 550 the input power is calculated by adding the power losses in the real and imaginary phases, while copper losses due to the resist-

```
10 REM TRANSFORMER ANALYSER
20 REM J.M.HOWELL JULY 1985
30 CLS
40 PRINT
50 PRINT "CORE CENTRE LEG WIDTH AND STACK HEIGHT (INCHES) ";
60 INPUT D1,D2
70 IF D1<=0 OR D2<=0 OR D1*D2>100 THEN GOTO 40
80 PRINT
90 PRINT "HOW MANY WINDINGS (INC. PRIMARY) ";
100 INPUT N
110 IF N<2 OR N>12 THEN GOTO 80
120 DIM A(N),P(N),R(N),T(N),V(N)
130 PRINT
140 PRINT "ENTER DC RESISTANCES(OHMS) AND MEASURED AC VOLTAGES"
150 PRINT
160 RESTORE
170 FOR I=0 TO N
180 IF I<3 THEN READ A$
190 PRINT A$;
200 IF I>1 THEN PRINT I-1;
210 PRINT TAB(30);" ";
220 INPUT R(I),V(I)
230 NEXT I
240 DATA "PRIMARY SERIES RESISTOR"
250 DATA "PRIMARY WINDING"
260 DATA "SECONDARY WINDING NUMBER "
270 BO=V(1)^2-(V(0)*R(1)/R(0))^2
280 IF BO>0 THEN 310
290 PRINT "ERROR IN PRIMARY CIRCUIT DATA"
300 GOTO 130
310 BO=SQR(BO)
320 X=0
330 FOR I=2 TO N
340 T(I)=V(I)/BO
350 X=X+T(I)^2/R(I)
360 NEXT I
370 KE=.00096*X/D2
380 B=28*D1*D2/SQR(X)
390 FOR I=2 TO N
400 A(I)=.04*B*T(I)/R(I)
410 NEXT I
420 BSAT=B*1.5
430 ALPHA=BO*R(0)/V(0)/(1-BO/BSAT)
440 H=3*B/ALPHA
450 IP=B*(.04*X+KE)
460 V(1)=SQR((B+R(1)*IP)^2+(H*R(1))^2)
470 A(1)=SQR(H^2+IP^2)
480 FOR I=2 TO N
490 V(I)=T(I)*B
500 NEXT I
510 CLS
520 PRINT
530 PRINT "OPERATING CONDITIONS"
540 PRINT
550 PIN=(B+R(1)*IP)*IP + H^2*R(1)
560 PTOT=B^2*KE
570 FOR I=1 TO N
580 P(I)=A(I)^2*R(I)
590 PTOT=PTOT+P(I)
600 NEXT I
610 PRINT "WINDING";TAB(15);"VOLTAGE";TAB(30);"CURRENT"
620 PRINT "PRIMARY";TAB(15);V(1);TAB(30);A(1)
630 FOR I=2 TO N
640 PRINT "SEC.";I-1;TAB(15);V(I)-R(I)*A(I);TAB(30);A(I)
650 NEXT I
660 PRINT
670 PRINT "IRON/COPPER LOSS      WATTS    % INPUT"
680 PRINT "PRIMARY       ";TAB(20);P(1);TAB(30);100*P(1)/PIN
690 PRINT "IRON CORE     ";TAB(20);B^2*KE;TAB(30);B^2*KE*100/PIN
700 FOR I=2 TO N
710 PRINT "SEC.";I-1;TAB(20);P(I);TAB(30);100*P(I)/PIN
720 NEXT I
730 PRINT "TOTAL      ";TAB(20);PTOT;TAB(30);100*PTOT/PIN
740 PRINT
750 PRINT "ENTER DESIRED PRIMARY VOLTAGE " ;
760 INPUT V(1)
770 FOR I=2 TO N
780 PRINT "CURRENT DRAWN FROM SEC. ";I-1;TAB(31);
790 INPUT A(I)
800 NEXT I
810 IF V(1)<.95*BSAT THEN 840
820 PRINT "CORE SATURATION IS ";V(1)/BSAT*100;" PERCENT"
830 GOTO 740
840 X=0
850 FOR I=2 TO N
860 X=X+T(I)*A(I)
870 NEXT I
880 IF X<.4*V(1)/R(1) THEN GOTO 910
890 PRINT "SECONDARY CURRENT TOO HIGH"
900 GOTO 740
910 H=0
920 FOR I=1 TO 3
930 B=(SQR(V(1)^2-(H*R(1))^2)-X*R(1))/(1+KE*R(1))
940 H=B/ALPHA/(1-B/BSAT)
950 NEXT I
960 IP=B*KE+X
970 GOTO 470
```

ances of the windings (which have been measured) are deduced using the familiar formula: P=I×R (lines 570 to 600, 680, 710). Iron loss is derived from the equivalent load Re (P=B/Re, lines 560, 690).

The last of the four parts of the program effects a shift in operating conditions (defined in lines 750 to 800) and checks that the transformer core will not saturate (lines 810 to 830).

From the specified secondary loadings a value for the primary winding current may be derived (lines 840 to 870), while lines 880 to 900 ensure that this is a realistic load for the transformer. However, this value does not allow for iron losses, so it is necessary to make an estimation of primary current and from this deduce the magnetising voltage B and hence the iron loss.

The value for primary current is then adjusted and the process repeated three times at lines 910 to 950 in order to obtain an accurate value for B. It is then possible to calculate the actual secondary output voltages, primary current and losses.

The program then loops back to recalculate the operating conditions and losses using the same formulae as before. This will repeat until interrupted by the user in a manner suitable to the particular machine.

Interpreting results

Although this program has been prepared using sound design principles, when applied to transformers which are marked with their ratings surprising answers may result.

Typical of these is that military grade transformers may appear to be designed for considerably higher input voltage than marked on the terminal block. This is due to the fact that these are very

```
CORE CENTRE LEG WIDTH AND STACK HEIGHT (INCHES) ?
1.25 , 2.5
HOW MANY WINDINGS (INC. PRIMARY) ? 2

ENTER DC RESISTANCES(OHMS) AND MEASURED AC VOLTAGES

PRIMARY SERIES RESISTOR        ?  30 , 15
PRIMARY WINDING                ?  3.5 , 241
SECONDARY WINDING NUMBER  1    ?  .2 , 42

OPERATING CONDITIONS

WINDING          VOLTAGE           CURRENT
PRIMARY           229.356           1.43327
SEC. 1            37.5659           7.82624

IRON/COPPER LOSS         WATTS       % INPUT
PRIMARY                  7.18996     2.27257
IRON CORE                2.94        .929263
SEC. 1                   12.25       3.87193
TOTAL                    22.38       7.07376

ENTER DESIRED PRIMARY VOLTAGE ?  240
CURRENT DRAWN FROM SEC.  1    ?  10

OPERATING CONDITIONS

WINDING          VOLTAGE           CURRENT
PRIMARY           240               1.81352
SEC. 1            38.7545           10

IRON/COPPER LOSS         WATTS       % INPUT
PRIMARY                  11.511      2.72615
IRON CORE                3.18899     .755246
SEC. 1                   20          4.73658
TOTAL                    34.7        8.21797

ENTER DESIRED PRIMARY VOLTAGE ?
Break in 760
```

conservatively rated, and although in theory the higher input voltage is possible, before using at higher ratings it is necessary to carefully examine the insulation between windings and core.

Many low cost consumer type transformers, especially surplus types, may seem overloaded when checked by this program. In such cases the user should ascertain that the power dissipation is not excessive. Reasonable limits for this are 20% in the case of a small transformer and 10% for a large one.

A final consideration is whether the power losses are acceptable. These result in a temperature rise in the transformer. The temperature rise of an operating transformer should not be permitted to exceed 50°C, for beyond this degradation of the insulation may occur.

The temperature rise of a transformer may be roughly estimated from the formula: temperature rise = (power loss (watts))/(total area (sq inches)) × 80°C.

Examples

We have included two worked examples for two reasons: firstly, they allow the user to be confident that the program has been accurately keyed into the computer, and secondly, they permit the user to gain a little experience with the program before using it 'in anger'.

The first example concerns a surplus transformer, sold without tag markings but described by the dealer as 'mains input, 40V, 10 amps output'.

The estimated design conditions suggest that it is suitable for 240V mains input, but if operated at 10A rms output the power losses will be relatively high and the output voltage will drop to 38.75 volts, which suggests that the dealer was rather generous in his estimate of the rating of the transformer.

The second example is a transformer removed from a 1950s broadcast receiver. This has a centre-tapped HT secondary for use with a double diode rectifier and is considered as two separate windings, each feeding a half wave rectifier.

The estimated design conditions confirm that the transformer is suitable for mains voltage use and that the low voltage secondary is 6.3 volts. However, the program assumes purely resistive loads, and in order to make a full analysis allowance must be made for the intermittent loading of the high voltage secondary windings during the mains cycle.

The desired output current is 80mA, provided by two rectifiers supplying 40mA each. The surge current through a half-wave rectifier is approximately five times the mean output current, ie 0.2A. For convenience the mains cycle may be considered in three parts:

1. Rectifier on HT secondary 1 conducts (20%).
2. Rectifier on HT secondary 2 conducts in opposite half cycle to 1 (20%).
3. Neither rectifier is conducting and the only load is the current drain on LT secondary 3 (60%).

```
CORE CENTRE LEG WIDTH AND STACK HEIGHT (INCHES) ?  1 , 1

HOW MANY WINDINGS (INC. PRIMARY) ?  4

ENTER DC RESISTANCES(OHMS) AND MEASURED AC VOLTAGES

PRIMARY SERIES RESISTOR        ?  15 , 1.1
PRIMARY WINDING                ?  50 , 249
SECONDARY WINDING NUMBER  1    ?  207 , 303
SECONDARY WINDING NUMBER  2    ?  224 , 301
SECONDARY WINDING NUMBER  3    ?  .25 , 8

OPERATING CONDITIONS

WINDING          VOLTAGE           CURRENT
PRIMARY           217.472           .157879
SEC. 1            245.126           .049341
SEC. 2            243.508           4.52954E-02
SEC. 3            6.47197           1.07866

IRON/COPPER LOSS         WATTS       % INPUT
PRIMARY                  1.24629     3.736
IRON CORE                .75264      2.25619
SEC. 1                   .503948     1.51068
SEC. 2                   .459574     1.37766
SEC. 3                   .290878     .871964
TOTAL                    3.25333     9.75251

ENTER DESIRED PRIMARY VOLTAGE ?  240
CURRENT DRAWN FROM SEC.  1    ?  .2
CURRENT DRAWN FROM SEC.  2    ?  0
CURRENT DRAWN FROM SEC.  3    ?  2.5

OPERATING CONDITIONS

WINDING          VOLTAGE           CURRENT
PRIMARY           240               .330983
SEC. 1            230.734           .2
SEC. 2            270.338           0
SEC. 3            6.56005           2.5

IRON/COPPER LOSS         WATTS       % INPUT
PRIMARY                  5.47749     6.95804
IRON CORE                .854903     1.08598
SEC. 1                   8.28        10.5181
SEC. 2                   0           0
SEC. 3                   1.5625      1.98484
TOTAL                    16.1749     20.5469

ENTER DESIRED PRIMARY VOLTAGE ?  240
CURRENT DRAWN FROM SEC.  1    ?  0
CURRENT DRAWN FROM SEC.  2    ?  .2
CURRENT DRAWN FROM SEC.  3    ?  2.5

OPERATING CONDITIONS

WINDING          VOLTAGE           CURRENT
PRIMARY           240               .329403
SEC. 1            272.232           0
SEC. 2            225.635           .2
SEC. 3            6.56263           2.5

IRON/COPPER LOSS         WATTS       % INPUT
PRIMARY                  5.42532     6.92563
IRON CORE                .855516     1.0921
SEC. 1                   0           0
SEC. 2                   8.96        11.4378
SEC. 3                   1.5625      1.99459
TOTAL                    16.8033     21.4501

ENTER DESIRED PRIMARY VOLTAGE ?  240
CURRENT DRAWN FROM SEC.  1    ?  0
CURRENT DRAWN FROM SEC.  2    ?  0
CURRENT DRAWN FROM SEC.  3    ?  2.5

OPERATING CONDITIONS

WINDING          VOLTAGE           CURRENT
PRIMARY           240               .102277
SEC. 1            286.925           0
SEC. 2            285.031           0
SEC. 3            6.95059           2.5

IRON/COPPER LOSS         WATTS       % INPUT
PRIMARY                  .523026     2.5623
IRON CORE                .950362     4.65582
SEC. 1                   0           0
SEC. 2                   0           0
SEC. 3                   1.5625      7.65468
TOTAL                    3.03589     14.8728

ENTER DESIRED PRIMARY VOLTAGE ?
Break in 760
```

With these conditions, the rms voltages seen by the conducting rectifiers (which will determine the smoothed dc voltage) have been calculated. The total power dissipation is the sum of the dissipation in each part of the mains cycle, ie (16.17 × (20/100)) + (16.8 × (20/100)) + (3.03 × (60/100)) = 8.412W REW

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Until recently the humble, antiquated valve was a much neglected beast. Recently, however, even the big boys are heavily into vacuum tubes (protection from the EMP, don't you know)

Roger Alban gives the low-down on those funny little light bulb thingies

The teaching of valve theory is no longer included in the syllabus for the Radio Amateurs Examination. However, the new amateur is likely to encounter new and secondhand equipment which contains valves, and to be confident in the use of the equipment he should have a reasonable understanding of the theory behind the operation of a valve. This article is intended to resolve the problem.

The Edison Effect

In 1883 the American scientist and inventor Thomas Alva Edison was experimenting with an electric filament lamp which contained a second filament. Apparently during these early days of the electric lamp the life of a filament was very short, and one way of extending the operational life was to insert a second filament into the glass envelope of the lamp to be used when the first filament had failed.

Thomas Edison discovered, *Figure 1*, that when the first filament was giving light, if he connected a battery and galvanometer between the first and second filament, a small current flowed through the galvanometer if the second filament was positive with respect to the first. If the battery was reversed, so that the second filament was negative with respect to the first filament, no current flow took place. This was called the Edison Effect, and remained nothing more than a scientific curiosity for many years until an explanation was forthcoming from OW Richardson.

Early in the twentieth century Richardson, who was for a time Professor of Physics at Princeton University, carried out investigations of the emission of electrons from the surface of hot metals. He explained the Edison Effect by assuming that electrons evaporate from the hot filament in much the same way as vapour molecules leave a hot liquid such as water in the form of steam. But what is actually happening?

Richardson explained the Edison Effect by assuming that negatively charged electrons evaporate from the hot filament and eventually return to the filament.

However, if another piece of positively charged metal is introduced into the lamp's glass envelope then the negatively charged electrons will be attracted to the positively charged piece of metal (second filament), and electric current flow will take place.

Thermionic emission

Electron emission produced by raising the temperature of a material is called *thermionic emission*. With many metals the temperature necessary for electron emission to occur is so high that the material completely evaporates before the desired temperature is attained. Tungsten is a suitable metal, as a useful electron emission is produced at a temperature of 2,200°C, which is well below the melting point of 3,300°C.

However, if the material is surrounded by air at atmospheric temperature and pressure, the motion of the escaping electrons is restricted by collisions with the heavy air gas molecules. It is therefore essential to ensure that the emitting material is surrounded by either a vacuum or an inert gas at minimum pressure. Electrons will be freely emitted when the tungsten filament is brought to a state of incandescence by a small electrical current being passed through the filament to cause it to glow. The number of electrons released will increase with temperature.

Negatively charged

The electrons leaving the filament are negatively charged, *Figure 2*. As each electron leaves the filament it makes the filament take up a positive charge, producing an attractive force urging the electrons to return to the filament.

However, because each electron has an equal negative charge, there also exists a force of mutual repulsion between the electrons themselves. Many of the electrons are prevented from returning to the filament because of the repulsion of other electrons leaving the filament. These electrons also repel

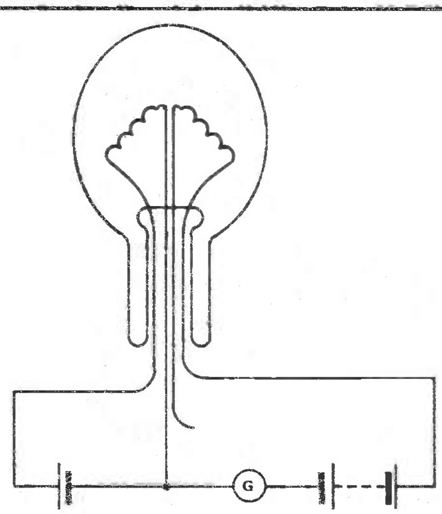

Fig 1 *Thomas Edison experiment*

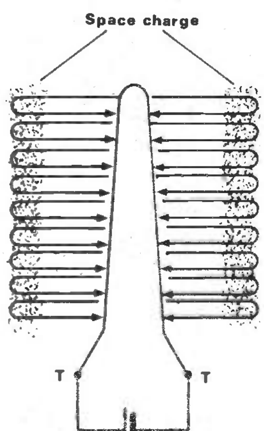

Fig 2 *Electrons leaving the filament create a cloud around it called the space charge*

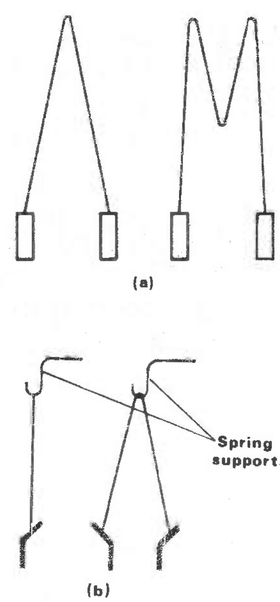

Fig 3 *Types of directly heated cathodes*

other electrons which are attempting to leave the filament.

The net result is that on attaining the critical temperature the filament is quickly surrounded by a cloud of electrons setting up a region of negative charge known as the *space charge*. Stability is reached when the number of electrons leaving the filament is balanced by those returning to it.

The cathode

One of the most important factors on which the electron emission depends is the 'electron affinity' of the surface of the material. It is a measure of the work which an electron must do in order to escape from the surface. Another important factor is the surface temperature of the material. The higher the temperature the higher the electron activity, and consequently a larger number of electrons will escape to form the space charge. The material from which the electrons escape is called the *cathode*, and in valves this can take the form of two different types of construction, the directly heated and the indirectly heated cathode.

The directly heated cathode consists of a wire of platinum, nickel or tungsten upon which is deposited a coating of barium oxide or strontium oxide. These materials will readily emit electrons at a temperature of about 1,000°C. Directly heated filaments may take the form of a letter I,V, or W, *Figure 3a*, to obtain the desired length and surface area. Spring suspension units are employed to keep the filament taut as it expands with heat, *Figure 3b*.

The indirectly heated cathode consists of a metal tube, *Figure 4*, usually of nickel, coated upon the outside with barium or strontium oxide. The heater filament is a tungsten wire loop placed inside the tube, the loop being coated with an insulating material such as aluminium oxide which is not affected by heat.

Large mass

The tungsten filament is heated by the passage of current, typically 0.3 amps at 6.3 volts. Owing to the relatively large mass of the cathode it takes an appreciable time to warm up, and there is a slight delay after switching on the heater wire before the electron emission commences.

The anode

If a positively charged piece of metal is brought near to the cathode, *Figure 5*, some of the electrons will be attracted to this piece of metal (the *anode*), thus reducing the space charge and permitting further electrons to leave the cathode. As the positive anode potential is increased the space charge will be gradually reduced until all the electrons which are leaving the cathode are attracted to the anode.

Any further increase in anode voltage will have no further effect on the flow of electrons, and the valve is said to be at 'saturation'. A greater flow of electrons can only be obtained by raising the temperature or increasing the size of the cathode surface.

The diode valve

The phenomenon described above was first explained by J A Fleming in 1904 using the principle of thermionic emission in a radio detector valve called the diode. The diode valve comprises two electrodes, the cathode and the anode, enclosed within a glass envelope from which gas has been excluded. The reason for removing the air from within the glass envelope is to ensure the free passage of electrons between cathode and anode. The lack of air also prevents oxidisation of the filament and consequently extends its operational life.

The air is removed from the glass envelope by using an air pump during manufacture. Any remaining air is removed by burning a small amount of magnesium which sits within the gettering pan inside the glass envelope and is ignited by eddy current heating. The burnt magnesium leaves a mirror deposit on the inside of the glass envelope, and is a good indicator as to the amount of air remaining inside the valve. If a large quantity of air should find its way inside the glass envelope then the deposit of magnesium will turn a milky colour.

The anode may be in the form of a flat plate, which gives the alternative American name for it, *plate*. It is usual for the anode to be of a cylindrical or oval shape surrounding the cathode.

With no voltage applied to the anode, the potential in the region of the heated cathode is due to the space charge. The potential gradient between cathode and anode may be represented by the graph of *Figure 6a*. When the anode is made positive, if the cathode is cold the potential will fall uniformly from anode to cathode.

With the cathode heated, the potential at any point is due to the sum of the positive anode charge and the negative space charge; the potential gradient between anode and cathode takes the form illustrated in *Figure 6b*. As the electrons move away from the cathode, with increasing distance the potential becomes increasingly negative until a distance *X*mm from the cathode is reached.

In this region the electrons experience a force drawing them back towards the cathode, whilst at a greater distance from the cathode the electrons are attracted towards the anode on account of the positive potential.

As a result of the space charge, only those electrons which leave the cathode with sufficient initial velocity to travel beyond the region of the negative potential will reach the anode. All the other electrons will return to the cathode. It can be seen that the region of the space charge plays a vital role in the operation of the electronic valve.

To be continued

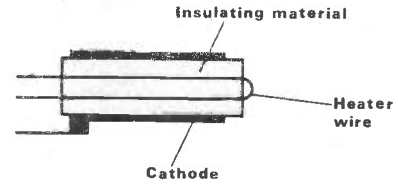

Fig 4 *Indirectly heated cathode*

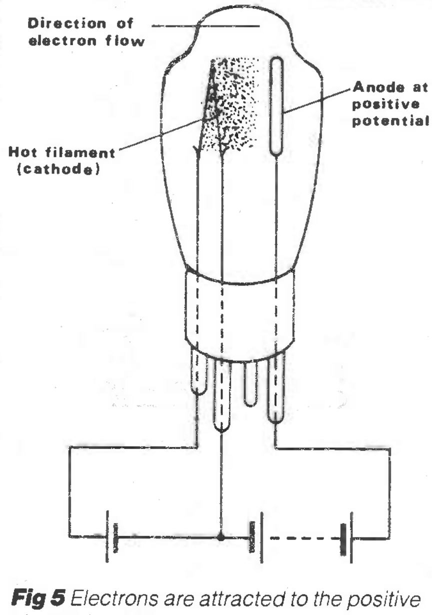

Fig 5 *Electrons are attracted to the positive charged anode*

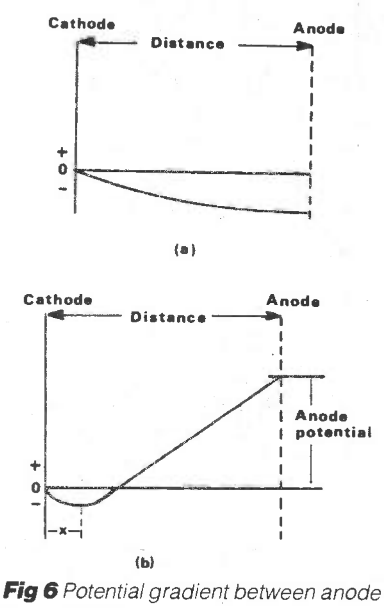

Fig 6 *Potential gradient between anode and cathode*

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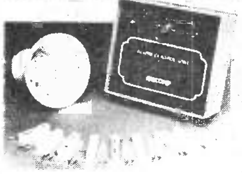

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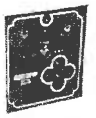

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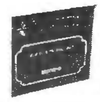

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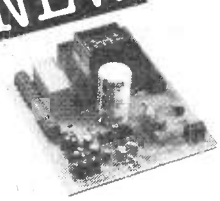

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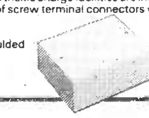

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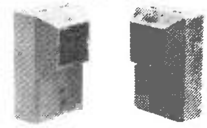

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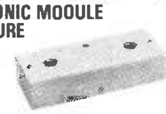

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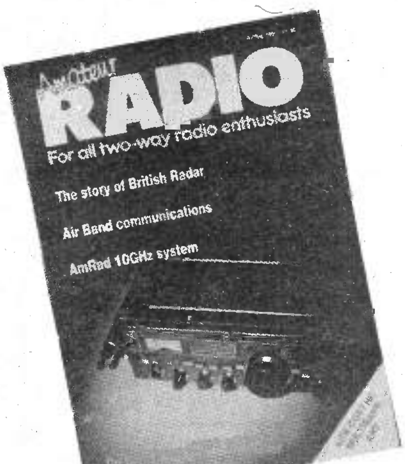

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DATA FILE . . .

Ray Marston takes a detailed look at voltage amplifying transistor circuits this month

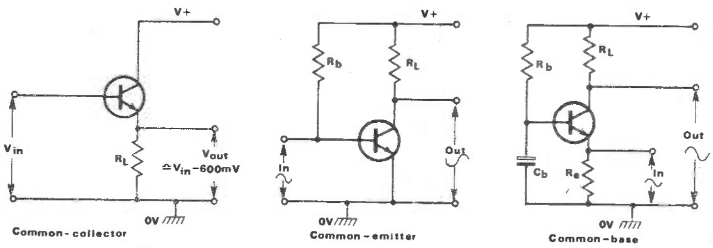

Fig 1 The three basic transistor configurations

	Common-collector	Common-emitter	Common-base
Z_{in}	High ($\simeq h_{fe} \times R_L$)	Medium ($\simeq$1k0)	Low ($\simeq$40R)
Z_{out}	Very low	$\simeq R_L$	$\simeq R_L$
A_v	$\simeq$1	High	High
A_i	$\simeq h_{fe}$	$\simeq h_{fe}$	$\simeq$1
Cut-off frequency	Medium	Low	High
Voltage phase shift	Zero	180°	Zero

Fig 2 Comparative performances of the three basic configurations

In the last two editions of *Data File* we have given an introductory outline of the discrete bipolar transistor and its basic characteristics, a general round-up of popular applications configurations, and have also taken a detailed look at the common-collector transistor amplifier and its derivitives. In the present edition of 'The File' we continue the transistor theme by examining common-emitter and common-base 'voltage amplifier' circuits.

To refresh the reader's memory, *Figures 1* and *2* show the circuits of the three basic transistor amplifier configurations that have already been discussed and detail the comparative performances of these three amplifiers. Note in particular that the common-collector amplifier gives near-unity overall voltage gain but features a high input impedance and low output impedance. This circuit is thus used primarily as a unity-gain voltage follower and impedance converter.

The common-emitter and common-base circuits, on the other hand, each provide substantial voltage gain, and are thus used primarily as voltage amplifier circuits. The common-base circuit gives near-unity current gain, and is used mainly in wideband or high frequency voltage amplifier applications. The common-emitter circuit provides both voltage and current gain, and is thus of particular value as a high gain power amplifier.

The common-emitter amplifier (also known as the common-earth or grounded-emitter circuit) can be used in a wide variety of digital and analogue amplifier applications. Let's begin by looking at some 'digital' circuits.

Digital circuits

Figure 3 shows the practical circuit of a simple npn common-emitter digital amplifier, inverter or switch, in which the input signal is either at zero volts or at a substantial positive value. Here, when the input is at zero volts the transistor is fully cut off, and the output is thus at full positive supply rail voltage value.

When the input switches to a positive value greater than 600mV (the nominal voltage needed to forward bias the base-emitter junction of the transistor), the transistor turns on and causes a collector current to flow in R_L, thus pulling the output voltage towards zero. If the input voltage is sufficiently large the transistor is driven to saturation (ie, fully on), and the output voltage falls to a saturation value of only two or three hundred millivolts. Thus the output signal is an amplified and inverted version of the original input signal.

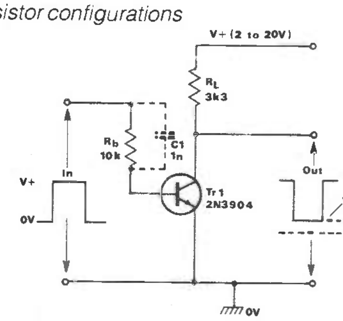

Fig 3 Digital inverter/switch (npn)

Safety resistor

In *Figure 3*, R_b acts mainly as a safety resistor that limits the base-drive current to a safe value; the input impedance of the circuit is slightly greater than the R_b value. It should be noted that R_b influences the rise and fall times of the output signal: the greater the R_b value, the worse these times are.

This snag can be overcome by shunting R_b with a 'speed-up' capacitor (typical value about 1n0), as shown dotted in the diagram. In practice, R_b should have as low a value as possible consistent with safety and input impedance requirements, and should never be greater than $R_L \times h_{fe}$.

Figure 4 shows a pnp version of the digital inverter/switch circuit. In this case the transistor is switched fully on when the input is at zero volts, and the output thus takes up a value roughly 200mV less than the positive supply rail value. The transistor only turns off when the input rises to within less than 600mV of the supply rail value, and under this condition the output falls to zero volts.

It should be noted that the sensitivity of the *Figure 3* and *Figure 4* circuits can be greatly increased by simply replacing Tr1 with a pair of transistors wired in the Darlington or Super-Alpha configuration. A very high gain *non*-inverting

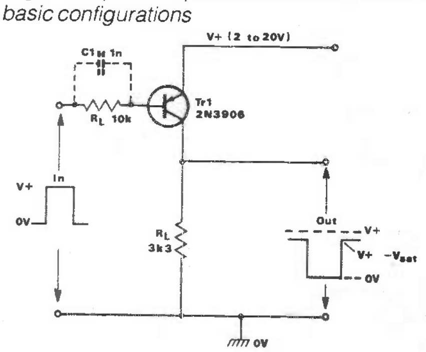

Fig 4 Digital inverter/switch (pnp)

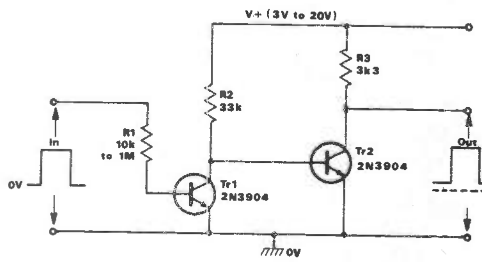

Fig 5 Very high-gain non-inverting digital amplifier/switch using npn transistors

digital amplifier/switch can be made by using a pair of transistors in either of the configurations shown in *Figures 5* or *6*.

The *Figure 5* circuit, which uses a pair of npn transistors, operates as follows:

When the input signal is zero volts, Tr1 is cut off and is thus effectively removed from the circuit. Under this condition, Tr2 is driven to saturation via R2, and the output signal has a value of a few hundred millivolts. When, on the other hand, the input signal is significantly greater than 600mV, Tr1 is driven to saturation and pulls Tr2 base down to only 200mV or so above zero. Under this condition, Tr2 is cut off, and the output is at full supply voltage value.

The *Figure 6* circuit, which uses one npn and one pnp transistor, works in a slightly different manner from that described above. Here, when the input is at zero volts, Tr1 is cut off, so Tr2 is also cut off via R2-R3 and the output signal is

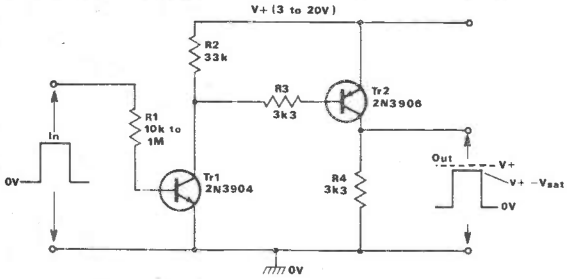

Fig 6 *Alternative non-inverting digital amplifier/switch using an npn-pnp pair of transistors*

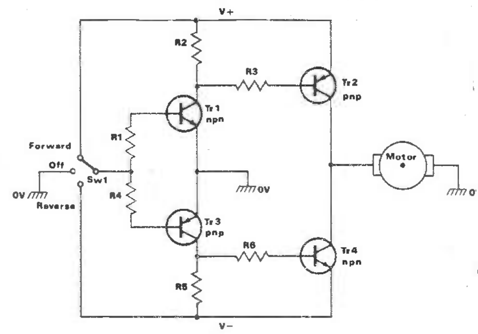

Fig 7 *dc-motor direction-control circuit*

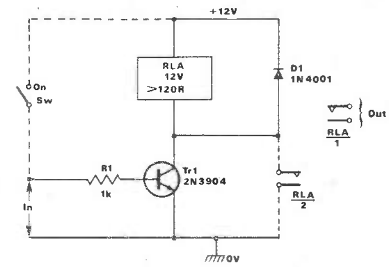

Fig 8 *Simple relay-driving circuit*

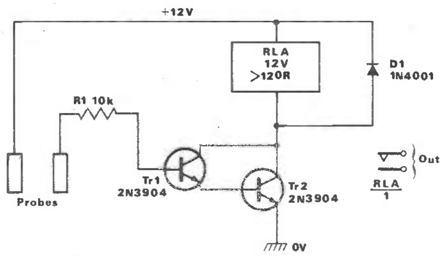

Fig 9 *Touch, water or steam-operated relay circuit*

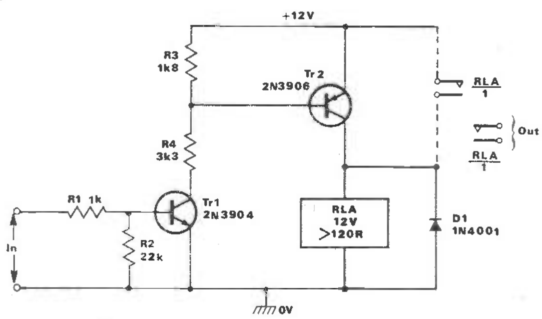

Fig 10 *Ultra-sensitive relay driver (needs an input of 700mV at 40μA*

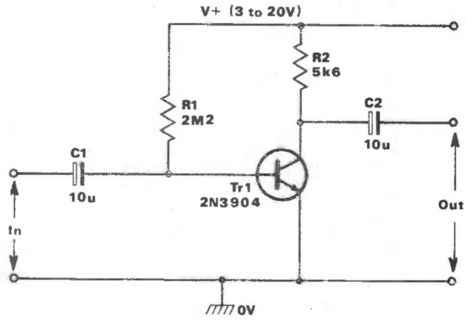

Fig 11 *Simple npn common-emitter amplifier*

thus at zero volts. When the input signal is high (above 600mV), on the other hand, Tr1 is driven on and derives most of its collector current from Tr2 base via R3, thus driving Tr2 to saturation. Under this condition, the output takes up a value 200mV or so less than the positive supply rail value.

Finally, to complete this look at 'digital' common-emitter amplifier circuits, *Figure 7* shows (in basic form) how a complementary pair of the *Figure 6* circuits can be used to make a dc-motor direction-control network using a dual power supply.

Operation

The circuit operates as follows:

When SW1 is in the *forward* position, Tr1 is driven on via R1 and Tr2 is driven on via R3 and Tr1, but Tr3 is cut off via R4 and Tr4 is cut off via R5 and R6. Thus, the 'live' side of the motor is connected (via Tr2) to the positive supply rail under this condition and the motor runs in a forward direction.

When SW1 is in the *off* position, Tr1 is cut off via R1 and Tr2 is cut off via R2-R3, and simultaneously Tr3 is cut off via R4 and Tr4 is cut off via R5-R6. The 'live' side of the motor is thus effectively open circuit under this condition, and the motor is inoperative.

Finally, when SW1 is in the *reverse* position, Tr3 is biased on via R4, and Tr4 is driven on via R6 and Tr3. Tr1, however, is cut off via R1 and Tr2 is cut off via R2-R3. Thus, the live side of the motor is connected (via Tr4) to the negative supply rail under this condition, and the motor runs in the reverse direction.

The basic digital circuits of *Figures 4* to *6* can be used to drive a variety of resistive loads, including lamps and LED-resistor combinations etc, without modification. If they are used to drive inductive loads, such as relay coils etc, the circuits must be provided with simple diode protection networks, to limit inductive switch-off back-emfs to a safe value. Common-emitter amplifiers make far more sensitive relay drivers than do common-collector amplifier circuits (described last month), and *Figures 8* to *10* show some practical examples of relay driving common-emitter circuits.

Figure 8 shows the circuit of a simple but versatile 1-transistor relay driver, which increases the relay's operating current sensitivity by a factor of about 200 (the nominal h_{fe} value of Tr1). Resistor R1 gives base drive protection, and can have a larger value than 1k0 if required.

The relay can be turned on either by applying a dc voltage greater than 700mV to the input, or via switch SW1 (shown dotted). The basic *Figure 8* circuit gives non-latching operation, but can be made self-latching by wiring a spare set of relay contacts (RLA/2) between the collector and emitter of Tr1, as shown dotted.

The current sensitivity of the *Figure 8* circuit is limited by the current gain of Tr1: the sensitivity can be greatly increased (to a factor of about 20,000) by replacing Tr1 with a Darlington-connected pair of transistors. *Figure 9* shows how this principle can be used to make a relay driving circuit that can be activated by placing a resistance of less than a couple of megohms across a pair of stainless metal probes. Water, steam

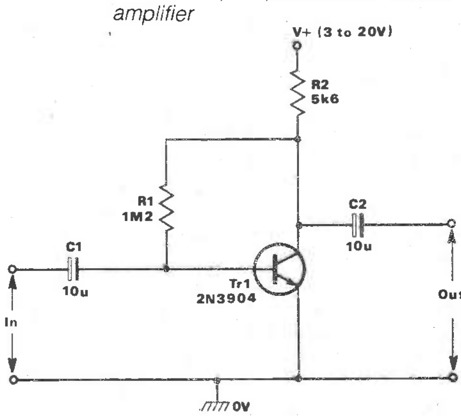

Fig 12 *Common-emitter amplifier with feedback biasing*

and skin contacts have resistances below this value, so this simple little circuit can be used as a water, steam or touch-operated relay switch.

Finally, *Figure 10* shows the circuit of another ultra-sensitive 2-transistor relay driver. This particular design needs an input of about 700mV at 40μA to activate the relay, and is based on the *Figure 6* design. Resistor R2 is wired between the base and emitter of Tr1 to ensure that this transistor (and also Tr2) is fully cut off if the input terminals are open circuit.

Linear biasing circuits

A common-emitter circuit can be made to function as a linear ac amplifier by applying a dc bias current to its base, so that the collector takes up a quiescent value of roughly half-supply volts (to accommodate maximal undistorted output signal swings) and by then feeding the ac input signal to the base and taking

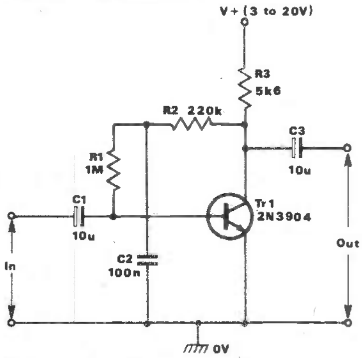

Fig 13 *Amplifier with ac-decoupled feedback biasing*

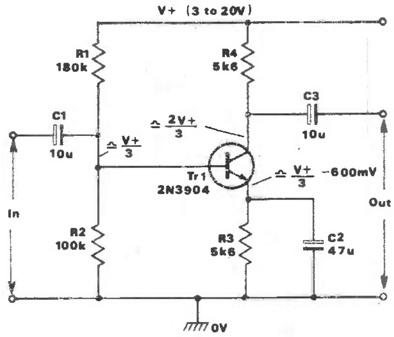

Fig 14 *Amplifier with voltage-divider biasing*

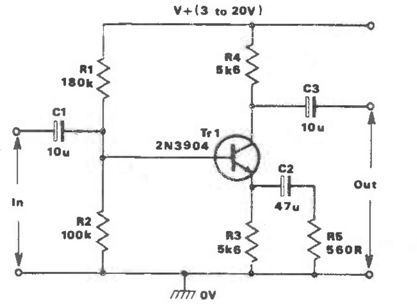

Fig 15 *Fixed gain (= x 10) common-emitter amplifier*

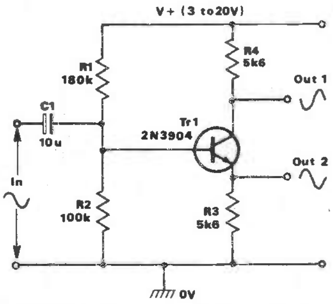

Fig 16 *Unity-gain phase splitter*

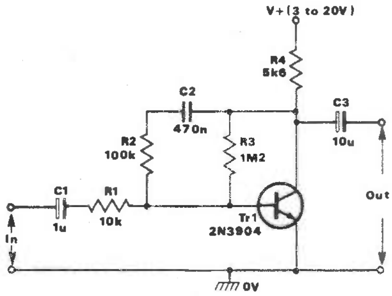

Fig 17 *Alternative fixed gain (×10) amplifier*

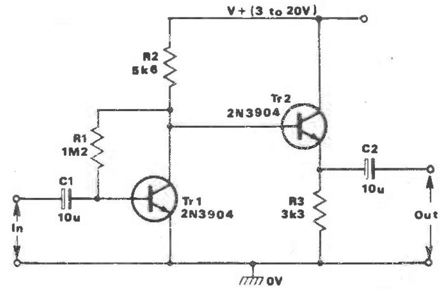

Fig 18 *Wideband amplifier*

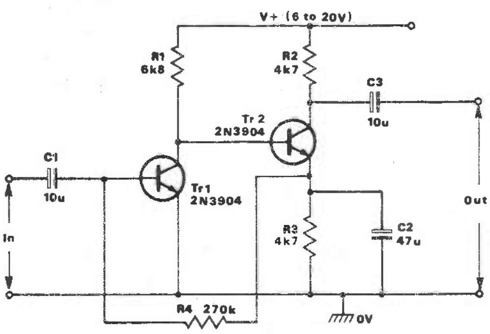

Fig 19 *High-gain 2-stage amplifier*

the ac output signal from the collector. *Figure 11* shows a simple circuit of this type.

The first step in designing a circuit of the *Figure 11* type is to decide on the value of load resistor R2. The lower this value, the higher will be the amplifier's upper cut-off signal frequency (due to the smaller shunting effects of stray output capacitance on the effective impedance of the load), but the higher will be the quiescent operating current of Tr1.

In the diagram, R2 has a compromise value of 5k6, which gives an upper '3dB down' frequency of about 120kHz and a quiescent current consumption of 1mA from a 12 volt supply. To bias the output to half-supply volts, R1 must be given a value of R2×2h_{fe}, and (assuming a nominal h_{fe} value of 200) this works out at about 2M2 in the example shown.

The matters of input impedance and voltage gain of the *Figure 11* circuit are fairly easy to work out, and are both determined by the forward biased impedance of the internal base-emitter junction of Tr1. This junction has an impedance of about 25/I_c, where I_c is the collector current value in mA, eg this impedance is 25R at 1mA, 12R5 at 2mA, or 50R at 0.5mA. The input impedance into the transistor base equals this impedance multiplied by the h_{fe} value of Tr1. Thus, in *Figure 11* the input impedance equals roughly 5k0, shunted by R1.

The voltage gain of the *Figure 11* circuit equals the R2 collector-load resistor value divided by the base-emitter junction impedance value and works out at about 46dB, or ×200. Note that, in theory, this gain figure also determines the maximum attainable upper 3dB point of the frequency response, which equals F_T/A_v. The F_T of the 2N3904 is about 300MHz, so the maximum attainable 3dB point of the *Figure 11* circuit (ignoring the effects of stray capacitance) is 1.5MHz.

A weakness

A major weakness of the simple *Figure 11* circuit is that its quiescent biasing point is highly dependent on the current gain (h_{fe}) of the individual transistor used. This problem can be overcome by modifying the circuit as shown in *Figure 12*. Here, biasing resistor R1 is wired in a dc feedback mode between the base and collector, and is given a value of R2 × h_{fe}. The 'feedback' action is such that any shift in the output biasing point (due to variations in h_{fe}, temperature or component values) automatically causes a counter-change in the base-current biasing level, thus tending to cancel the original shift.

The *Figure 12* circuit provides the same values of bandwidth and voltage gain as the *Figure 11* design, but has a lower total value of input impedance. This is because the ac feedback action of *Figure 12* causes the apparent impedance of R1 (which shunts the 5k0 base impedance of Tr1) to be reduced by a factor of 200 (=A_v), thus giving a total input impedance of 2k7. If desired, the shunting effects of the biasing network can be eliminated by using two feedback resistors and ac-decoupling them, as shown in *Figure 13*.

Finally, if the ultimate in biasing stability is required, this can be obtained by using the potential-divider biasing technique shown in *Figure 14*. Here, potential divider R1-R2 sets a quiescent voltage slightly greater than V+/3 on the base of Tr1, and 'voltage follower' action causes 600mV less than this to appear on Tr1 emitter. Thus, V+/3 is developed across 5k6 emitter resistor R3, and (since the emitter and collector currents of Tr1 are almost identical) a similar voltage is dropped across R4, which also has a value of 5k6, thus setting the collector at a quiescent value of 2V+/3. Note that the R3 emitter resistor is ac-decoupled via C1, enabling the circuit to give a voltage gain of 46dB to ac signals.

Circuit variations

Figures 15 to *18* show some simple but very useful variations of the basic *Figure 12* and *Figure 14* common-emitter designs. *Figure 15* shows how the *Figure 14* design can be modified to give a fixed voltage gain of about ×10. These designs rely on the fact that the common-emitter voltage gain equals the collector load impedance value (R4) divided by the effective 'emitter' impedance value. In *Figure 14*, the effective emitter impedance is that of the internal base-emitter

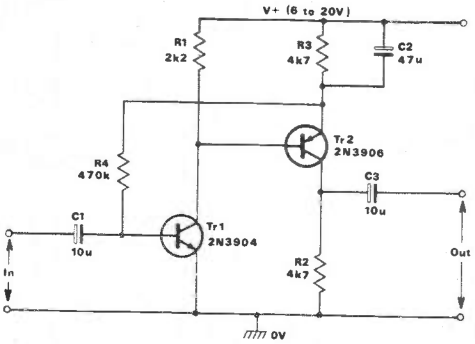

Fig 20 *Alternative high-gain 2-stage amplifier*

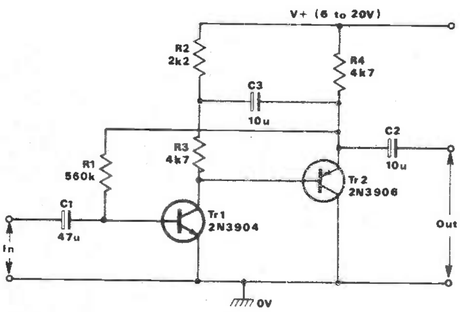

Fig 21 *Bootstrapped high-gain amplifier*

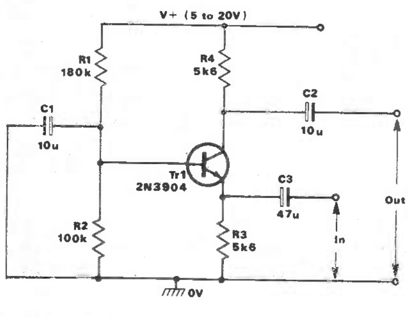

Fig 22 *Common-base amplifier*

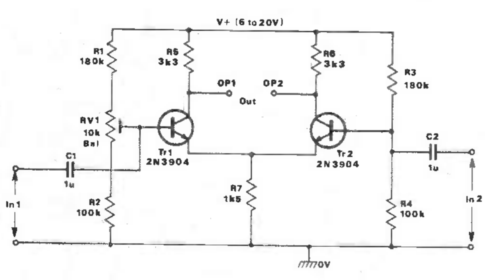

Fig 23 *Simple differential amplifier or long-tailed pair*

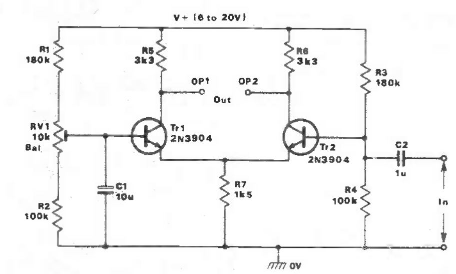

Fig 24 *Phase splitter*

junction, and equals 25R at 1mA. This circuit thus gives a voltage gain of ×200.

In *Figure 15*, on the other hand, resistor R3 is decoupled by series-connected C2-R5, and the emitter impedance (at ac signal frequencies) thus equals the internal junction value in series with the parallelled values of R3 and R5. This works out at roughly 560R, thus giving a final voltage gain of about ×10. Alternative gain values can be obtained by altering the R5 value.

Figure 16 shows a simple variation of the above design. In this case R3 is not decoupled, its impedance thus equalling the R4 value, and the circuit gives unity voltage gain. Note, however, that this circuit provides two unity-gain output signals, with the emitter output in phase with the input and the collector signal in anti-phase. This circuit thus acts as a unity-gain phase splitter.

Figure 17 shows an alternative way of varying the circuit gain. This design is a variation of *Figure 12:* it still gives 46dB of voltage gain between Tr1 base and collector but feedback biasing resistor R3 is ac-shunted by R2, thus giving the *Figure 17* circuit a base impedance of about 500R. R1 is wired in series between the input signal and Tr1 base, and thus (in conjunction with the 500R base impedance) gives a signal attenuation action between the input and base. The overall voltage gain of the circuit thus works out at roughly ×10, or R2/R1. Alternative gain values can be obtained by altering the values of either R1 or R2.

Finally, *Figure 18* shows how the *Figure 12* design can be modified to give a wideband performance by simply wiring a direct-coupled emitter follower stage (Tr2) between Tr1 collector and the output terminal.

It was pointed out earlier that *Figure 12* has a maximum potential bandwidth of 1.5MHz but in practice the shunting effects on R2 of stray output capacitance reduce the actual bandwidth to about 120kHz. By buffering the output via Tr2 these shunting effects are reduced and the bandwidth is extended to several hundred kHz.

High-gain circuits

A 1-transistor common-emitter amplifier circuit cannot give a voltage gain significantly greater than 46dB when using a resistive collector load. If a voltage gain greater than 46dB is needed, a multitransistor circuit must be used. *Figures 19* to *21* show three useful high-gain 2-transistor voltage amplifier circuits.

The *Figure 19* circuit acts like a direct-coupled pair of common-emitter amplifiers, with the output of Tr1 feeding directly into the base of Tr2. It gives an overall voltage gain of 76dB, or about ×6,150, but has an upper −3dB frequency point of only 35kHz.

Note that feedback biasing resistor R4 is fed from Tr2's ac-decoupled emitter (which 'follows' the quiescent collector voltage of Tr1) rather than directly from Tr1 collector, and that the bias circuit is thus effectively ac-decoupled. *Figure 20* shows an alternative version of the above design, using a pnp output stage; the performance of this circuit is the same as that of *Figure 19.*

The *Figure 21* circuit uses a very different way of giving a high voltage gain (about 66dB, or ×2000). In this case Tr1 is wired as a common-emitter amplifier with a split collector load (R2-R3), and Tr2 is wired as a common-collector amplifier or emitter follower, and feeds the ac output signal (derived from Tr1 collector) back to the R2-R3 junction via C3, thus 'bootstrapping' the value of R3 (as described last month) so that R3 acts as a near-infinite impedance to ac signals and Tr1 gives a very high voltage gain. The bandwidth of this circuit extends up to about 32kHz, but the design gives an input impedance of only 330R.

Other designs

To conclude this edition of *Data File, Figures 22* to *24* show the basic circuits of some other types of linear voltage amplifier. *Figure 22* shows an example of a common-base amplifier, which gives a good wideband response. This circuit is biased in the same way as *Figure 14.*

Note, however, that in *Figure 22* the base is ac-decoupled via C1, and the input signal is applied to the emitter via C3. The circuit has a very low input impedance (equal to that of the forward biased internal base-emitter junction), gives the same voltage gain as the common-emitter amplifier (about 46dB), and gives zero phase shift between input and output.

Figure 23 shows the circuit of a so-called 'differential' amplifier or long-tailed pair. The two transistors share a common emitter resistor (the 'tail'), and the circuit bias point is adjusted via RV1 so that the two transistors pass identical collector currents (giving zero difference between the collector voltages) under quiescent conditions.

The two transistors interact via the emitter tail, and the circuit action is such that the output signals (available from either collector) are proportional to the difference (the differential voltage) between the two input signals. If identical signals are applied to the two inputs, the circuit will (ideally) give zero output.

Finally, *Figure 24* shows how the above circuit can be modified for use as a phase splitter, which provides two anti-phase outputs from a single-ended input signal. In this case the base of Tr1 is simply ac-grounded via C1 and the input signal is applied to the base of Tr2.

In next month's edition of *Data File* we'll take a look at transistor oscillators and multivibrator circuits. REW

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130. 2 – centre zero panel meters 100-0-100 UA
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134. 10 – model aircraft motor – require no on/off switch, just spin to start
136. 2 – car radio speakers 5" round 4 ohm made for Radiomobile
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172. 10 – 12V 6W bulbs Philips m.e.s.
178. 3 – oblong amber indicators with lilliputs 12V
180. 6 – round amber indicators with neons 240V
181. 100 – p.v.c grommets ⅜ hole size
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     2 – double pole 20 amp 250V flush mounting switch – white
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193. 6 – 5 amp 3 pin flush sockets brown
195. 5 – B.C. lampholders brown bakelite threaded entry
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290. 3 7" reel to reel tape spools
291. 1 ten turns 3 watt pot ¼ spindle 100 ohm
292. 5 two plate brown bakelite ceiling roses
293. 50 silicon diodes mixed unmarked
294. 50 Germanium transistors mixed and unmarked
295. 10 round pointer knobs ¼ spindle
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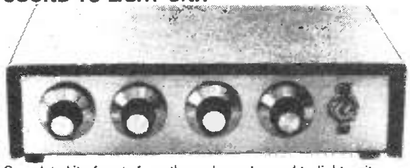

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these notes are often hastily written and technical information sheets are seldom available about the items we have to describe, also advertisements sometimes go to press without our having a chance to correct any mistakes, however, everything we sell is supplied on the understanding that if it is not suitable for your project you may return it within 7 days for credit. If there was a definite error of description in our copy then we will pay postage. If not, then you pay the postage. Note this offer applies to kits, but only if construction is **not started.**

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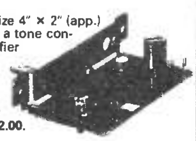

Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new. perfect condition, offered at the very low price of **£1.15 each, or 13 for £12.00.**

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2P71 –1 PAPST 240 5 hz motor
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CAN YOU 'EAR ME, MOOTHER?

J M Stevenson presents a 5-element quad for 2m on the cheap

Do you recall the article on aerial design I had published in the April 1985 issue of *Radio & Electronics World*? You do? Great! That saves me talking to myself. Well, now that you've cut up your mum's bread board to make the wooden blocks I wrote about, I'll give you something to do with them. I'm going to describe a small 2m quad that you can build using the wooden blocks and a few other bits and pieces. It will only cost a couple of pounds to build, an amount I'm sure all of you can afford.

The nuts and bolts of the matter

To build the quad you will need:

Five of the aforementioned wooden blocks, drilled.
A wooden broom handle (straight, please unless you're interested in moon bounce).
Twenty 16in lengths of ¼in dowel.
A small reel of 26swg enamelled copper wire.
A strip of 5 amp rated connector block (we need one double and four single units, remove the metal innards of the four singles.)
A small tin of weather varnish plus a brush.
Five wood screws to lock blocks to boom.
Twenty panel pins and four press tacks.
A wooden pole to mount the antenna, long enough to clear the elements.
A clamp to affix the pole to the boom.
Co-ax cable as required.

Got all that? If not, off you go to Woolies and get it. I'll have none of that 'I didn't know' business in this project.

The antenna, simple to construct, is small, light and, if you so desire, portable.

Construction details

Firstly give all the parts to be used in the project, including the connectors, a good coat of varnish. This will protect them from the elements, and gives the wood a nice shine to boot. When that's done, and the wool from your sleeve removed from the varnish, allow the bits to dry.

To obtain the correct spacing for the elements, measure and mark the boom from what will be the reflector end. First make a mark for the centre of the reflector's block, then from that mark measure the following: 16, 29, 37 and 45 inches.

Thus the space between the reflector and the driven element will be 16 inches; between the driven element and the first director 13 inches; between the first and second director 8 inches; and between the third and fourth director also 8 inches.

If your pencil broke during that operation, don't worry, you won't be needing it again.

Next cut the 26swg wire to the following lengths:
Reflector length – 87 inches
Driven element length – 83 inches
Director lengths – 77 inches.

When the wire is cut, scrape the coating from the ends of the wires: about ¼inch is needed. This allows continuity when the wire ends are screwed down in the connector block.

The arms for the quad are 16 inch lengths of ¼ inch dowel, and you will need to make 20 such arms.

Getting it together

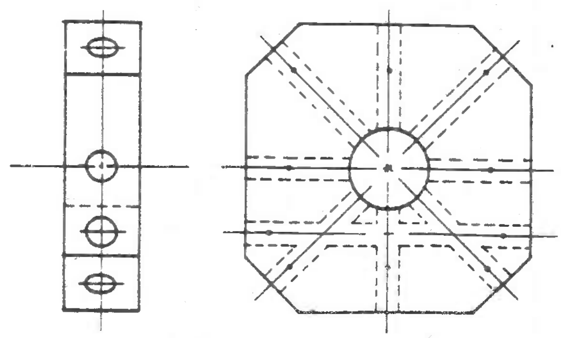
Making the elements isn't a difficult job, as you will see. Firstly, lay a wooden block flat on the workbench and push four dowel rods into the holes drilled in the quad configuration. Use the four press pins to temporarily position the wire on the arms, making sure that all sides are equal. When this has been done to your satisfaction, drill a small hole in each arm at those points and thread the 26swg wire through. Scrape the coating from the ends of the wire, and join it together using a single connector.

Be gentle

When the elements are built, gently pull each arm away from the centre to make the wire taut, and secure the arm with a panel pin through the block. Don't overdo the pulling, otherwise you may bend the dowel rods.

Now the elements are built, they can be slid onto their marks on the boom. When satisfied that all is correct, secure the blocks with the wood screws.

Figure 4 shows how to position the co-ax cable on the driven element. The



The block as originally outlined in April 1985

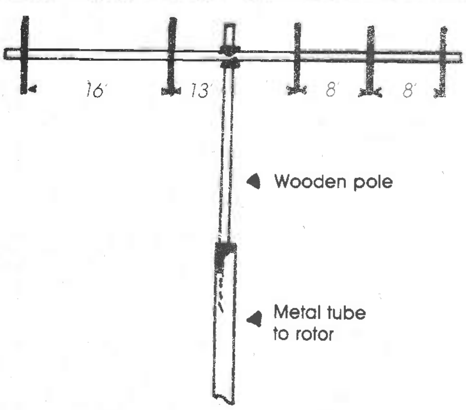


Fig 1 *Setting up the boom*

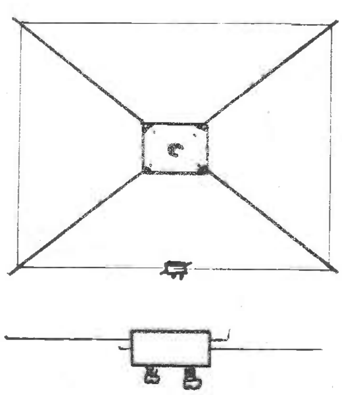


Fig 2 *Joining the element wire*

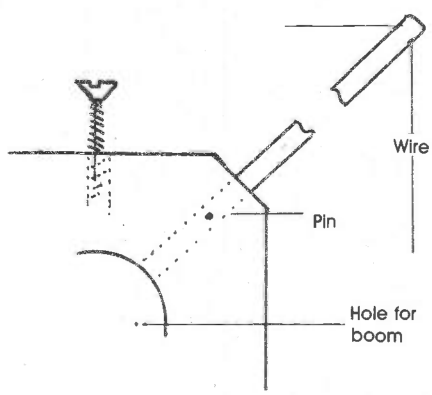


Fig 3 *Fixing to the boom*

antenna is fed at a point approximately 1 inch along from the lower left-hand dowel rod, when looking through the reflector. Note that the co-ax cable comes into the block from the top. Tape the cable along the arm and down, in a fairly loose loop, to the support pole where it is again secured. This eliminates any stress on the arm itself, and prevents one tripping over loose co-ax.

Mounting the quad on the rotator

A length of ali tube can be joined to the support pole, to address the rotator. Remember the support pole must be made of wood or plastic. It has been my experience with this type of quad that they don't like metal poles passing between their elements . . . say no more!

The antenna shouldn't need to be tuned as the SWR is quite flat, not above 1.4:1. Moving the feed point slightly either way will affect the SWR reading, if adjustment is needed.

This is a good project for those among us who do not have a lot of QRK to throw around. It is cheap to make, simple to construct and it works well. When I first built this antenna, I set it up in my shack tied to an old music stand (helps with the harmonics!) and pointed its nose in the direction of Dover, seventy odd miles from my location in Brentwood.

With 1 watt I opened the Dover repeater, and had a nice QSO with a fellow amateur who was out walking his dog. I don't think it had passed the RAE (I didn't like to ask), but its master gave me a Q5 report, which pleased me.When one considers I couldn't even hear Dover with the bought Yagi I was using at the time, this seems most acceptable.

Once the quad was up on the rotator, it got me into Germany, France, Holland and the Netherlands on SSB, and into Birmingham on FM, among other places. It has proved its worth time and time again.

Remember it can break down and be packed away in the car boot, which makes it a handy implement for the average camper. The only complaint I have is that I can't pack it away in the saddle bag of my push-bike! REW

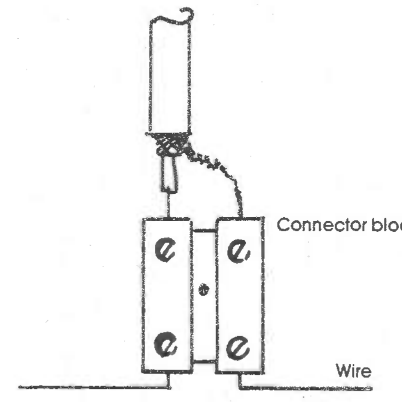


Fig 4 Co-ax fixing

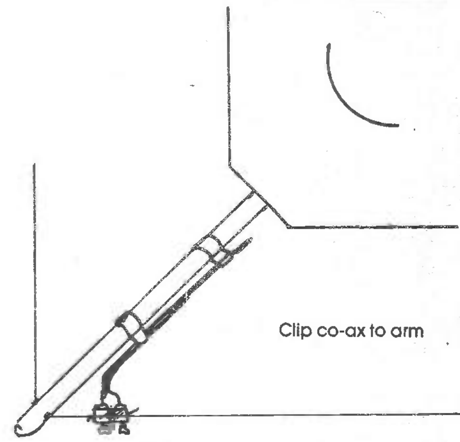


Fig 5 Driven element feed point

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TELEX 966371 TOS PM

INTEGRATED CIRCUITS

AN124	2.50
AN214Q	2.50
AN239	2.50
AN240P	2.80
AN264	2.50
AN612	2.15
AN362L	2.50
AN7140	3.50
AN7145	3.50
AN7145M	3.95
AN7150	2.95
BA521	3.35
CA1352E	1.75
CA3086	0.46
CA3123E	1.95
CA3140T	1.15
ETT6016	2.50
HA1339A	2.95
HA1366W	2.75
HA1377	3.50
HA1156W	1.50
HA1551	2.95
LA1230	1.95
LA4102	2.95
LA4140	2.95
LA4031P	1.95
LA4420	1.95
LA4430	2.50
LA4400	4.15
LA4422	2.50
LA4461	3.95
LC7120	3.25
LC7130	3.50
LC7131	5.50
LC7137	5.50
LM1011	3.15
LM324N	0.45
LM380N8	1.50
LM380N8	1.75
LM383T	2.95
LM390N	3.50
M51513L	2.30
M5155L	2.95
M51521L	1.50
MB3712	2.00
MB3756	2.50
MC1307P	1.00
MC1310P	1.95
MC1327	1.70
MC1327Q	0.95
MC1349P	1.20
MC1350P	0.95

MC1351P	1.50
MC1357	2.35
MC1358	1.58
MC14518CP	7.50
MC1495	3.00
MC1496	1.25
MC145106P	7.95
MC1723	0.50
MC3357	2.75
MC3401L	2.50
ML231B	1.75
ML232B	2.50
MSM5807	8.75
PLL02A	5.75
SAA500A	3.50
SAA1025	7.25
SAS560S	1.75
SAS570S	1.75
SAS580	2.85
SA/SB/T/U	1.00
SL901B	7.95
SL917B	6.65
SL1310	1.80
SL1327	1.10
SL1327Q	1.10
SN76003N	3.95
SN76013N	3.95
SN76023N	3.95
SN76033N	3.95
SN76110N	0.89
SN76115N	1.25
SN76131N	1.30
SN76226DN	2.95
SN76227N	1.05
SN76533N	1.65
SN76544N	2.65
SN76570N	1.00
SN76650N	1.15
SN76660N	0.90
STK014	7.95
STK015	5.95
STK025	11.95
STK043	9.50
STK078	11.95
STK415	7.95
STK433	5.95
STK435	7.95

STK437	7.95
STK439	7.95
STK461	11.50
TA7061AP	1.50
TA7108P	1.50
TA7120P	1.95
TA7129P	2.50
TA7130P	1.50
TA7137P	1.00
TA7176AP	2.95
TA7193P	3.95
TA7203	2.95
TA7204P	2.15
TA7205AP	1.15
TA7222AP	1.80
TA7227P	4.25
TA7310P	1.80
TA7313AP	2.95
TA7314P	2.95
TA7137P	1.00
TA7314P	2.95
TA7321P	2.25
TA7609P	3.95
TA7611AP	2.95
TAA310A	1.95
TAA320A	1.95
TAA350A	1.95
TAA570	1.95
TAA661B	1.95
TAA700	1.70
TBA120AS/B/C	1.00
TBA395	1.50
TBA396	0.75
TBA440N	2.55
TBA480Q	1.25
TBA510	2.50
TBA510Q	2.50
TBA520	1.10
TBA520Q	1.10
TBA530	1.10
TBA530Q	1.10
TBA540	1.25
TBA540Q	1.35
TBA550Q	1.95
TBA560C	1.45
TBA560Q	1.45
TBA570	1.00
TBA651R	2.50

TBA720A	2.45
TBA750Q	2.65
TBA800	0.89
TBA810AS	1.65
TBA810P	1.65
TBA820M	0.75
TBA820Q	1.45
TBA890	2.50
TBA920	1.65
TBA950/2X	2.35
TBA990	1.49
TBA990Q	1.49
TCA270	1.50
TCA270SQ	1.50
TCA650	2.50
TCA800	2.95
TCA830S	1.95
TCA900	2.50
TCA940	1.65
TDA440	2.20
TDA1001	2.95
TDA1002A	2.95
TDA1003A	3.95
TDA1006A	2.50
TDA1010	2.15
TDA1035	2.50
TDA1037	1.95
TDA1044	2.15
TDA1170	1.95
TDA1190	2.15
TDA1270Q	3.95
TDA1327	1.70
TDA2002	1.95
TDA2003	2.95
TDA2010	1.95
TDA2020	2.95
TDA2030	2.80
TDA2140	3.95
TDA2151	1.95
TDA2160	2.50
TDA2190	3.95
TDA2521	3.25
TDA2522	1.95
TDA2523	2.95
TDA2524	1.95
TDA2530	1.95
TDA2532	1.95
TDA2540	1.95
TDA2541	2.15
TDA2560	2.15
TDA2571	2.95

TDA2581	2.95
TDA2582	2.95
TDA2593	2.95
TDA2600	6.50
TDA2610	2.50
TDA2611A	1.95
TDA2640	3.50
TDA2680A	2.75
TDA2690	2.45
TDA3310	2.95
TDA4600	2.50
TDA9503	3.15
TDA3560	3.95
TEA1009	1.35
UPC566H	2.95
UPC575C2	2.75
UPC1025H	1.95
UPC1028H	1.95
UPC1032H	1.50
UPC1156H	2.75
UPC1158H	0.75
UPC1167C2	1.95
UPC1181H	1.25
UPC1182H	2.95
UPC1185H	3.95
UPC1191V	1.50
UPC1350C	2.95
UPC1353C	2.45
UPC1365C	3.95
UPC2002H	1.95
555	0.35
556	0.60
723	0.50
741	0.35
747	0.50
748	0.35
7808	0.60
7805	0.65
7812	0.65
7815	0.65

NEW BRANDED CATHODE RAY TUBES – Please allow additional £3 per tube for carriage

A1865/20	65.00
AW36 11	25.00
CME822W	19.00
CME822GH	25.00
CME1428GH	45.00
CME1428W	39.00
CME1431GH	39.00
CME1431W	39.00
CME1523W	39.00
CME202GH	45.00
CME2024W	45.00
CME2325W	45.00
CME3128W	45.00
CME3132GH	45.00
CME3155W	45.00
CRE1400	25.00
CV429	89.00
CV1450	35.00
CV1526	19.00
CV2185	15.00
CV2191	19.00
CV2193	15.00
CV5119	85.00
CV5320	85.00
CVX389	55.00
D9-110GH	39.50
D10-210GH	45.00
D10-210GH68B	65.00
D10-230GH	35.00
D10-230GM	35.00
D10/293GY/90	55.00
D13-30GH	49.50
D13-47GH/26	69.00
D13-47GH	55.00
D13-51GL/26	85.00
D13-51GM/26	85.00
D13-450GH/01	55.00
D13-471GH/26	55.00
D13-600GM	59.00
D13-610GH	59.00
D13-611GH	59.00
D13-611GM	59.00
D13-630GH	59.00
D14-150GH	75.00
D14-150GM	75.00
D14-172GH/84	59.00
D14-172GR	55.00
D14-172GV	55.00
D14-173GH	55.00
D14-173GM	53.00

D14-173GR	55.00
D14-181GH/98	65.00
D14-181GJ	55.00
D14-181GM	53.00
D14-181GM50	59.00
D14-182GH	59.00
D14-200BE	89.00
D14-200GA/50	85.00
D14-200GM	75.00
D14-210GH	75.00
D14-270GH/50	75.00
D14-310W	110.00
D14-320GH/82	85.00
D14-340GH/KM	45.00
D14-340KA	45.00
D16-100GH	65.00
D16-100GH/65	69.00
D16-100GH/67	65.00
D16-100GH/79	69.00
D16-100GH97	65.00
D18-160GH	69.00
D21-10GH	65.00
DB7 36	35.00
DB7 36	55.00
DG7 5	55.00
DG7.32	45.00
DH3.91	55.00
DH7.91	45.00
DP7 5	35.00
DP7.6	45.00
DN13.78	35.00
F16-101GM	75.00
F16-101LD	75.00
F21-130GR	75.00
F21-130LC	75.00
F31-10GM	75.00
F31-10GR	75.00
F31-10LC	75.00
F31-10LD	75.00
F31-12LD	75.00
F31-13GR	75.00
F31-13LD	75.00
F31-13LG	75.00
F41-123LC	185.00
F41-141LG	185.00
F41-142LC	185.00
M7-120W	19.00
M14-100GM	45.00
M14.100LC	45.00
M17-151GVR	175.00
M17-151GR	175.00

M19-103W	55.00
M23-110GH	55.00
M23-112GM	55.00
M23-112GV	55.00
M23-112GW	55.00
M23-112KA	55.00
M23-112LD	55.00
M24-120GM	59.00
M24-120LC	59.00
M24-120WAR	59.00
M24-121GH	55.00
M28-12GH	55.00
M28-13LC	49.00
M28-13LG	49.00
M28-13GR	49.00
M28-131GR	55.00
M28-133GH	55.00
M31-101GH	55.00
M31-182GR	55.00
M31-182GV	53.00
M31-184W	65.00
M31-184GH	65.00
M31-184P31	65.00
M31-186W	69.00
M31-190GH	55.00
M31-190GR	55.00
M31-190LA	55.00
M31-191GV	55.00
M31-220W	59.00
M31-270GY	65.00
M31-271P31	65.00
M31-271GW	65.00
M31-271W	65.00
M36-141W	75.00
M36-170LG	75.00
M38-103GR	65.00
M38-120W	65.00
M38-120WA	65.00
M38-121GHR	65.00
M38-121LA	65.00
M38-122GW	65.00
M38-140LA	65.00
M38-142LA	65.00
M38-341P31	65.00
M38-344P39	65.00
M40-120W	59.00
M43-12LG/01	65.00
M44-120LC	65.00
M44-120GR	65.00
M50-120GH	65.00
M50-120GR	65.00

M50-120GV	65.00
M50-120LC	65.00
M61-120W	75.00
S6AB	45.00
SE4/D-P7	45.00
SE42BP31AL	55.00
SE42BP31	55.00
SE5Fp31	55.00
T937	65.00
T948N	65.00
T948H	65.00
V4150LC	55.00
V5004GR	59.00
V5004LD	59.00
V6001GH	65.00
V6007DP31	59.00
V6008GH	59.00
V6034WA	59.00
V604CLA	59.00
V6048J	49.00
V6052GR	65.00
V6064BP31	55.00
V6064CLA	55.00
V6069GH	55.00
V6070P31	49.00
V7016A	65.00
V7030	59.00
V7031GH	59.00
V7031/67A	59.00
V7035A	49.00
V7037GH	45.00
V8004GR	65.00
V8006GH	65.00
V8010A	65.00
VCR139A	11.50
2BP1	13.50
3BP1	11.50
3DP1	11.50
4EP1	30.00
3H/OBM	55.00
3WP1	18.50
5BP1	9.00
5BHP1	30.00
5BHP1FF	30.00
5BHP31	30.00
5CP1	10.00
6EP7/S	39.00
13BP1	13.50
13BP4	17.50
17DWP4	25.00
32J/1085	69.00
88D/88B/89D/89L	15.00
1273	39.00
1564	39.00
1844	45.00
55451GM	75.00
9442E1	80.00
95447GM	75.00
95449	75.00
7709631	79.50

TAPE HEADS

Mono Head	1.80
Auto Reverse	3.50
Stereo Head	2.95

ELECTRO-OPTICAL

9677M	22.00
P4231BAM	19.00
XP1002	29.00
XP1117M	24.00
XP42040	38.00
9524H	28.00

SEMICONDUCTORS

AAY12	0.25
AC126	0.45
AC127	0.20
AC128	0.28
AC128K	0.32
AC141	0.28
AC141K	0.34
AC142K	0.45
AC176	0.22
AC176K	0.31
AC187	0.25
AC187K	0.28
AC188	0.25
AC188K	0.37
AD142	0.79
AD143	0.82
AD149	0.70
AD161	0.39
AD162	0.39
AD161/2	0.90
AF106	0.50
AF114	1.95
AF121	0.60
AF124	0.65
AF125	0.35
AF126	0.32
AF127	0.65
AF139	0.40
AF150	0.60
AF178	1.95
AF239	0.42
AU106	4.50
AU107	3.50
AU110	3.50
AY102	2.95
BC107A	0.11
BC107B	0.11
BC108	0.10
BC108A	0.11
BC108B	0.12
BC109	0.10
BC109B	0.12
BC109C	0.12
BC114A	0.09
BC116A	0.15
BC117	0.19
BC119	0.24
BC125	0.25
BC139	0.20
BC140	0.31
BC141	0.25
BC142	0.21
BC143	0.24
BC147A	0.12
BC147B	0.12
BC148A	0.09
BC148B	0.09
BC149	0.09
BC153	0.30
BC157	0.12
BC158	0.09
BC159	0.09
BC161	0.28
BC170B	0.15
BC171	0.09
BC171A	0.10
BC171B	0.10
BC172	0.10
BC172B	0.10
BC172C	0.10
BC173B	0.10
BC174	0.09
BC174A	0.09
BC177	0.15
BC178	0.15

BC182	0.10
BC182LB	0.10
BC183	0.10
BC183L	0.09
BC184LB	0.09
BC204	0.10
BC207B	0.13
BC208B	0.13
BC212	0.09
BC212L	0.09
BC212LA	0.09
BC213	0.09
BC213L	0.09
BC214	0.09
BC214C	0.09
BC214L	0.09
BC237B	0.09
BC238	0.09
BC239	0.12
BC251A	0.12
BC252A	0.15
BC258	0.25
BC258A	0.39
BC284	0.30
BC300	0.30
BC301	0.30
BC303	0.26
BC307B	0.09
BC327	0.10
BC328	0.10
BC337	0.10
BC338	0.09
BC347A	0.13
BC461	0.35
BC478	0.20
BC527	0.20
BC547	0.10
BC548	0.10
BC549A	0.10
BC550	0.14
BC557	0.08
BC557B	0.08
BC558	0.10
BC639/10	0.30
BCY33A	1.60
BD115	0.30
BD124P	0.59
BD131	0.42
BD132	0.42
BD133	0.40
BD135	0.30
BD136	0.30
BD137	0.32
BD138	0.30
BD139	0.32
BD140	0.30
BD144	1.10
BD150C	0.29
BD159	0.65
BD160	1.50
BO166	0.55
BD179	0.72
BD182	0.70
BD201	0.83
BD202	0.65
BD203	0.78
BD204	0.70
BD222	0.46
BD223	0.59
BD225	0.48
BC232	0.35
BD233	0.35
BD234	0.35
BD236	0.49
BD237	0.40

BD238	0.40
BD242	0.65
BD246	0.75
BD376	0.32
BD410	0.65
BD434	0.65
BD437	0.75
BD438	0.75
BD520	0.65
BD538	0.65
BD597	0.95
BD701	1.25
BD702	1.25
BD707	0.90
BDX32	1.50
BF115	0.35
BF119	0.65
BF127	0.39
BF154	0.20
BF158	0.22
BF160	0.27
BF167	0.27
BF173	0.22
BF177	0.38
BF178	0.26
BF179	0.34
BF180	0.29
BF181	0.29
BF182	0.29
BF183	0.29
BF184	0.28
BF185	0.28
BF194	0.11
BF195	0.11
BF196	0.11
BF197	0.11
BF198	0.16
BF199	0.14
BF200	0.40
BF241	0.15
BF245	0.30
BF257	0.28
BF258	0.28
BF259	0.28
BF271	0.26
BF273	0.18
BF336	0.34
BF337	0.29
BF338	0.32
BF355	0.37
BF362	0.38
BF363	0.65
BF371	0.25
BF394	0.19
BF422	0.32
BF423	0.25
BF457	0.32
BF458	0.36
BF467	0.68
BF595	0.23
BF597	0.25
BFR39	0.23
BFR40	0.23
BFR81	0.25
BFR88	0.30
BFR90	1.50
BFR91	1.75
BFT42	0.35
BFT43	0.35
BFW61	0.60
BFW92	0.85
BFX29	0.30
BFX84	0.26
BFX85	0.32
BFX86	0.30

BFX88	0.25
BFY50	0.21
BFY51	0.21
BFY52	0.25
BFY90	0.77
BLY48	1.75
BR100	0.26
BR101	0.49
BR103	0.55
BR303	0.95
BRC4443	1.15
BRY39	0.45
BT100A/02	0.85
BT106	1.49
BT116	1.20
BT119	3.15
BT120	1.65
BU105	1.95
BU108	1.69
BU124	1.25
BU125	1.25
BU126	1.60
BU204	1.55
BU205	1.30
BU208	1.39
BU208A	1.52
BU208D	1.85
BU326	1.20
BU326S	1.50
BU407	1.24
BU500	2.25
BU508A	1.95
BU526	1.90
BU807	2.25
BUY20	2.15
BUY69B	1.70
MJ3000	1.98
MJE340	0.40
MJE350	
MJE520	0.48
MJE2955	
MPSA13	0.29
MPSA92	0.30
MRF237	4.95
MRF450A	13.95
MRF453	17.50
MRF454	26.50
MRF455	17.50
MRF475	2.95
MRF477	10.00
OC16W	1.95
OC23	1.50
OC29	2.25
OC36	2.25
OC42	0.75
OC44	0.75
OC45	0.55
OC70	0.45
OC71	0.55
OC75	0.95
OC81	0.50
OC16W	2.50
R2008B	1.45
R2010B	1.45
R2322	0.58
R2323	0.66
R2540	2.48
RCA16334	0.90
RCA16335	0.80
S2060D	0.95
SKE5F	1.45
TIP29	0.40
TIP29C	0.42
TIP30C	0.43
TIP31C	0.55

TIP32C	0.42
TIP33C	0.95
TIP34B	0.95
TIP41A	0.45
TIP41C	0.45
TIP42C	0.47
TIP47	0.65
TIP120	0.60
TIP125	0.65
TIP142	1.75
TIP146	2.75
TIP161	2.95
TIP2955	0.80
TIP3055	0.55
TIS91	0.20
TV106/2	1.50
ZRF0112	16.50
2N1100	6.50
2N1308	1.35
2N1711	0.30
2N2219	0.28
2N2905	0.40
2N3053	0.40
2N3054	0.59
2N3055	0.52
2N3702	0.12
2N3703	0.12
2N3704	0.12
2N3705	0.20
2N3706	0.12
2N3708	0.12
2N3733	9.50
2N3773	2.75
2N3792	1.35
2N4280	3.50
2N4427	1.95
2N4444	1.15
2N5294	0.42
2N5296	0.48
2N5298	0.60
2N5485	0.45
2N5496	0.95
2SA329	0.95
2SA715	0.60
2SC495	0.80
2SC496	0.80
2SC931D	0.95
2SC1096	0.80
2SC1106	2.50
2SC1172Y	2.20
2SC1173	1.15
2SC1307	1.75
2SC1364	0.50
2SC1449	0.50
2SC1678	1.25
2SC1945	2.65
2SC1953	0.95
2SC1957	0.80
2SC1969	1.95
2SC2028	1.15
2SC2029	1.95
2SC2078	1.45
2SC2091	0.85
2SC2098	2.95
2SC2166	1.95
2SC2314	0.80
2SC2371	0.36
2SC931D	0.95
1SD234	0.50
2SD325E	1.65
3N211	2.95
3SK88	0.95

VIDEO SPARES

HEADS

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BA156	0.15
BA157	0.30
BAX13	0.04
BAX16	0.06
BB105B	0.30
BT151	0.79
BY126	0.10
BY127	0.11
BY133	0.15
BY164	0.45
BY176	1.20
BY179	0.63
BY182	0.55
BY184	0.35
BY199	0.40
BY206	0.14
BY208-800	0.33

BY210-800	0.33
BY223	0.90
BY298-400	0.22
BY299-800	0.22
BYX10	0.20
BYX36-150R	0.20
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IN5402	0.14
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VA1056S	0.23
VA1104	0.70
VAT8650	0.46
VA1097	0.25

BZY88 0.07

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DL63 1.00
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DL73 2.50
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EB91 0.60
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EBF93 0.95
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ECH83 0.78
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ECL82 0.85
ECL81 0.55
ECL83 2.50
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EF73 1.00
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EL41 3.50
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EL81 6.95
EL82 0.58
EL83 5.95
EL84 0.75
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EL90 2.15
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PCC88 0.70
PCC89 0.70
PCC189 0.70
PCC805 0.70
PCC806 0.80
PCE82 0.80
PCF80 0.65
PCF82 0.60
PCF84 0.65
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PCF87 0.40
PCF200 1.80
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YL1000 9.50
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YL1071 195.00
YL1290 59.50
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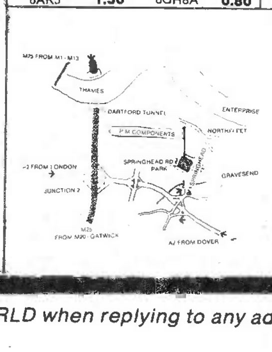

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DAMP DETECTOR

If your bidet's bubbling over, you'll want to know before it starts dripping into your cornflakes

Terry Pinnell has the answer

Domestic disasters are mercifully few and far between in our household. One was that time the ceiling fell in. Well, not the entire ceiling, one corner of it, but by the time we had paid for replastering and repainting, I recall regarding it as definitely worthy of the 'disaster' label.

The cause was distinctly out of proportion to the effect. A simple matter of water seeping through the sealing around the edge of a bath and through the other kind of ceiling down below. Anyway, repairs complete, my mind turned to future avoidance. Ideally I wanted a more helpful warning of trouble than the appearance of another ominous stain.

At last, a real motive to make an electronic water sensor!

The first step was to do a little research and dig up some suitable designs from the available literature. Altogether I found 13 circuits, 6 from books and 7 from old magazines. These fell into two reasonably distinct categories, as follows.

Rain or water alarms

These typically detected water present in substantial volume. Applications included a bath reaching a certain level, rain falling on an outdoor strip of Veroboard, an overflowing washing machine, a flooded bilge in a boat, and so on.

With one exception, all ten of the circuits in this category were based on the principle shown as a block diagram in *Figure 1*.

In the presence of water or any other liquid which conducts adequately, the sensor, usually just a pair of wires or other suitable probes, passes sufficient current to bias a transistor into the 'on' state, or enable a CMOS or TTL gate, thereby activating an oscillator circuit. This drives a suitable loudspeaker, typically of around 64 to 80 ohms.

Variations on this theme were mainly in the type of oscillator circuit, the most popular being the complementary astable, using one npn and one pnp transistor. Some circuits activated a relay rather than an audio oscillator, allowing bells, buzzers or lights to become the output signal.

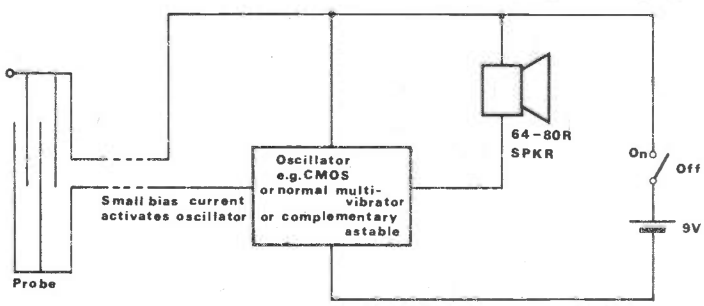


Fig 1 *Block diagram of typical water alarm*

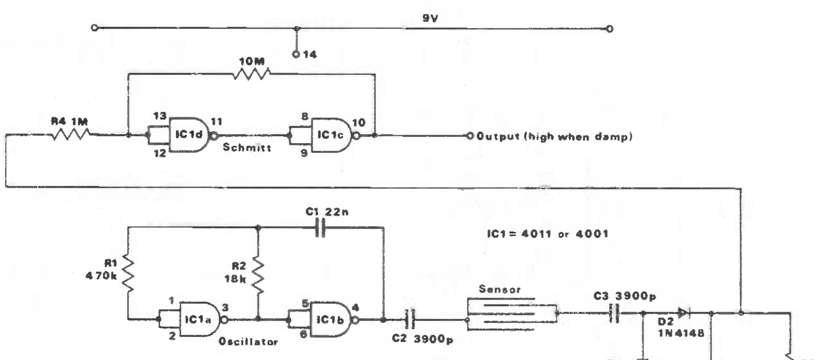


Fig 2 *The experimental ac circuit*

An exception

The exception I mentioned was interesting because it was the only one which acknowledged a possible snag with the usual type of circuit. This is the tendency for probes using direct current to become corroded over a longish period. This circuit therefore used ac instead, which its author claimed drastically reduced corrosion due to the electrolytic effect.

It employed a 4093, which I did not have in my stock of CMOS ICs, so I redesigned it for the more popular 4011 or 4001, so that I could experiment a little with it. The circuit is shown in *Figure 2*.

As you see I have only shown the first part of the circuit, ie up to the point at which an output is produced which can be used to activate either a simple low power oscillator or a relay as before.

Operation is straightforward. The first two gates, IC1a and IC1b, are used as inverters (ie their inputs are connected directly together) and with R1, R2 and C1 form a simple oscillator. The frequency of this did not appear at all critical; I used components at hand and these gave about 3kHz. This, our ac signal, is passed via an isolating capacitor to one 'side' of the sensor, eg one of two wires immersed in the container or whatever.

If there is a sufficiently conductive path due to the presence of liquid, this signal is passed on to the next circuit element, a doubler/rectifier. This produces a dc signal from the ac one. So if the amplitude of the ac signal passing through is large enough, a high voltage (ie close to the 9V supply) will be passed on to the next element, a Schmitt trigger.

Briefly, all this does is produce a 'snap-action' effect, so that as soon as the dc voltage at its input (the left-hand side of R4) reaches a certain level, say 4 or 5V, its output (pin 10 of IC1) will suddenly change from 0V to 9V. This high output of the Schmitt can then be used in precisely the same way as before to activate an audio oscillator or relay, etc.

Moisture detectors

The three examples of these were all concerned with testing indoor or outdoor soil conditions. This category was potentially of most interest for my own application, as I wanted to spring into action when things got damp, not wet.

However, none of them at first sight did all that I wanted. This prompted me to list

the functions I required in my own design:
Battery operated – bathroom!
Negligible quiescent current consumption – so that I could forget about changing the battery for a year or so.
No action required – ie able to leave it switched on. I expected this to be easy to achieve if consumption was negligible. Note that this doesn't mean that an on/off switch was unnecessary, because it still needs switching off after the alarm has sounded.
Audible alarm – should be loud enough to be heard downstairs in reasonably quiet conditions (which I assumed would occur for a few seconds or so at some time before the battery ran out).
Reliable switching – one characteristic of most of the circuits I had seen was their inability to deal properly with the 'intermediate' condition I wanted, when the bathroom floor was neither flooded nor bone dry. What I did not want was for it to switch on and off irritatingly when conditions were in this half and half stage, but to give a nice positive indication at the first sign of damp. Clearly a case for a Schmitt trigger.
Simple and cheap – these usually go together (although common exceptions are specialised easy to use ICs, which tend to be pricey).

A happy state

The circuit evolved to meet my requirements is shown in *Figure 3*. When a happy state of dryness prevails under the bath, the resistance across the sensor is very high, ie many megohms, and as the sensor and R1 are arranged as a potential divider across the 9V supply, the input voltage at the left of R2 is close to zero.

IC1a and IC1b are two gates of a 4011 CMOS IC arranged as a Schmitt trigger.

Any Schmitt trigger has the important characteristic that its output changes abruptly from low to high when its input increases above a certain voltage,

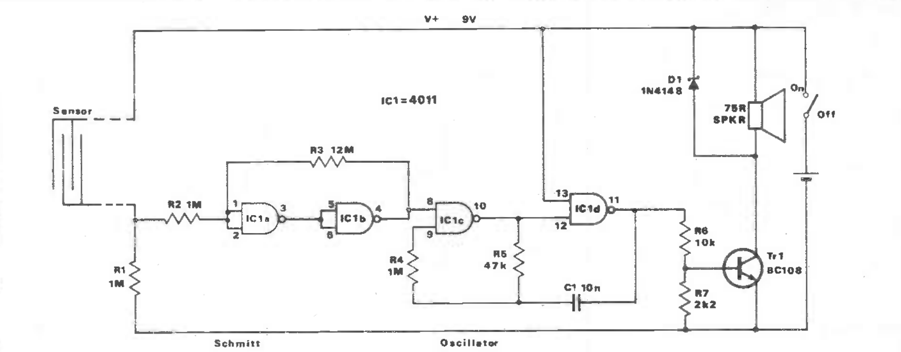


Fig 3 *Final circuit of the damp detector*

usually called the upper trip level. The output changes abruptly back to low again if the input voltage is reduced below a lower trip level.

The key point is that this lower trip level is *lower* than the upper trip level, so that if the circuit swings high at, say, 6 volts input, it will only swing low again if the input voltage goes below, say, 5V. This difference, 1V in this imaginary example, is called hysteresis.

It is a kind of backlash effect, and in our damp detector ensures that if the input voltage gradually increases from close to zero up to the trigger point, ie up to the upper trip level, due to the insidious leakage of water round the edge of the bath, then the alarm will go on *and stay on* until someone does something about it, rather than go on and off intermittently as it dries out a little then gets damper and so on.

Schmitts can be made out of discrete transistors (bipolar or FETs), TTL logic ICs, 555 timer ICs or 741 op amps. In my damp detector the specification for negligible quiescent current consumption prompted me to choose CMOS.

The hysteresis, H, of a simple CMOS Schmitt trigger is very easy to calculate:

$H = V_{supply} \times R_{input} \div R_{feedback}$

In our circuit R_{input} is 1M and $R_{feedback}$ is 12M, so

$H = 9 \times 1 \div 12 = 0.75V$

The upper and lower trip levels would then be evenly spaced above and below the gate transition voltage which is roughly half the supply voltage.

In the specific case of our damp detector we could therefore expect the output of the Schmitt to swing high when the input was approximately 4.5 + 0.4, ie 4.9V, and to swing low again if the input goes below 4.5 – 0.4, ie 4.1V.

Some variation

Actually the transition voltages of individual IC chips varies a bit, depending on manufacturing tolerances etc, so don't expect a precise correspondence of theory and practice.

When testing the finished circuit the actual values I measured were as follows:

Upper trip level = 5.74V
Lower trip level = 4.77V

So the actual hysteresis was a little higher than the .75V calculated (but I recently measured the actual supply voltage of the PP9 battery, which has been installed for nearly two years, as 9.5V, and my 12M resistor proves to be 11.85M.

Feeding these values into the formula above yields a result of .8V hysteresis, which is a bit closer).

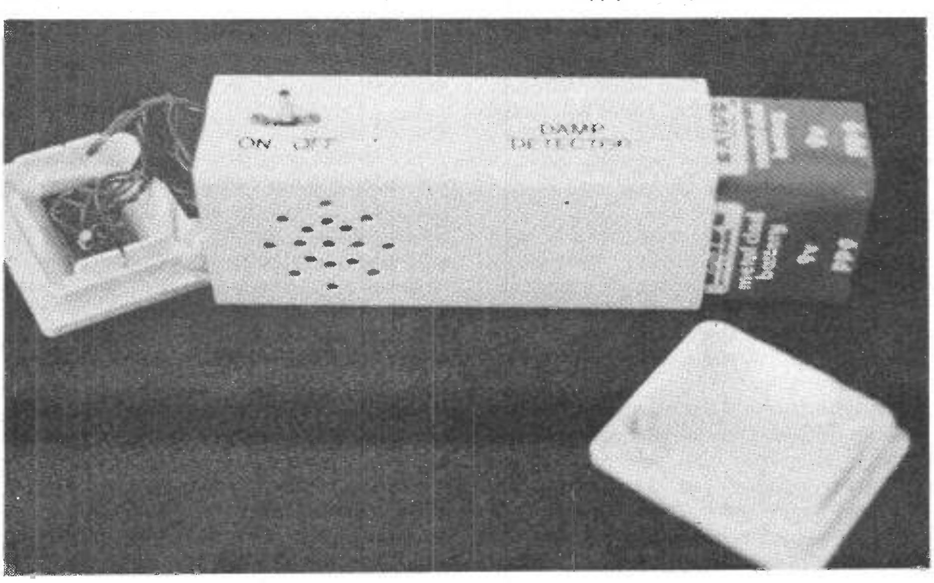
Incidentally, remember to use a high impedance meter (10M or more) when taking such voltage readings, as the results will otherwise be misleading.

To test the circuit before entrusting it to its lonely vigil in the bathroom, kitchen, garage or wherever, you can simply use a high value potentiometer in place of the final sensor. I used a 1.5M pot, and by carefully increasing it measured the two 'trip points' as:

Upper trip point = 650k (output goes high and alarm sounds).
Lower trip point = 1M (output goes low and alarm stops)

Remember to remove at least one side of the test pot to measure its resistance after detecting the switch of output.

The Schmitt output is used to enable or disable (ie to start or stop) the oscillator,



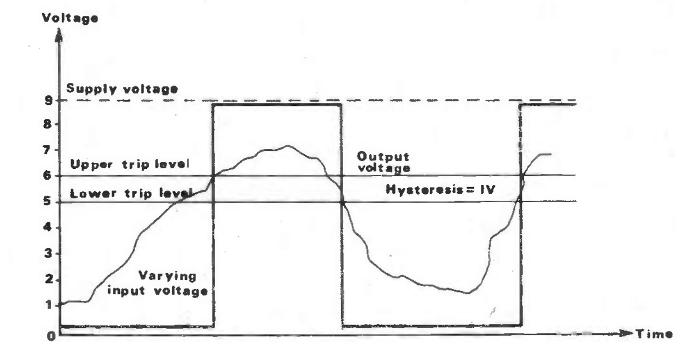


Fig 4 Schmitt trigger operation

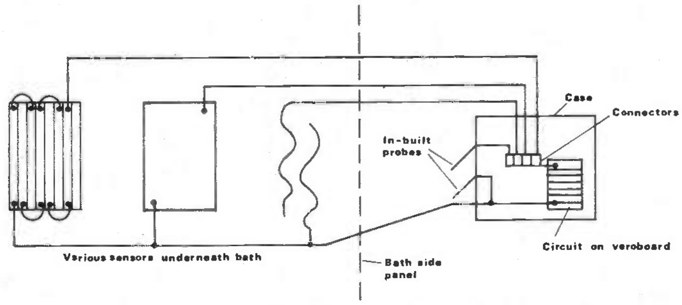


Fig 5 Sensor wiring

made out of the other two gates of our 4011 chip.

CMOS gated oscillator

If you look back at *Figure 2*, the CMOS oscillator there was a simple, ungated version; when power was applied it oscillated. In *Figure 3*, on the other hand, pin 8 is used as the enabling pin. When this is low, the oscillator is inactive; when pin 8 is high, however, oscillation occurs. Its frequency is determined by the values of R4, R5 and C1, and in my damp detector was about 1kHz, chosen after experiment.

When inactive it is of course important that the oscillator output from pin 11 is low. If it was high then a dc current would flow through the speaker, as Tr1 would be on.

One other difference between this CMOS oscillator and that in *Figure 2* is that pin 13 goes to V+. Actually this is immaterial; I could equally well have connected pins 12 and 13 together . . . I seem to recall wiring it like this out of curiosity.

Output stage

It probably seems generous to call the five remaining components a 'stage', but logically that is what they constitute. Tr1 is switched on and off by the CMOS oscillator output, via the potential divider R6 and R7, which provides additional current limiting as well as ensuring that Tr1 goes fully off when pin 11 is low, thus achieving our design aim of a negligible standby current.

Tr1 drives the speaker, which has a sufficiently high resistance to limit the collector current through the transistor to its permissible level (when Tr1 is on most of V+ appears across the speaker, so the maximum current at those times would be about 9 ÷ 75, around 120mA).

D1 protects Tr1 against high switching voltages induced in the speaker windings. I've seen many circuits which do not include this feature, so I remain uncertain just how necessary it really is; better safe than sorry, anyway, and a 1N4148 or similar costs next to nothing.

There is nothing critical about any of these components and you could cheerfully use any reasonably similar values you may have to hand. If you want to try a low impedance speaker, however, say an 8 ohm miniature, then you should use a small power transistor for Tr1, with an adequate current and power dissipation rating (you may then find that it gets insufficient base current through R6, so experimenting may be necessary).

Construction

I used a small piece of 0.1 inch Veroboard in constructing the damp detector. The finer details of construction will depend on the size and shape of your choice of case and speaker. You may even want to use a smaller battery if space is critical.

Use a holder for IC1, and insert the chip last to minimise the risk of damage. I use a holder for *all* ICs now, so that on those regrettably frequent occasions that my projects don't work *(here speaks an honest man! – Ed)*, I can easily swap the chips without the misery of desoldering.

The case I used was a little unusual, being a piece of plastic drain-pipe with press-fit ends. I bought quite a length of this from a local DIY shop, together with a dozen end pieces, and used it on several projects. At the time it was pretty economical, but I'm not sure about current prices. The end pieces are the constraining factor, because although insignificant at the ends of a 20 foot length of guttering, they start to look pricey on an 8 inch case.

A really nice feature of this Marley section is that it is a perfect fit for PP9 batteries, as you can see from the photograph on the previous page.

Although the word 'sensor' is used in the circuit diagram, in practice of course there can be any number of them wired in parallel. I used five. Four were placed at various strategic points under the bath, and the other was a last minute decision to build in a couple of wires to the underside of the case, so that obvious 'local' flooding would not be overlooked.

A couple of my sensors were just lengths of bare wire laid close together on top of the plasterboard. The others were pieces of Veroboard a few inches square, with alternate rows wired together. These were placed copper side down in spots likely to get the first of any future leaks.

Two wires lead from each sensor, one being connected in common at a convenient point under the enclosed bath. All five resulting wires were then connected inside the case, together with the pair from the in-built probe, and taken to the Veroboard, as shown in *Figure 5*.

The reason for keeping one of each of the pair of wires separate until they are all eventually connected inside the unit itself was so that the resistance of each one could be measured conveniently, without having to take the side panel off the bath, in the event of the alarm being triggered. This has proved useful in practice, because short of an out and out flood it is by no means always clear where the damp spot is. A quick check with the ohmmeter soon narrows it down.

Conclusions

The damp detector has been in place for about four years now and has probably been activated in anger about three times during that period, ie excluding spillages from the wash basin or direct hits from the shower. On each of those three occasions close examination indicated worn sealant, precisely the original cause, and it was promptly renewed (usually by my wife, I have to admit; my only attempt proved messy to say the least). So I think it can be claimed to have justified its existence.

Very recently it gave its first false alarm, ultimately traced to a probe becoming a bit corroded. The next model will be an ac version! REW

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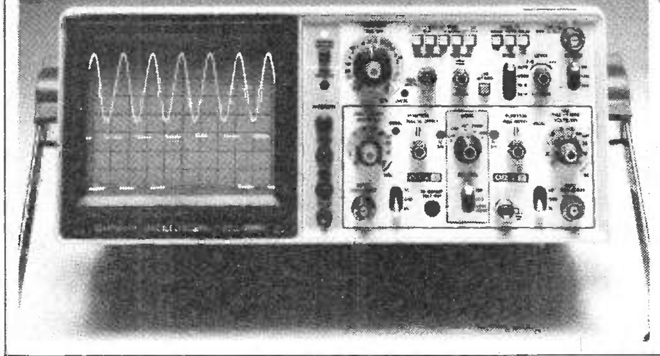

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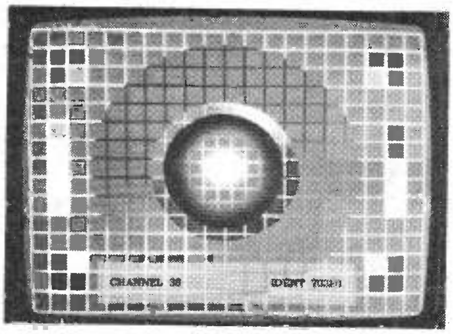
DX-TV RECEPTION REPORTS



Compiled by Keith Hamer and Garry Smith

January was, in general, an inactive month for DX-TV, a fact reflected by the log reports. Like most months during the winter there were one or two highlights, the most notable being a sporadic-E opening on the 22nd. It started during the afternoon and sustained signals were reported as lasting for well over an hour.

Reception was from the south-east, with test transmissions from Yugoslavia on channel E3 and cartoons from Italy on channel IA. Signals were also present on channels R1 and R2 from 1545, but unfortunately programmes were in progress, making station identification virtually impossible. The most likely source was Hungary, from the high power transmitters at Budapest and Pecs.

The Quadrantids meteor shower produced intense activity during the month on Band I frequencies. The best days were the 3rd and 4th. Unfortunately, most 'pings' were of programmes with very few test cards or identification captions. However, not all reception via meteor shower was of short duration. Some activity lasted for twenty seconds or more, creating the effect of messy and patchy sporadic-E propagation.

Reception via enhanced tropospheric conditions was virtually non-existent for most of the month. It would appear that a couple of French stations did penetrate as far north as Leeds on the 9th!

DX-TV log for January

The following rather sparse log shows reception conditions noted by the authors in Derby. It seems typical of most other enthusiasts' results elsewhere in the UK.

2/1/86: CST (Czechoslovakia) on channel R1 with the 'EZO' electronically generated test pattern bearing the 'RS-KH' identification and an unidentified transmission on R1 consisting of a female announcer.

3/1/86: Frantic activity via meteor shower but only on programmes.

4/1/86: Further meteor shower activity but, again, only programmes were noted, making positive station identification difficult.

7/1/86: Unidentified feature film noted on channel R1 via short duration meteor shower activity.

10/1/86: Danmarks Radio (DR-Denmark) on channel E3 from the Fyn transmitter showing the PM5534 test card and the identification 'DR DANMARK'. CST on R2 with the 'RS-KH' test card.

12/1/86: SR-1 (Sweden) on channel E2 radiating the 'TV1 SVERIGE' PM5534 test card. Unidentified programme noted on channel R2.

13/1/86: Unidentified caption on channels E3 and E4 consisting of a figure or head in the centre of the screen with two fairly wide dark stripes either side. This could have been some form of opening caption. Did anyone else see this?

19/1/86: Unidentified cartoon received at 0954 on channels E2 and E3.

22/1/86: Unidentified female announcer (not from TSS-Russia) on R1 and R2. The signal faded before the appearance of an identification caption or programme credits. JRT (Yugoslavia) on E3 with no less than three test cards. RAI (Italy) on IA with cartoons, including *Popeye*. JRT on E4 showing a 'Studio Zagreb' caption. This was followed by Sportski Program which featured a basketball match.

Watch those test cards

The start of the 1986 sporadic-E season is only a few weeks away. A close watch on any test card identification should be maintained, as it may provide a clue as to the transmitter of origin. Unfortunately some countries carry a national identification. For example, Sweden radiates the 'TV1 SVERIGE' inscription on their PM5534 test card from all transmitters in Band I, thus making it practically impossible to ascertain the exact source of reception.

The Yugoslavian reception noted on January 22nd provided a good example of how useful regional identifications can be. The first JRT test card to be received bore the inscription 'JRT BGRD' in the lower black rectangle of the PM5544. This indicated that the studios at Beograd (Belgrade) were responsible for its origination. The nearest channel E3 transmitter to Beograd is Kapaonik with an ERP of 50kW. A co-channel test card appeared carrying the identification 'RTV LJNA'. This later switched to 'RTV' at the top and 'LJUBLJANA' at the bottom. The nearest E3 outlet to Ljubljana is at Kum in the far north of the country. Its ERP is also 50kW.

Possibly the best form of identification is used by NRK in Norway. The name of the actual transmitter is normally included on the PM5534 and thus provides positive identification. It reminds us of the good old days in the UK when the ITA, as it was then called, included details of the transmitter site at the bottom of test card 'D' during the mid-sixties.

Reception reports

Andy Webster of Billinge, near Wigan, telephoned to say that January had been the bleakest month for TV DX. The reason is quite simple; his aerials came down during severe gales earlier in the year. Andy reported that the 1½in diameter mast carrying the aerials had snapped just above the rotator, bringing the whole lot down onto the roof. His Band I beam was clamped approximately six inches above the rotator, with the Band III and UHF arrays above this. We feel that the Band I clamp would have been in a better position immediately above the rotator. This may have helped to prevent sway in the beam from exerting strain on the mast. We have adopted this idea on several systems, so far without any problems.

Lunchtime loggings

Several lunchtime test cards have been logged by Simon Hamer of New Radnor in Powys during the month. The Telefunken TO5 monoscopic test card appeared from Austria on channel E2a on the 5th. This particular monochrome test card has been used for many years and carries the identification 'ORF FS1'. The FuBK test pattern from the West German channel E2 transmitter at Grünten was resolved on the 9th. This outlet radiates programmes from the BR service.

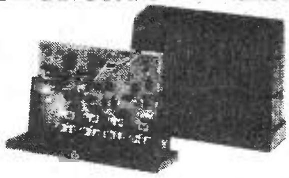
An interesting pattern from the south on channel E2 was logged by Simon on the 12th. It was a chessboard pattern, similar to the one used by TVE in Spain. This pattern hasn't been seen very much in recent times. Perhaps the colour bar pattern generator had packed in!

Iain Menzies of Aberdeen also saw lots of DX via meteor shower on the 3rd. The following day, while playing with his tuner, he heard a very strong vision buzz on the French L3 channel in Band I at 1350GMT.

Auroral activity was present on the 6th (an aurora was in evidence 27 days earlier) resulting in signals from Norway on channels E2 and E3, and Russia on R2. The 11th proved interesting, with performing bears on push bikes at 1630 on R1 and R2. The programme is thought to have originated in Hungary.

Norway on E2 and Russia on R1 were logged via sporadic-E on the 21st at 1950, while on the 22nd Iain noted programmes from RAI-Italy on channel IA with a carrier frequency of 53.745MHz. Presumably he was using a scanner to be aware of this offset.

Rijn Muntjewerff of Beemster in the Netherlands has forwarded his impressive log which covers the tropospheric opening noted last October. The entries seem endless, with many Russian Band III and UHF transmissions. One of the recently opened Danish local stations came through on channel E54, fortunately on test card. Rijn's sporadic-E



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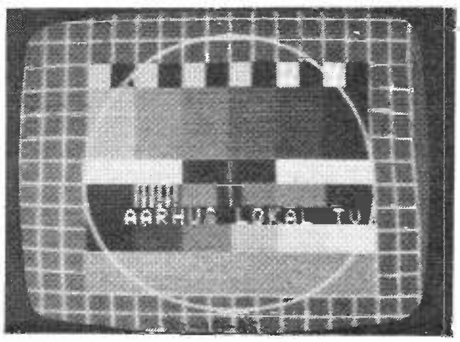
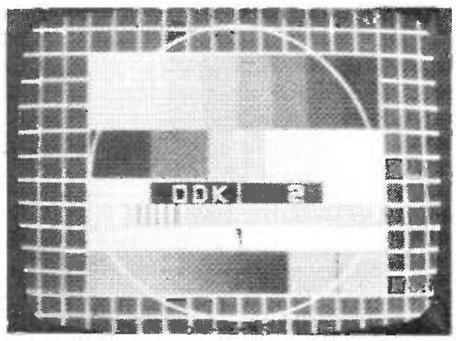
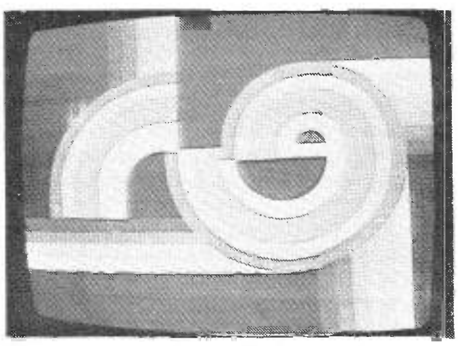


Test card radiated by one of the regional TV services in Denmark on channel E54

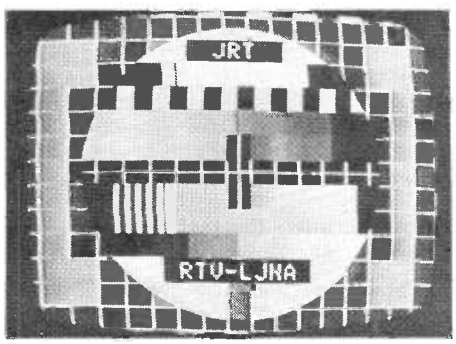
An unusual test card used by Italian pirate station L'Antenna



FuBK test card used by the 2nd network in Czechoslovakia (CST-2) with 'ODK 2' ident



Opening caption transmitted by the TV service in Egypt



PM5544 test card from Yugoslavia showing the use of regional ident from Ljubljana

Identification caption radiated by the new Danish TV service, 'Kanal 2' successes during January include Russia on R1 and R2, Norway on E2 and E3, Spain (2nd network on channel E2) and RTP-Portugal from the channel E3 outlet at Lousa.

Finally, Brian Cole G1DXC would like to know if there is a supplier of tuners with an IF of 10.7MHz covering the Eastern-bloc OIRT FM radio band which operates roughly between 63MHz and 73MHz. If anyone can help, please write to Brian at 32 Catherton, Stirchley, Telford, Shropshire TF3 1YT, or to the authors via *Radio and Electronics World.*

Italian pirate mystery solved

Kevin Jackson of Leeds has forwarded details of the new Italian private/pirate station which appeared on many DXers' screens during the latter part of the 1985 sporadic-E season. It is called 'Radio Tele Uno' and it is located at Tarvisio on the border with Austria, near Udine. The station operates on channel IA but, at the moment, the ERP is not known.

It is interesting to note that the other private station 'Nord Center Television', shares this channel in the same area of Italy. The test card used by Radio Tele Uno is very similar to that radiated by the relatively new Danish service, Aarhus Lokal TV.

How to become a DXer – part 2

Last month we gave details about sporadic-E propagation in relation to DX-TV reception. Although this is possibly the most interesting form of TV DX, the easiest method is via enhanced tropospheric conditions. Provided that the enthusiast is not too interested about receiving sound channels, a domestic UHF TV can be used. Transmissions via this mode of propagation are often available from countries such as Belgium, West Germany and the Netherlands. Occasionally signals at UHF from further afield may be seen.

The troposphere extends to about 7,500 metres above the surface of the Earth. Slow moving areas of high pressure can affect television reception at irregular intervals. This type of weather pattern, often referred to as 'anticyclonic', produces clear blue skies by day and clear but cold nights. The Earth warms up during the day due to the lack of cloud cover but at night the accumulated heat is allowed to escape quickly. This heating and cooling process inevitably leads to inversions of temperature. The troposphere then acts as a waveguide, directing TV signals of above approximately 60MHz back to the Earth.

This type of propagation has the advantage that signals tend to suffer less from rapid fading and phase distortion. The opposite is generally the case with sporadic-E propagation.

For enthusiasts wishing to experiment with tropospheric reception, we recommend that they tune into the BBC weather forecasts in order to keep a check on the Atlantic chart for the appearance of high pressure systems. During intense trop openings it is quite likely that the local TV programmes will suffer from co-channel interference, thus alerting the prospective DXer to possible signals from the Continent.

Aerials for Band I TV

For initial experiments with SpE propagation, a dipole with each element cut to fifty inches will suffice. This roughly corresponds to the centre of the band. The dipole is best mounted horizontally, since most transmissions encountered are horizontally polarised.

Where possible the dipole should be erected externally. The height isn't too important since signals propagated in this way arrive at an angle. Some method of rotation is desirable for maximum signal pick-up, but a second or even third dipole could be installed with simple switching arrangements to select the most productive aerial.

The more serious enthusiast generally progresses to the luxury of a beam in order to receive the weaker signals. A second benefit is improved discrimination between co-channel transmissions arriving from different directions. 3 or 4-element wideband arrays are popular. For a more ambitious system a wideband array plus a couple of single channel aerials for channels E3 and E4, for instance, can be employed.

Aerial availability

Protel, of 295 Ballards Lane, London N12, carry a wide range of aerials suitable for DX reception. Their Band I range consists of fixed dipoles which they will supply cut to any required channel. A 4-element wideband array is available which will suit the needs of the more ambitious DXer. There is also a 4-element channelised design.

The aerials in stock are cut to channel E4, although Protel will construct systems for other Band I channels at no extra cost. For tropospheric reception at UHF, various wideband or grouped arrays are available. For trop DXing in Band III they can supply their own 5-element wideband design or the popular 13-element wideband Triax array.

Complete satellite TVRO systems, which include a multi-standard receiver, can be supplied with dish sizes from 1.2m upwards for really hardened telly addicts! Full details of all these receiving systems plus details about masts, brackets and accessories, can be obtained from Steve Stilwell on (01) 445 4441.

Multiband TV receivers

Various receivers (mainly colour) are now available within the UK without too many problems. However this was not the case a few years ago when enthusiasts had to go to great lengths to obtain multiband equipment.

The French TV company Thomson can supply a 10-inch colour TV/monitor, model TF2502PI. It caters for Bands I/III and UHF. PAL or SECAM colour transmissions can be resolved and the set will operate in Western Europe on systems B, G and I (5.5MHz and 6.0MHz intercarrier sound systems). It does not cover the Eastern European systems D and K (6.5MHz sound), although it will display the picture.

The TF2502PI will receive French system L transmissions and the different standards can be memorised on any of the programme selectors.

A brochure is available from the following UK distributor: Heron Electronics Limited, 1st Floor, Lawford House, 429 Harrow Road, London W10 4RE. Tel: (01) 968 4488.

Service information

Netherlands: The FuBK electronic test card is once again in use by NOS from three transmitters. The test card is radiated prior to the normal test transmission opening time of 0900 local time, and identifications include 'LOPIK', 'GOES' and 'MARKELO'. The latter outlet only broadcasts the FuBK via NOS-1 on channel E7.

It is anticipated that some low power transmitters will come into service for Dutch army personnel stationed in West Germany. An NOS-2 test card has been received on channel E41 from the general direction of West Germany.

Belgium and West Germany: The Belgian BRT transmitter at Bensberg in West Germany is now using channel E25. Previously BRT programmes for Belgian army personnel were on channel E39, but regional transmissions from the WDR-3 outlet at Düsseldorf now occupy this channel.

Belgium: The BRT (Flemish language service) and RTBF (French language service) UHF transmitters at Wavre have been taken out of use on a permanent basis. The reasons are high operational costs and the extensive cable TV systems in the country.

West Germany: New identifications are in use with the FuBK test card radiated by the first network of Norddeutscher Rundfunk (NDR-1). The details are as follows: Hamburg – NDR-1 HAMBURG; Schleswig Holstein – NDR-1 KIEL; all other NDR regions – NDR-1 HANNOVER.

NDR's third network (NDR-3) is also using a new identification on the FuBK test card. It is radiated daily from all third network stations. The inscription is 'NDR-3 HMBG' and originates from Hamburg. A digital clock is incorporated.

The above information was kindly supplied by Gösta van der Linden of Rotterdam, Netherlands. REW

ATV ON THE AIR

Andy Emmerson G8PTH puts you in the picture

This article is being written in what is described as the coldest February since 1947 – all I can say is that I hope the snow has thawed by the time it appears in print!

Sometimes a cold, bright spell gives us an opening on VHF and UHF, but this year there has not even been that to cheer us up. Never mind: I have received a tidy bunch of letters – and promises of more. First, however, I will just mention that the chairman of the Swiss ATV club USAT, Fritz HB9RWD, came to London recently on a rapidly arranged visit. I had the pleasure of meeting him and presenting him with some BATC publications. We spent an interesting afternoon and evening discussing ATV operations in our two countries and agreed on the need to co-operate through the European ATV Working Group.

An interesting point is that in Switzerland ATV is officially banned on 70cm. Banned not by the licensing authorities, but by USKA, the national radio society! They have interpreted literally the IARU 'Brighton' recommendation that 'ATV should move to higher frequencies'. This recommendation was, unfortunately, one of the worst ever made, since the word 'should' is capable of two interpretations, namely 'must' or 'ought to'.

As a result there has been more than one interpretation of the words, and the Swiss have taken the more restrictive one, officially that is. There are, however, twenty-five ATV stations on 70cm. On 24cm there is just one, HB9RWD, but six or seven are also constructing and should be on the air soon. They all use the French (F3YX) FM system, so in future it should be worth keeping an eye open in the Swiss direction on 1255MHz.

70 centimetres

Firstly, I have received a letter all the way from Italy, from Stefano Malaspine I6MQS in Fermo. He says that ATV activity is rather low, just himself and I6CEY, although in Milan there are many more stations. He uses a Microwave Modules transmitter and receiver and has built a Wood and Douglas pattern generator. To compensate for the lack of ATV activity Stefano is into weather satellites and has built a VHF receiver and scan converter. All this works very well and has been a source of great satisfaction.

News is still coming in about the lift last October. For Ron G6GHP in Westgate on Sea (Kent), 13 October was not an unlucky day – he managed to make a P4 contact with John G4HMG in Devon. He also made some good 24cm contacts which I'll cover next. No more 70cm news, so on to higher things.

24 centimetres

On G6GHP's log for 13 October is G3DFL in Warley, who was on 1249MHz; Ron sent to him on 1275. Later, on the 17th he had a hook-up with John G3OGX in Essex. John has just one watt at his disposal but managed to put in a P4 picture in Westgate. This cross-water path is now worked regularly.

In January Ron was successful in working a number of Dutch stations on 24cm. On 27 September he got a P5 report from PE1HLR (after a P5 link-up on 70cm) and on the 30th he worked PE1AAQ and PE1HZR. Both stations were AM, which meant they had to slope detect Ron's signals, but despite this he had P5 reports from 'AAQ and P3 from 'HZR. Both stations were received P5 in AM at Westgate and Ron managed to work them both again on 30 September.

Another kind of 24cm test has been going on in Northamptonshire recently. Charlie Suckling G3WDG, well known for his moonbounce and other 23cm SSB activity, has lately equipped for satellite TV using equipment with an IF of 950 – 1450MHz. He hit on the excellent idea of trying a 23cm receiving aerial connected to the tunable IF downconverter, and asked me to send him some colour and sound signals. I am pleased to say this was a total success. Colour vision and audio signals on 1255MHz were received on 9 February with 10 to 11 carrier to noise margin, despite the slightly unusual receive set-up.

Repeater news

Some repeater news now. GB3UD, near Stoke-on-Trent, is in operation as a manned relay station. Output is just 200mW, and the best DX report to date is G5KS, who is receiving it at P3 strength. It is hoped to raise the power to 6W.

Another machine operating as a beacon and manned relay is Durham, although it is on a temporary site. It uses a pre-production DC-to-Light transmitter generating 2 watts. As soon as the licence is received the repeater will swing into full action. There are also whispers abroad that the Bath repeater may enter service during March.

I have received a nice long letter on smart-looking Bristol FM TV Group paper. It comes from Shaun O'Sullivan G8VPG, who also enclosed a call-up letter addressed to the FM fraternity in and around Bristol. They are very keen to build a TV repeater (FM only) for Bristol and are actively generating local support. Roger Worth G4ZQF and Shaun act as chairman/treasurer and secretary/chief engineer respectively.

Their intention is for a fairly simple repeater (initially), without all the bells and whistles such as teletext pages but with good RF engineering. ATV activity in Bristol is running at a high level now, with several newcomers joining the scene. Besides the usual Wednesday and Sunday local TV nets activity is often seen on other nights. Certainly a call on 144.750 will usually produce a response.

Bottom end

Roger G4ZQF, Chris G8GLQ and Shaun G8VPG carry out most of their exchanges on 24cm FM towards the bottom end of the band. Shaun and Roger are both fully equipped with Wood and Douglas gear, complete with pre/de-emphasis and subcarrier audio. They both use 23-element Tonna antennas.

Chris G8GLQ has mainly home-brew gear, including a 2C39 amplifier. He also has a corner reflector antenna. Len G8UUE is receive only at present but is building Allan Latham's transmitter. He has a Sandpiper helical antenna. Pete G0DRX is equipped with Wood and Douglas gear. Viv G1IXE and Ivor G1IXF are active viewers with Wood and Douglas equipment and a JVL 48-element loop yagi. They are awaiting the DC-to-Light transmitter.

Shaun is starting to dabble with 10GHz but has not had time to progress much. He and Roger have found that on 24cm the addition of Wood and Douglas's pre/de-emphasis modules have produced a staggering improvement in picture quality. Over their obstructed 14km path reports have gone from P2 to P3.5 to P4, with additional improvement in picture stability. So these modules are highly recommended, even if sound is still a bit scratchy (some more development work to be done!).

Another welcome letter has come from Andy Goy G4HJD in the city of Kingston upon Hull. After a great summer fun contest using BCD's call, G6CCV, they decided to carry out some more 1255MHz FM tests. The equipment was working but there was no-one to work during the contest! Andy had more luck in his summer holidays when he worked three of the Worthing stations on 1255MHz on their home ground.

Andy's transmitter is constructed using Wood and Douglas modules and G8KOE's design of audio modules. His receiver is the Fortop TVC1300 and BATC FM demodulator. Andy has had some problems with the intercarrier sound but a circuit by Martin G8KOE cured the problem. He also had problems of interaction between sound and vision, but the November *CQ-TV* video strip should solve this. The tunable sound demodulator is already built and works well.

Getting out and about he and Nick G8PSE have been operating /P from a field six miles from Andy's QTH. Picture quality was P5 but colour eluded them. Dave G4WCD has also assisted in these tests. They are hoping to attract more people up to 24cm and intend to apply for a repeater next year. In the mean time they will take portable ATV systems to some public special events.

SSTV

Finally the slower scanners – and writers. Once again, despite promises to the contrary, the only letter is from Richard G3WW. What an idle lot you slow-scanners are! But back to the plot.

Firstly, commiserations to Grant Dixon, who suffered a fall in his shack while looking up some data for another amateur! He should be well by the time you read this, so here's hoping all is now to rights.

G3WW tells me he is still receiving phone calls asking him to compare the Wraase SC-1 with the Robot 1200C in terms of their operation. The answer is that they are compatible for black and white but not for colour. The most recent enquiry was from EA5FIN on 20 metres, who proceeded to give Richard a lengthy lecture on the 1200's capabilities – based on the literature alone.

A new station worked was I5HHE on 20 metres using a Commodore 64: he wanted a QSL card direct just to show his friends who said it wasn't possible.

A local 144.5 FM net has sprung up using BBCs and Spectrums. It comprises G6YQJ (Littleport, Cambridgeshire), G0BDD (Ramsey St Mary, Cambridgeshire), G1ACB (Brinkley, Suffolk), G6OHM (Wimblington, Cambridgeshire), G4VYG (Tofts, Cambridgeshire), G4UVU (Newmarket, Suffolk), G8XOC (Stoke Ferry, Norfolk), G1MIA (Southery, Norfolk), G1ACO (Wretton, Norfolk), and G1EMW (Wareham, Norfolk). They are known as the 'Fenland Net' and aim to meet at 1930 on Monday evenings (to give night shift workers a chance before they disappear to work), although most of these operators seem to be on nightly.

Richard is making two-way contacts to EU and the USA (when 20 metres is open) in black and white and colour using the SC-1 and the 1200C. The Ferguson Movie Star TV is working well as a colour monitor 'after 12+ has been taken off IFs'. G3WW suggests that SSTV might liven up 29.6MHz FM.

Moving house

Never think of moving house after 43 years; Richard is in the process of doing just this and the preparation is ghastly, even though the house is not yet sold. Discards from the junkbox will apparently fill several dustbins!

Finally, a couple of SSTV snippets. G4VYG (mentioned above) has made a very good job of a G3WCY transmit and receive converter and has also made a 24 second single-frame colour adapter. G3CDK has made an excellent 1200C tape of the shuttle flight in colour.

That's it for now. We could do with a few more letters for the next round-up, so don't keep all the news to yourselves. Drop me a line at 71 Falcutt Way, Northampton NN2 8PH or leave a 3 minute message on the answering machine: (0604) 844130. REW

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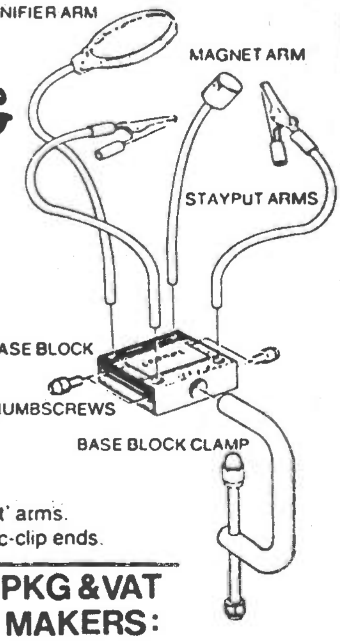

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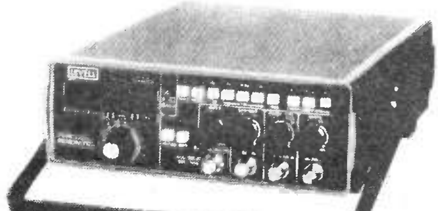

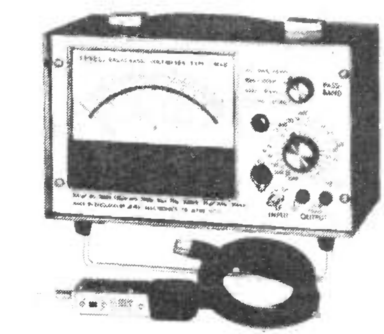

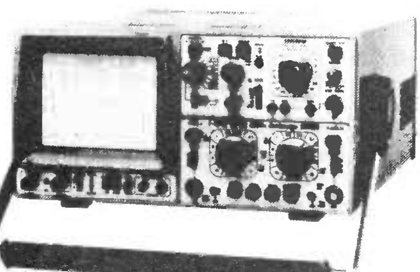

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HAMEG DIGITAL STORAGE 20MHz HM208 £1300
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MEDIUM WAVE DXING

by Steve Whitt

If nothing else, this winter has seen one of the most varied DX seasons for many years. On the MW band conditions have ranged from the excellent to the downright appalling!

On one hand some excellent DX from North and South America as well as the Far East was reported at the end of November '85 and around January 20th '86. In contrast, radio conditions took a steep downturn (at lest for those of us listening to the bands below 30MHz) around the start of February.

In fact, one of the strongest geomagnetic storms since 1976 struck on February 8th, disrupting world-wide communications. This storm, which lasted approximately 24 hours, was the result of a series of powerful solar flares observed in the previous week. During such a storm a surge of high energy particles from the sun enters the Earth's magnetic field, leading to a concentration of intense ionisation in the polar regions. This led to the aurora that was reported to be visible in much of Britain, much further south than is usually the case. Geomagnetic storms disrupt power distribution, satellite and long distance cable communications, and sky wave radio communications.

The UK-based MW DXer will have noticed a complete absence of DX for about 10 days, so if at the time you suspected a faulty receiver or aerial now you know what was really going on.

Long waves

Although not really medium wave, the long wave band (150kHz – 290kHz) is often lumped together with the former under the term medium frequencies. Two things have prompted this item about this rather neglected band. Firstly, in the April issue of *R&EW* there was an article by Richard Marris describing a loop antenna specially for the LW band, and secondly a number of significant frequency changes have recently taken place.

The 1979 World Administrative Radio Conference (WARC) decided that the arrangement of channels in the LF band should be standardised along the same lines as those on MF; that is all channels should be harmonic multiples of 9kHz. It was decided that the first five LF channels (currently 155, 164, 173, 182 and 191) would move on 1/2/86 to 153, 162, 171, 180 and 189kHz. The next five channels are due to shift on 1/2/88 and the last five on 1/2/90.

So far Deutschlandfunk has moved to 153, France Inter remains on 163.84, Moscow home service has gone to 171, Stimme der DDR is now on 177 (ex 179), Europe No 1 is on 183 (ex 185), and Sweden is now on 189kHz.

Desirable

Although a loop aerial would be a desirable accessory for listening to LW, it is perfectly possible to get good reception from a portable radio using the directional properties of the internal ferrite rod aerial to optimise reception from a particular direction.

Well, what can you hear? In addition to the stations listed above, a selection of stations from Europe, the USSR and North Africa are easily heard. Outside this area the LW band is not generally used for broadcasting. As a guide to what you'll hear I've included *Figure 1*.

Signals on the LW band behave much like their counterparts on the MW band. During daylight hours propagation is via the ground wave, which is augmented by a sky wave signal at night. If you recall the item on MW propagation in this column last month you'll remember that the lower the frequency the greater the range of the ground wave signal. It is for this reason that the BBC can provide coverage of most of the UK with its 200kHz Radio 4 service from just one transmitter.

In addition, propagation via the sky wave is subject to less fluctuation than for MW signals. Consequently it is possible to provide good reception over large areas throughout the day and night.

The principle drawbacks associated with LW broadcasting are two-fold. Firstly there is only a limited amount of radio spectrum available – in fact only 15 channels – which restricts the number of users, and secondly the long wavelengths involved (1000-2000 metres) require the use of either massive (and expensive) aerials or smaller, less efficient aerials and very powerful (and expensive) transmitters.

It's back to the medium waves for the next item, which was prompted by a letter from John Cooper of Hull, who wrote seeking some advice regarding the interconnection of aerials and receivers.

John seemed to be having problems getting the best performance from an external aerial when used with a National Panasonic R2000 multiband portable fitted with an internal MW aerial. Often a portable radio will have such an internal ferrite rod aerial as well as a socket for an external aerial. The problems usually arise because the internal aerial is not disabled when the external one is connected and the two signals interact.

Theoretically, in these circumstances it would be possible to delve inside the radio and disable the internal aerial, but this would probably make reception even worse due to receiver overload, since the internal aerial is tuned to provide the front-end selectivity of the radio.

One possible solution is the use of an aerial tuning unit between the external aerial and the radio to provide a better match between the two. Another solution is to use an external MW loop aerial instead of a long wire and to use a technique known as inductive coupling to get the signal from the aerial into the radio.

Inductive coupling relies on the transformer prinicple whereby the windings of the loop aerial and the ferrite aerial form the primary and secondary of an air-cored transformer. With a normal communications-type receiver some sort of electrical interconnection between loop

kHz	
153	Deutschlandfunk, W Germany
162	France Inter, France (actually on 163.84kHz)
171	Moscow Home Service, USSR
80	Stimme der DDR, E Germany (actually on 177kHz)
←	Europe No 1, W Germany (183kHz)
189	Sweden
200	BBC Radio 4,UK
209	Deutschlandfunk, W Germany, RTM, Morocco
218	R Monte Carlo, Monaco
227	Warsaw 1, Poland
236	RTL, Luxembourg
245	Danmarks Radio, Denmark
254	RTA Algiers, Algeria, Finland
263	Home Service, USSR, First Programme, Bulgaria
272	Czechoslovakia
281	Home Service, Minsk, USSR

Fig 1 *Long wave band scan*

and receiver is needed, but for inductive coupling to a portable radio there is no need for any cables or indeed for a loop amplifier. All that is required is a loop with its tuning capacitor to be located physically close to the ferrite rod of the portable radio (say 1-4 feet) and for it to be tuned to the same frequency as the radio.

With the loop so positioned and tuned, a marked increase in signal strength should be noted. For optimium performance and to make best use of the directional property of the aerials both the loop and the ferrite rod aerial should be correctly orientated so that their directional nulls coincide *(Figure 2)*. To null out interference, both the loop and the radio need to be rotated as a pair together.

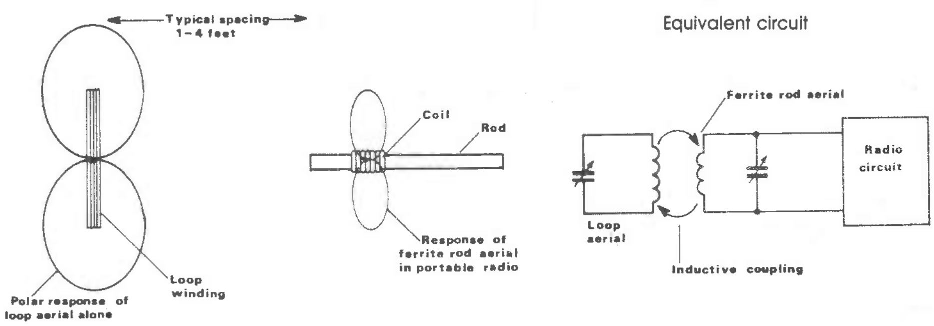

***Fig 2** Plan view of loop and ferrite rod aerials*

DX File

This month we welcome a relative newcomer to the MW band, 14 year old Darrell Rostron from Rochdale, who reports an interesting selection of European DX using his Trio R600 plus wire antenna. Darrell received good early evening signals from R Caroline in the N Sea (963kHz), Deutschlandfunk from Cologne (1269kHz), R Sweden International (1179kHz), Sud Radio Andorra (819kHz),Trans World R Monte Carlo (1467kHz).

Another dial-twiddler to report this month is Paul Barton, who hails from Harrogate. Paul is a keen MW-DXer and in his letter he describes his home-made receiver which, together with a 75-foot wire aerial, enabled him to hear the following mix of stations:

585kHz Madrid, Spain at 2330

891kHz RTA Algiers, Algeria, Arabic music at 2037

930kHz CJYQ St Johns, NF, Canada, pop music at 2325

981kHz RTA Algiers, Algeria, English programme at 2030

981kHz Athens, Greece, local pop music at 2050

1010kHz WINS New York, USA, news at 0010

1470kHz R Vibracion, Curapano, Venezuela, identification at 2400

1510kHz WMRE Boston, MA, USA, adverts at 2335

Finally before I close I'd like to say thanks for all the correspondence last month, and if you have any suggestions, problems or DX listening tips feel free to drop me a line c/o *R&EW*. So 73s till next month. REW

NEXT ISSUE

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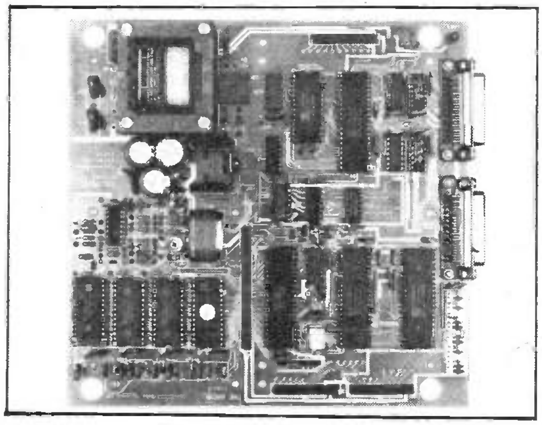

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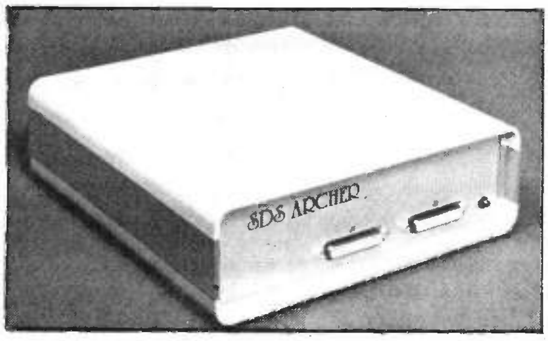

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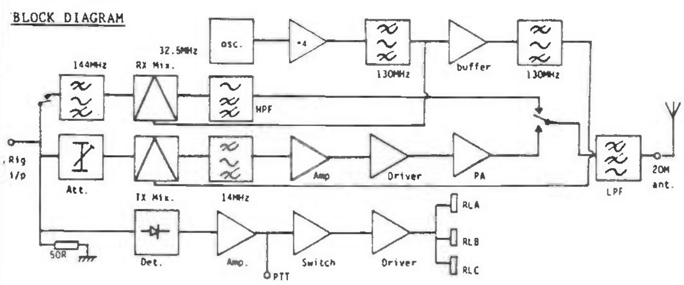

Both the HC220 and HC280 offer a good 10W RF output from missmatch proof transistors. The 2M drive level required is adjustable between .5 and 5W, but it can be easily modified to accept 10W or so. The use of a high proportion of fixed value filter components keeps alignment simple, and the output spectrum clean. No fancy test equipment is needed to align your kit.

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HC220 2M in, 20M out transverter kit: £48.90. **Assembled PCB: £79.90.**
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Listen to the news, sport, music, political comment from around the world on the new HOWES TRF3 shortwave receiver. The design features switchable input impedance so that it can be used with long or short antennas, and there is an input attenuator for strong signal conditions. Up to 2W of audio output are available, but the low quiescent current consumption means that it can easily be battery powered, if you wish. Frequency coverage is 5.7 to 12.8 MHz in three bands using a 50pF tuning capacitor (available at £1.50). This simple TRF design may be firmly rooted in the silicon age, but the old thrill of far away stations heard on a home built set is still strong! Great fun to build and use – educational too!
HOWES TRF3 kit: £13.90. **Assembled PCB module: £18.90.**

DcRx Direct Conversion Communications Receiver.
This simple, but very effective, single band receiver is available for 20, 30, 40, 80 & 160M. Up to 1W audio output, stable FET VFO, and amazingly good performance for a simple set. How about using one with an MTX20 or CTX transmitter for a QRP holiday and portable station? Suitable tuning capacitors for all but the 160M version are £1.50 each – you need two per receiver.
DcRx kit: £14.80. (Please state band required) **Assembled PCB module £19.90**

MTX20 20M CW TRANSMITTER.
The HOWES MTX20 is a 20M CW transmitter giving up to 10W RF output, but this is adjustable, so you can turn it down to take part in the G-QRP Club's activities and awards. The design pays very careful attention to the quality of the output signal. Full key click and RF output filtering are provided.

The HOWES MTX20 is crystal controlled (one crystal provided), but you can wire up a tuning capacitor to VXO the frequency a few kHz, which is very useful. A matching VFO should be available soon. The MTX20, like its smaller cousins the CTX40 and CXT80, has the output transistor's heatsink mounted on the board, and it requires very little alignment. A super, new transmitter, and one that we feel will become very popular indeed.
MTX20 kit: £19.95. **Assembled PCB module: £26.95.**

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CVF40 or CVF80 VFOs for CTX	**Kit: £9.30.**	**Assembled PCB Module: £14.90**
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If you would like further information on any item, simply drop us a line, enclosing an SAE. We have a full page of information on each kit, plus a general catalogue.

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73 from Dave G4KQH Technical Manager.

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Pride of place in this month's Latest Literature must go to the ***World Radio TV Handbook***. This year is the 40th anniversary of this illustrious tome, and the 1986 edition has seen some changes in design aimed at making the book easier to use.

For those unfamiliar with the DXer's bible, WRTH provides details of the world's radio and TV broadcasters. Frequencies and times, contact addresses, languages and powers are all given, along with brief details of programming. In addition, broadcasts are listed by time, and long, medium and short wave stations are listed by frequency.

Further reference sections cover solar activity, most suitable bands, clubs for DXers, and so on, and there are excellent reviews of new equipment. Indeed, these reviews would be worth a book of their own, collated from past issues of WRTH.

Obviously, WRTH is essentially a series of lists, but don't think it is inherently unreadable as a result, and there is a wealth of general features to enjoy. It forms an invaluable source of info for the serious DXer and the novice alike.

WRTH is produced in Denmark by Billboard A G, and the official cover price is $19.95 (ISBN 0 902285 11 44). It is distributed in the UK by Pitman Publishing, 128 Long Acre, London WC2E 9AN. The agent for New Zealand is Arthur Cushen, 212 Earn Street, Invercargill, and for the USA and Canada is Watson Guptill, 1515 Broadway, New York NY10036. Rush out and order your copy now!

On the subject of guides and lists, the fourth edition of ***Dial-Search*** has just been published. This appears every two years, and is an A5 booklet of 46 pages designed as a quick reference guide for European listeners. Where WRTH could be regarded as an encyclopaedia to be referred to as required, *Dial-Search* is a handy pocket book to be kept close at hand when listening in.

It contains such information as the broadcast band frequencies, a list of European medium and long wave stations likely to be heard using a domestic receiver without special aerials, a list of British stations, English broadcasts, etc. Maps of Europe and the British Isles give details of transmitter sites and high ground, and for the musically inclined there is a brief list of regular classical and jazz transmissions.

Dial-Search (ISBN 0 9508575 2 1) costs £3.30 including postage in the UK, or £3.50 (or 15 IRCs) in Europe, from George Wilcox, 9 Thurrock Close, Eastbourne, East Sussex BN20 9NF. It is also available through bookshops.

From one handy reference book to another: the 16th edition of ***Newnes' Radio and Electronic Engineer's Pocket Book***, by Keith Brindley. This contains an amazing amount of information considering its size, from abbreviations and formulae to aerial dimensions and UK radio stations.

Apparently, this edition has been 'completely revised, reset and redesigned in an easier-to-use format.' It will certainly prove immensely useful, and, even if it isn't *fully* comprehensive, it cannot be rivalled at the price (£5.50, ISBN 0 408 00720 6). Newnes Technical Books are at 84-88 The Centre, Feltham, Middlesex TW13 4BH.

The next book we come to is a real gem for computer-literate short wave listeners and RTTY enthusiasts. George Sassoon's ***The Radio Hacker's Code Book*** is a detailed introductory guide to the reception of radio-teletype transmissions, especially those of non-amateur origins. These come from meteorological offices, international news agencies, embassies, oil rigs, even homesick Russian sailors!

Judging from its tone, this book is aimed at computer enthusiasts who seek new avenues to explore with their precious number crunchers. It is not primarily a book for radio amateurs who want to delve further into data transmission (it is worth noting that George Sassoon is evidently a radio amateur).

As a result, there is an obvious assumption that the reader has a certain degree of familiarity with a computer, and the basics of receiving RTTY are outlined for the uninitiated (and it is an excellent history of Baudot *et al*).

Sassoon takes the reader from setting up a station, through an outline of what RTTY is, to the hardware and software requirements. There are numerous Basic and Z80 machine code listings, and a full description of a terminal unit (with circuits in the appendices).

With such basics established, we are introduced to the prospect of decoding encrypted transmissions. I must admit, the idea of cracking the codes of, for example, the Soviet Navy appeals to me immensely (but then I always wanted to be James Bond). Sassoon describes various encrypting systems used and the elements of using a computer to decipher them. Perhaps of equal importance here is the admirable bibliography included at the end of the book, since the limited space in a book of 240 pages could not do justice to such an intricate topic.

Even if you're only mildly interested in RTTY, I believe you'll find *The Radio Hackers Code Book* fascinating. A word of warning, though: it is a book to whet the appetite, so don't blame me if you get badly bitten by the code-cracking bug.

It is published by Duckworth and Company Ltd, The Old Piano Factory, 43 Gloucester Crescent, London NW1 7DY. Tel: (01) 485 3484. The price is £6.95 (ISBN 0 7156 2068 1).

More bits and bytes in the next publication, ***An Introduction to Computer Communications***, by that prolific writer R A Penfold.

This book is exactly what it claims to be, an introduction, so don't regard it as a manual for use in serious applications: the reader is expected to be a curious home micro user, not a businessman thirsting for hi-tech.

The text is divided into three chapters, these being modems, local networks (strictly home micros), and radio communications. The principles of data transmission are covered first in a very competent manner, and then the intricacies of communicating via a modem are unravelled. The network section is brief as this area is somewhat limited for home micros, but some interesting possibilities are pointed out, and some useful general information is covered.

The radio communications chapter is similarly brief (after all, the whole book totals just 72 pages), and outlines RTTY, CW, AMTOR and packet systems. It is a chapter to awaken the computer user to the possibilities of radio communications, not a detailed and highly technical guide to this form of communication.

LATEST LITERATURE

Datel UK

The new 126-page DPM and calibrator catalogue from Datel provides information on the company's broad product range, together with an easy to follow guide to selection.

Also included is a comprehensive tutorial section on the fundamentals of DPM design and a glossary of terms.

The book is arranged in nine sections. Section 1 discusses the features and functions to be looked for in a DPM, and provides a tabulated quick selection guide. Section 2 comprises 50 pages of concise information on Datel's DPM product range, and includes details on several new families of instruments. This is followed by a 10-page section on specialised panel instruments (bar meters and programmable counter-timers) and by a 7-page section on voltage calibrators (hand-held, bench and panel-mounted).

A section on accessories lists connectors, ac-to-dc power converters and newly-developed temperature sensors which are completely compatible with Datel instruments. Further sections provide product and panel cutout dimensions, circuit diagrams of typical DPM applications, functional pin-out descriptions and an explanation of the theory of DPM operation. Finally, there is a 3-page glossary of terms.

Datel (UK) Ltd,
Belgrave House,
Basing View,
Basingstoke,
Hants RG21 2YS.
Tel: (0256) 469085.

Aerial Techniques

Aerial Techniques' 1986 catalogue is now available. It comprises a representative cross-section of equipment available from the aerial industry and should fulfil most receiving needs.

However, if a customer is unable to find a specific requirement in the catalogue he should contact Aerial Techniques, who have access to all major suppliers and manufacturers.

The catalogue is available, together with a separate price list, by return of post for 65p.

Aerial Techniques,
11 Kent Road,
Parkstone,
Poole,
Dorset BH12 2EH.
Tel: (0202) 738232.

Fulcrum

Fulcrum's latest product catalogue incorporates the S100/696 computer board products which the company supplies, including the VME, IBM, Apple computer board products and single PCBs which it has recently become the distributors of.

The catalogue details the specifications and price of every product and there is a section on extra services and products which the company can supply.

Fulcrum (Europe) Ltd,
Valley House,
Purleigh,
Essex CM3 6QH.
Tel: (0621) 828763.

Papst

The Papst Motors' 1986 price list for Fan Products is now available.

Despite pressure from the German deutschmark against sterling, many items listed last year have been either reduced in price or held in check. In addition thirty-one new units have been added to the 1986 list.

Copies are available on request.

Papst Motors Ltd,
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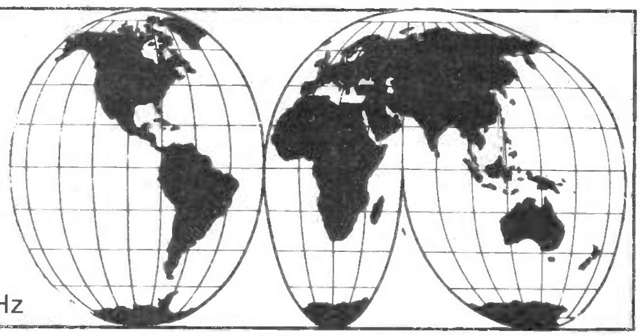
SHORT WAVE NEWS FOR DX LISTENERS



By Frank A Baldwin

All times in GMT, **bold** figures indicate the frequency in kHz

In this issue, the out of band Far Eastern station review continues by listing those currently operating between the limits **4500** to **4735**.

Xinjiang

On **4500** Xinjiang PBS (People's Broadcasting Station) operates at Urumqi, China. With a power of 50kW it radiates programmes in the Home Service from 2300 to 0200, from 0330 to 0730 and from 1030 to 1730 in Chinese. From 1800 to 1855, from 1900 to 1955 and from 2000 to 2055 it relays the Radio Beijing Foreign Service in Russian which is, needless to say, jammed.

Nei Menggu PBS, Hohhot carries the Home Service in Mongolian from 2120 to 0600 and from 0800 to 1515, the power being 10/50kW on **4525**.This one, unlike that listed above, is seldom logged here in the UK, although the chance of a DX 'catch' always exists for the inveterate out of band searcher.

Clandestine

Next in ascending frequency order is thé seldom heard clandestine Voice of the Revolutionary Party for Reunification, located in Haeju, North Korea on **4557**. Except for an English transmission from 1400 to 1430, it programmes in Korean from 2000 to 2230, from 0300 to 0400, from 1000 to 1400 and from 1500 to 1700 with a power of 100kW.

Mainly intended for South Korean ears, the programmes are pro-communist in content, the policy favouring the reunification of Korea on communist terms. This clandestine identifies in Korean as Tongil Hyongmyongdang Moksoti Pangsongimnida.

China, Laos and Vietnam

Another station rarely reported by European DXers is Radio Beijing on **4620**. It operates with a power of 50/120kW presenting programmes in Korean from 1100 to 1500 and in Russian from 1500 to an indeterminate sign-off time. The entire transmissions are jammed, of course.

Super DX exists, if only one could log it, on **4660** in the shape of Houa Phan in Laos. With a power of 1kW it serves the local community from 2300 to 0100, from 0330 to 0530, from 1000 to 1155 and from 1255 to 1425. The frequency is likely to vary slightly on occasions.

Two rarely heard Vietnamese transmitters are those based at Son La and Gia Lai-Kon Tum. The former occupies the **4700** channel, the latter **4701**. Both are apt to vary in frequency slightly. Son La is in operation from 2230 to 2300 and from 1140 to 1400. This schedule includes programmes in Montagnard from 1200 to 1300 and from 1330 to 1400, and in Vietnamese for the remainder of the time. The latter station features programmes in Vietnamese and other local languages and is on the air from 2300 to 2330, from 0300 to 0430 and from 1030 to 1400. The powers are not known.

Burma

On **4725** may be found the oft reported BBS Rangoon. At 50kW, it is scheduled with local programmes from 1030 to 1455 (Saturday and Sunday until 1545) during January, February, May, June, September and October, and from 1030 to 1545 (Saturday and Sunday until 1445) during March, April, July, August, November and December.

For those addicted to tape recording, the local-style music is well worth taping – it is not every day that one can savour the sounds of clashing cymbals and sonorous gongs.

Identifying in Uigher

Adjusting the receiver to **4735** will almost certainly result in the signals of Xinjiang PBS, Urumqi, China being heard. Among other programmes it features the Home Service in Uigher and identifies as Xinjiang Khalk Radiyo Istansisi.

It is scheduled on the air from 2300 to 0230, from 0330 to 0730 and from 1030 to 1730, this including relays of the Radio Beijing Minority Language Service in Uigher from 1100 to 1126 and from 1330 to 1356. From 1900 to 1955 and from 2000 to 2055 it relays the Radio Beijing Foreign Service in Russian.

AROUND THE DIAL

When seated comfortably at the receiver operating position, study this section, note the times herein, adjust the receiver to the frequencies specified, and listen. Hopefully you will receive similar results.

AFRICA

Ascension Island

BBC Relay on **11820** at 1919, OMs and YLs with a discussion about the British economy during an English programme for South Africa, timed from 1800 to 2030.

Cameroon

Radio Garoua on **5010** at 0430, the National Anthem at sign-on followed by OM with the station identification in French and vernacular then readings from the Holy Quran. This 100kW transmitter is on the air in vernaculars and French from 0425 to 0800 (Saturday and Sunday until 0700) and from 1645 to 2200. There is an English news bulletin from 0500 to 0505 and an English programme from 1830 to 1900.

Egypt

Cairo on **9850** at 1950, YL with songs in the General Arabic Domestic Service which is on this channel from 1500 to 2345.

Cairo on **12050** at 0917, OM and YL with a discussion in the General Arabic Programme for the Arabic world, scheduled from 0700 through to 2345.

Gabon

Radio Japan (Gabon Relay) on **15210** at 1540, light orchestral music then OM with a talk about Japanese trees during an English transmission for Europe and the Middle East, timed from 1500 up until 1600.

Ghana

Accra on **4915** at 0600, OM with the station identification followed by a newscast mostly about local events and affairs. This is GBC1 at 10kW radiating in vernaculars and English from 0545 to 0800 (Sunday until 2200) and from 1200 to 2200.

Mali

Bamako on **4835** at 1927, OM with a talk in vernacular. This one is on the air from 0600 (Sunday from 0700) to 0800, and from 1800 to 2400.

Mozambique

Maputo on **3335** at 0309, OM choir, then OM with announcements in Portuguese.

Radio Mozambique is scheduled from 0300 to 0530 and from 1500 to 2215 with a power of 10kW in Portuguese and vernaculars. The frequency is variable. Maputo, formerly Lourenco Marques, is the seaport capital at the head of Delagoa Bay on the East African coast.

Nigeria

FRCN Kaduna on **4770** at 1950, OMs with a pop song in English, 4 'pips' time-check at 2000UTC then OM with the station identification and a newscast in English, mostly about local affairs.

Seychelles

FEBA (Far Eastern Broadcasting Association), Mahe on **11755** at 0443, OM with a talk in the Arabic transmission beamed to Africa from 0345 to 0445. Carrier off at 0446.

Togo
Togblekope on **5047** at 0532, congregation with hymns followed by OM with a sermon in vernacular. The Home Service in French and vernaculars is on this frequency from 0530 to 0803 and from 1703 to 0005, but there is an English news bulletin at 2000. The power is 100kW.

CENTRAL AMERICA

Antigua
BBC Relay on **11775** at 1110, OM with the news in English, OM with the identification at 1115 during the English presentation to Australasia and the Pacific Islands scheduled from 1100 to 1130.

Cuba
Radio Havana on **6165** at 2245, OM with comments on current affairs between recordings of Spanish pops during the English programme to Northern Europe, timed from 2200 to 2300. Seven chimes at 2254 then YL with the station identification in English.

NORTH AMERICA

Canada
Montreal on **11915** at 1538, YL with the station identification, OM with world news in the English programme for Eastern Europe, scheduled from 1538 to 1545.

USA
World Harvest Radio, Indiana on **7355** at 1040, OM with a religious talk in English during a programme for Europe timed from 0800 to 1100. Sign-off without the National Anthem at 1056 after announcing an address in South Bend, Indiana.

SOUTH AMERICA

Argentina
Buenos Aires on **11710** at 2300, OM with the station identification and a newscast in Spanish during a programme in that language timed from 2200 to 0100, intended for South American listeners.

Dominican Republic
Radio Clarin, Santo Domingo on **11700** at 2139, YLs with some folk songs complete with a backing of guitars. Radio Clarin programmes in Spanish to Central America from 1100 to 0500.

ASIA

China
Zhejiang PBS (People's Broadcasting Station) on **2475** at 2236, OM with a talk in Chinese. Voice of the Strait, Fuzhou on **2800** at 1536, YL with a talk in Chinese.

CPBS (Central People's Broadcasting Station) Beijing on **3220** at 1512, YL with songs in Chinese. Xizang (Lhasa) PBS on **4035** at 1517, YL with a talk in Tibetan. Voice of the Strait, Fuzhou on **4045** at 1528, YL in Chinese, OM with announcements at 1530 then some local-style orchestral music.

Xinjiang PBS on **4220** at 1515, OM with announcements in Mongolian then OM with a song. Voice of the Strait, Fuzhou on **4330** at 1520, OM with a song, OM with announcements in Chinese. Xinjiang PBS on **4735** at 1428, OMs with a discussion in Uigher.

Xizang PBS on **4750** at 0042, YL in Chinese. Yunnan PBS on **4760** at 1512, violin music Chinese style. Xinjiang PBS on **4800** at 2335, OM in Chinese. Radio Beijing on **4815** at 1553, OM announcements in Mongolian at the end of a Foreign Service programme, 'East is Red' on chimes at 1600.

Gansu PBS on **4865** at 1440, Chinese classical music. Radio Beijing on **4960** at 1503, YL with a talk in Japanese during a Foreign Service programme for Japan.

Xinjiang PBS on **5060** at 1510, Chinese orchestral music and CPBS Beijing on **5075** at 2220, OM with a talk in Chinese in a Home Service 2 programme.

South Korea
Seoul on **7550** at 1557, YL and OM with a talk in the Italian programme for Europe and the Middle East, timed from 1530 to 1600.

Sri Lanka
Colombo on **11800** at 1450, YL with a song, Indian-type music then OM with some announcements in the Hindi transmission of the All Asia Service, scheduled on this channel from 1330 to 1730. The west coast city of Colombo is the capital of the republic, the artificial harbour being built by the British.

Pakistan
PBC Karachi on **4815** at 1534, OM with a talk in vernacular during a Regional Service programme. With a power of 10kW, this one is on the air from 0230 to 0600 and from 1200 to 1900.

Islamabad on **11995** at 1407, YL with a talk in Bengali to South and South-East Asia with many mentions of Pakistan. The schedule is from 1230 to 1445.

SOUTH-EAST ASIA

Philippines
FEBC (Far East Broadcasting Company) Manila on **11850** at 0950, OM with a religious talk and announcements in an English transmission for Australia, New Zealand and New Guinea, scheduled from 0700 to 1000.

FEBC Manila on **11890** at 1057, OM with a talk in the Chinese programme to Asia, timed from 1000 to 1100. OM with the station identification in English at 1059, OM in vernacular and off at 1100.

Vietnam
Hanoi on **12020** at 1332, OM with a newscast mainly composed of local events with some Asian items at the commencement of the English transmission to Asia, scheduled from 1330 to 1400.

NEAR AND MIDDLE EAST

Cyprus
BBC Relay, Limassol on **3990** at 0318, OM with a talk about the Turkish army in an English World Service programme timed from 0300 to 0330 on this channel.

Iraq
Baghdad on **11720** at 0518, OM with a song amid some Arabic music in the programme for the Middle East. This Arabic transmission starts at 0230 and ends at 1300 on this frequency.

Baghdad on **11750** at 0440, OM with the news in English followed by the station identification at 0445, the schedule being from 0300 to 0400 and directed to North America.

Lebanon
Radio Voice of Lebanon, Beirut on **6550** at 2235, light orchestral music Euro-style, YL with announcements in Arabic. The schedule is from 0415 to 2120, mainly in Arabic with some programmes in French and a few five minute newscasts in English.

Oman
BBC Relay Masirah Island on **11955** at 0220, OM with a talk all about the short waves in an English programme for Iran and South Asia, scheduled from 2330 to 0530.

Qatar
Doha on **9905** at 2100, six 'pips', OM with the station identification and a newscast in the Arabic presentation to Africa, from 0245 to 0700.

NOW HEAR THESE

Kalaallit Nunaata Radioa, Godthab, Greenland, on **3999** at 1022, OM in Icelandic then a 6-note interval signal repeated at 1030. The Home Service is on the air from 1000 to 0300 weekdays and on Sunday from 1100 to 0205 with a power of 1kW (dipole).

Choibalsan, Eastern Mongolia on **4995** at 1544, Chinese-style orchestral music, OM with a song just audible on peaks. This 12kW transmitter carries the Home Service 1 from 2200 to 1600. This schedule includes slots of the Moscow Foreign Service in Mongolian daily, and in Russian and Chinese on Tuesday and Friday. The frequency can vary from **4994** to **4996**.

NOW LOG THESE

For newcomers to the hobby, try for some of the Brazilians on the 25 metre (**11650** to **12050**) band.

Radio Nacional da Amazonia, Brasilia on **11780** at 2232, OM with a talk in Portuguese then OMs with local-style songs and guitars. Radio Guaiba, Porto Alegre on **11785** at 2225, OM with a newscast in Portuguese, OM with the station identification and a trumpet fanfare.

Radio Globo, Rio de Janeiro on **11805** at 0132, OM and YL with some commercials in Portuguese. Radio Brasil Central, Goiania on **11815** at 2150, OM with a talk in Portuguese with mentions of Brasilia, the capital. Radio Bandeirantes, Sao Paulo on **11925** at 0138, OM with pops in Portuguese. REW

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QSO

On these pages we present details of interesting contacts from clubs and individuals. We would be happy to receive any similar items from readers

Anglo-Scottish Rally

Hoping to emulate last year's success, Kelso, Borders and Galashiels Amateur Radio Society is hosting the third Anglo-Scottish Rally in Kelso's Tait Hall on Sunday 4 May from 11am to 5pm.

There will be talk-in on S22, a bring-and-buy, club and traders' stalls, raffles, a bar and hot and cold snacks. It is hoped that there will also be a Morse test room.

The entrance fee is £1.00, but accompanying non-licensed YLs and XYLs can enter free of charge, as can junior ops.

For further information and details about accommodation contact André Saunders GM3VLB on (0573) 24664 or Bruce Cavers GM4UIB on (0573) 24654 any evening.

WA Sparks G8FBX

We were very sorry to hear of the death of Bill Sparks G8FBX, a regular contributor to our sister magazine *Amateur Radio* and co-author of the excellent CB conversion articles in *R&EW*, November '84 and March '85, on 6 January this year.

A keen SWL in his youth, Bill became an electro-chemist working for a number of years for Salford Electrical Instruments and latterly as a principal in several electro-plating companies, until ill-health forced an early retirement.

He was a founder member of the Warrington and District Radio Society in late 1946, always taking a keen interest in club affairs and taking part in numerous field day and portable outings, being especially interested in VHF and UHF. He was also keen on home construction and design, contributing related articles to this and other amateur radio journals.

He will be remembered by a large number of recently licensed amateurs who he successfully tutored in the south Lancashire and north Cheshire areas, visiting many clubs and individuals as an RAE instructor.

A member of the RSGB and Raynet, he will be sadly missed by all who were fortunate enough to know him. 73 Bill.

G2FCV

Vale Royal Award

The Vale Royal Award has been announced by the Mid-Cheshire Amateur Radio Society, which is sponsoring the award with the Vale Royal District Council.

The objective of the award is to publicise the district of Vale Royal, in the heart of Cheshire, and to encourage radio amateur activity.

ERRATA

Readers should note the following errors and emissions published in S Dean's article, *RTTY decoding using the Spectrum – Part II*, in the March issue.

In the Basic part of the program, line 420 should read:

420 LET MSB=INT (ADD/256): LET LSB=ADD−256★MSB

Line 660 should read:

660 PRINT: PRINT "ENTER NEW MESSAGE: -'#' ENDS"

The curly brackets randomly placed in the listing should be the normal ( ) type brackets. This was due to a peculiarity of the word processor used by the author at the time.

In the Transmit M/C routine the 9th line from the top should have a label:

AGAIN: 3A 08 5C LD A, (5C08)

We apologise for any inconvenience caused by these errors, although most of them will not affect normal operation of the program.

The printing of the certificates has been financed by the council and any money left over after the costs of administering the award have been met will be distributed between the Radio Amateur Invalid and Blind Club (RAIBC) and Hebden Green Special School for Handicapped Children in Winsford, Cheshire.

There are two classes of award: class A for single band, multimode, and class B for multiband, multimode. To qualify for the award amateur stations must have achieved either of the following:

1. Worked nine stations who are situated in the district of Vale Royal or who are members of the Mid-Cheshire Amateur Radio Society, plus one Mid-Cheshire Amateur Radio Society station (G3ZTT, G8ZTT).
2. Worked both Mid-Cheshire Amateur Radio Society stations plus the Delamere Forest Microwave Activity Group station (G4ZTT) and the Vale Royal Contest Group station (G6ZTT).

Applications should be sent to Hans M Field, Awards Manager, Mid-Cheshire Amateur Radio Society, 6 Llandovery Close, Winsford, Cheshire CW7 1NA, together with an extract of their log showing the details of the contacts claimed, signed by themselves and one other licensed radio amateur to confirm that the extract is a true copy of the applicant's log. Also enclose a cheque or postal order, made payable to the Mid-Cheshire Amateur Radio Society, for the sum of £1.00 (sterling) or 5 IRCs for applicants outside the United Kingdom, and an A4 sized sae (UK only).

For any further information about the Vale Royal Award contact Dr E J Loader G6HXU on Runcorn (0928) 513844 during the day or phone Northwich (0606) 75660 in the evening.

Mobile radio rally

The Mid-Ulster Amateur Radio Club is holding its annual mobile radio rally on Sunday 18 May in the grounds of Parkanaur House, which is situated approximately six miles from Dungannon on the main Ballygally Road.

The event starts at 12.00 noon. There will be the usual trade stands and a bring-and-buy stall as well as talk-in on S22 FM 144.550MHz.

Monthly meetings of the Mid-Ulster Radio Club are held on the second Sunday of each month at 3.00pm in the Guide Hall, Castle Hill, Gilford. There is usually a talk or demonstration of interest to radio amateurs and everybody is welcome. For details about either the rally or the meetings contact the club secretary, Sam White, tel: (0762) 22855.

Hobby fair

The Wembley Conference Centre in London will host the Amateur Radio and Electronics Hobby Fair on 5 and 6 July. This is apparently the first two-day fair of its type to be held in the south of England, and is a major new event on the rally calendar.

A wide variety of retailers and manufacturers will be present offering a range of goodies: RTTY, satellite TV and communications, micro-waves, hobby components and amateur TV will all be included at the fair.

If you are interested in attending as an exhibitor, contact: *Amateur Radio Promotions, Woodthorpe House, Clapgate Lane, Birmingham B32 3BU.*

Binstead ARS

The Binstead Amateur Radio Society meets every Wednesday at the Scout Headquarters, Drill Hall Lane, Binstead. Morse lessons and instructions on the RAE are given where required, and AMTOR and ATV are demonstrated on certain dates according to requirements.

The society has its own radio shack built into the Scout buildings and runs a variety of activities, including exercises with the Scout group.

The club also has its own award: The Binstead Amateur Radio Society Isle of Wight Award. To qualify for this you must meet the following requirements: VHF – work ten Isle of Wight stations which must include the G0BAR club station; HF – work five Isle of-Wight stations, again including the G0BAR club call.

The award is printed in four colours and costs £2.50.

For further details contact: *D F Barnes G4VJF, 2 Sherbourne Avenue, Binstead, Ryde, Isle of Wight PO3 PX.*

Wireless revival

This popular annual mobile rally for radio amateurs is being held on Sunday 25 May at the Civil Service Sports Ground, Straight Road, Bucklesham, Ipswich, Suffolk.

With features such as traders, a car boot sale, an aerial testing range and a vintage radio display, plus non-radio stalls, a childrens' play area, a model flying display and other attractions, this rally provides a happy day out for the whole family. The admission price is 80p.

Further details are available from: *Jack Tootill G4IFF, 76 Fircroft Road, Ipswich IP1 6PX. Tel: (0473) 44047.*

Southgate ARC

The Southgate Amateur Radio Club meets at 7.30pm for an 8.00pm start on the second Thursday of each month at the Holy Trinity Church Hall, Green Lanes, Winchmore Hill, London N21.

On 8 May there is a talk by Stan Wood, the Marconi Company historian.

For further details contact: *R F Sandy G4OBE, 12 Borden Avenue, Enfield, Middlesex EN1 2BZ.*

May Day microwave

There is a BATC contest day on 5 May. The May Day Microwave, 23cm and 3cm fast scan, takes place between 0001 and 2359 hours.

For entry forms, log sheets and information about contest rules send an sae to: *Mike Wooding G6IQM, 3 Perkins Grove, Rugby CV21 4HU.*

COMPETITION RESULTS

The winning limerick in our competition to win the new TT/9003 transistor tester from Repro Electronic Systems (featured in the February issue) is from R E Mackenzie of Herne Bay, Kent:

A radar technician one day
Of a magnetron got in the way
'Twas the radial scan
That spiralled the man
To an 'ohm' in the Milky Way!

Congratulations, Mr Mackenzie. Your transistor tester is on its way! Well done everybody for your efforts, especially those of you who actually know what a limerick is (and it's amazing how many people don't . . .)

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■ Shimizu SS1055 9 band HF transceiver, 1.5-30MHz crystalled 11m FM SSB. Hershman SWR power meter. Tokyo HC200 ATU. Scarab interface and tuner unit plus software Spectrum RTTY. Shure base mic, Kenwood hand mic. Exchange for any 934 transceiver, prefer base unit but not essential. Also any 934 equipment, eg SWR meter antenna etc. Alan Vaughan, East Cornerfield, Slaley, Northumberland NE47 0BS. Tel: (043473) 554.

■ Two 813 new valves, snip at £32. Holder, South Furzehill, Lynton, N Devon EX35 6LN.

■ RCA 813 transmitting tube, unused, £20 or near offer. Tel: Southampton 463044.

■ Sharp pocket computer PC-1245 with instruction manual, new, £50. Howland West audio CIS-550 stereo, mono headphones, new, £10. Packer 90-200MHz wavemeter WB-2, £15. AC Gee, 21 Romany Road, Oulton Broad, Lowestoft, Suffolk HR32 3PJ. Tel: (0502) 65726.

■ PCB for PW Meon 50MHz trvt 10m input, double sided, drilled, £1.50. Wobbulator 7MHz-70MHz, spare new valves, £25. MM TV upconverter £17. 2m rack Tx 6ch mains PSU 12 watt o/p, £20. H/brew set of boards for CMH 80m CW tcvr with CCT, £5. Ben G4BXD. Tel: (021) 525 9772.

■ Model boat air/sea rescue launch, 35in long complete with 3.46cc water cooled diesel engine. Unused, mint condition, needs radio control and servos but including 10 2 volt miniature lead acid rechargeable sealed batteries, £45.00. No offers, buyer collects. Mr C W Woodward, 4 Fallows Road, Sparkbrook, B'ham B11 1PQ.

■ 2000 clear LEDs 3mm dia with mounting clips, type no SLV14 (450 bead tantalum caps 47μF 35VW, 450 bead tantalum caps 33μF 25VW, 450 bead tantalum caps 10μF 25VW, 450 bead tantalum caps 10μF 16VW). All 100% top grade components. Offers invited. Please enclose SAE for reply. Mr C W Woodward, 4 Fallows Road, Sparkbrook, B'ham B11 1PQ.

■ Datong AD370 MPU new, Datong DC144/28 unused. Discone 10 metre T with antenna. Also Slim Jim wavemeter, new, 4 watt PSU dc various SS mob antennas, large, all perfect. Bargains to early callers. Collect from QTH only. Bailey, 40 Wellington Way, Salisbury, Wilts SP2 9BX. Tel: (0722) 22646.

■ Microwave Modules 144/100-S linear amp, 10W in, 100W out, £95. Drae 13.8V 12 amp power supply unit, £45. Welz CH-20A coaxial switch, £10. All items vgc. Any offers? G4UWW, Colchester. Tel: (0206) 395720.

■ Hallicrafters Sky Chief, Osram Music Magnet, McMichael portable four, R109 military plus type 19 MkIII tank radio, Ekco A21, Murphy D34, Bush AC71, Ekco A23, Marconi 262, Marconi 559, Vidor 351 plus part of Marconi V2. Also several other old radios mostly complete and approx 1000 valves of the thirties and forties, £350 the lot or swap SW transceiver in good cond. Tel: (05694) 652.

■ 730/4 Eddystone receiver 5 band. Purchased reconditioned 1985, £80 ono. 1A Bridge Gardens, Farmborough, Nr Bath, Avon. Tel: Timsbury 70944, evenings.

■ Valves: SAE for list. Also many odds and ends. Cossor scope type CR100 – offers? As new, good receiver. All letters replied to. Mr R E White, 29 Nunnery Street, Castle Hedingham, Essex.

■ Realistic HF receiver DX302, 0MHz to 30MHz. Digital readout for sale, mint condition, boxed, manual, £95, or exchange for Pro2002 scanner or similar scanner with airband, in same as new condition. Derek Walton, 'Dalairn', Seabank, Invergordon, Rosshire, Scotland. Tel: Invergordon 853333.

■ Yaesu FR101 AM/FM, 6m, 2m with instruction manual, vgc, hardly used, £100. Yaesu FRG7 with FRT7700 instruction manual, vgc, hardly used, £100. Pye hi-fi sound project A8000, brand new, boxed, £40. Pye hi-fi sound project. A8000 tuner amp, as new. £40. Mr J Hewitt, 15 Delamere Close, Mill Park Estate, Eastham, Wirral L62 9EH. Tel: (051) 327 6588.

■ Gould Advance 3½-digit multimeters. One Beta type bench model 28 range LCD, 10A ac/dc, £60. One Gamma type bench model 28 range LCD 10A ac/dc, true rms mains power, £130. Feedback sine/square oscillator SS0603 10Hz-1MHz, £50. Phone Kevin on (0693) 66545 or write 34 Monaghan Street, Newry, N Ireland.

■ Clearance: very large box of circuit boards containing hundreds of useful electronic components, eg transistors, diodes, transformers, multi-turn pots, switches, resistors, capacitors, etc. Over 20 boards of at least 8 different types. Weight over 3kg. Will post for just £7.40 inclusive. Also box of loose components, must be over 1,000 parts, mostly new, £9.60 post free. 100 new semiconductors, £3 post free. K Bailey, 40 Seymour Close, Selly Park, Birmingham B29 7JD. Tel: (021) 472 3688.

■ Levell AF sig gen TM150, as new, £20.00. IE 0-50V 0.6A bench PSU vgc, boxed, £10.00. 5A variac, £15.00. Eddystone 770R Rx needs mains txmr and IF can, hence £20.00. Eddystone slow motion drives, £1.50 ea. Sharp FV1700 6 band gen coverage Rx, portable with BFO, AFC, sig meter, complete with mains PSU, h/phones and manual, ideal SWL's Rx, £35.00. HP412A VVM with probe, £10.00. Field strength meter, £2.00. Professional 134ft folded wire dipole (1.5-30MHz) with insulators, spacers, baluns, pulleys and lanyard, £18.00. SG Brown h/phones, £5.00. Matched new 813s with holders, £20.00 pair. QQV03-20A, new with holder, £8.00. DG7-5 2½in, CRT new with holder, £8. 807s new, £1.50 ea. G4FZG QTHr. Tel: (0242) 580329.

■ Colt 295, SWR power meter, two mobiles, twigs, 16ft silver rod, co-ax, 25W burner power pack, mag mount, co-ax, Binatone Long Ranger 12ch handheld, the lot, £130 ono. Tim, 1 Oaklands Cres, Builth, Wells, Powys LD2 3EN.

■ Revox G36 and active multiplex filter. Ten spare valves, service manual, unused since 1980, £250. Logic probe model 340, TTL, DTL, never been used, offers. Aiwa stereo cassette deck 5400, service circuit, Dolby 'B' unused last two years, £55.00. J M Bloodworth, 7 Calder Close, Maidenhead SL6 7RS. Tel: (0628) 26316.

■ Books and equipment from 1920s. Books covering design, application and servicing of radio and electronic equipment. Also electrical physics, maths, etc. Valves and equipment pre-1950s. Test equipment and valve data manuals. Some ex-government. Offers invited. N Walker, 5 Acacia Drive, Maldon, Essex. Tel: Maldon (0621) 53878.

■ Monitor, 19 inch 6 channel b&w, £40. Monitor, 14 inch green screen, £35. Monitor, 11 inch green screen RS232, £35. Hallicrafters S27 VHF receiver, £40. Hallicrafters S72 HF receiver, £40. Tel: Wokingham 782236.

■ Heath OS-2 scope, £50. GD-1U grid-dip meter, £30. Heath RF signal gen £30. AV-3U ten range valve voltmeter, £10. All perfect order with handbooks. Two 20m lengths low-loss co-ax UR67, £6 each. Linear amp four PL519, 8 band, fully metered. Self contained, £135. 4 PL519 valves new £24. 50MHz linear, 50W two 807, £40. G3OXV Earl, 1 Mayfield Drive, Daventry, Northants NN11 5QB. Tel: Daventry 702265.

■ Oscilloscope, Scopex 456, single beam, 6MHz, with padded case, probes, manual and circuit diagram. Hardly used, £180 new – sell for £65. Also Leader LSG-17 RF signal generator, 100kHz to 450MHz, £140 new, sell for £50. Please ring John on Bredon 73180.

■ UHF ⅝+⅝ new, £17. 2mtr ⅝ new £12. Bases for both, £7 with cable. N-type plugs to suit UR67, £2. 930MHz ¼+½ collinear +3dB, £19 unused. ASP UHF mobile collinear +3dB, £12, as new. PCB for 6mtr trvt as PW meon, £2. Sound and speech units for Spectrum, £10. G4BXD. Tel: (021 525) 9772.

■ Gemscan 70 channel scanner AM-FM 60-180, 380-520MHz 12 volt, 240 volt, £175. Fanon Courier 6 channel crystal hand-held scanner, high, low, VHF and UHF Nicads, £50.00. G8RHU QTHr. Tel: Newhaven (0273) 516801.

■ Software for 48K Spectrum. Filing program ideal for keeping stock of transistors, ICs etc. Also Morse Tutor program, will help you to learn Morse code quickly. Tape also includes a program to decode resistors' colour codes. All on one cassette tape. Send £2.50, which includes post and packing, to Mike Day, 39 Valnord Lane, St Peter Port, Guernsey, Channel Islands.

■ Sony ICF 7600D, excellent condition, boxed with mains transformer, manual and carry case. A very portable comms receiver. Paul. Tel: (0604) 413131, Northampton after 6pm.

■ RTTY terminal unit BARTG ST5, machine or computer complete with dot matrix printer, includes box of paper for hard copy, £100. TV b/w camera type Ikegami CTC5000 with superb 25mm 1:1.4 macro lens, can fill a TV with a postage stamp, £100. All sold with free spare parts. GM3WIL. Tel: (0292) 79217.

■ Heathkit RG-1 general coverage receiver. BFO, 1MHz xtal marker, handbook, £35. Meters: 2¾in dia, 5mA, 20mA, 30mA, 50mA, Weston, 1mA USA, 500μA. 2in dia 1mA, 25mA, 30mA, 50mA, £3 each. Class D wavemeter No1 Mk2, 1.9-8MHz, plus Harmonics, xtal controlled 1000kHz, 100kHz, VFO. Mains instructions, £12. Mains transformers. 300-0-300, 325-0-325V, 250mA, another 275-0-275, 300-0-300V, 250mA, Partridge, £4 each. Heavy collectors items: early AVO valve tester, about 1940, but meter box only with switching and 9 pin English input socket, circuit. Also AVO test bridge, about 1940, circuit, untested, offers. Ex-WD tank whip insulated base only, £3. Valves Y63 tuning indicator, 6CH6, 6V6, 6GM6, 6EW6, 150B2, £2 each. LF choke gardners, 20H, 100mA, £3. Edwards, 32 Heldhaw Road, Bury St Edmunds, Suffolk IP32 7ES. Tel: (0284) 60984.

■ RF preselector 1.8-10MHz (could be extended), mains. EF184, 2in Japanese Vernier dial. 8½ x 7 x 4ins. Improves older receivers, £6. Valves, 6L6M, 6L7M, £2.50 each. One GEC KT66, offers. Solon iron, 230-250V, 65W, medium, £3. FT101Z series AM unit, instructions, as new, £7. Headphones, communication, light, black colour, 300Ω, £6. Five AR88 fluted pointer knobs, £3. Ham-master speaker, 8Ω, noise filter. Adjustable bracket, £6. Edwards, 32 Heldhaw Road, Bury St Edmunds, Suffolk IP32 7ES. Tel: (0284) 60984.

■ PX4 triodes. 4 Osram, 1 Marconi. 2 are in manufacturers' original packing. Best offer secures. H Colborn, 6 Days Ground, Shrivenham, Swindon, Wilts SN6 8ET.

■ Trio TS520, virtually unused since purchased new, £300. WW2 Pye PCR2 communications receiver, good working order. Pair matched Weston 0-5 amp RF ammeters. 2 unused GEC KT88 valves. 2 unused Mullard PVO6/20 valves, offers. G3DOV QTHr. Tel: (0953) 882076, evenings.

WANTED

■ FC102 ATU, urgent in good cond. Tel: John G4USS Canterbury 731379. Good price paid, will collect.

■ AOR2001 scanner, £200 offered. G8RHU QTHr, tel: Newhaven (0273) 516801.

■ Scopex 4S-6 needed by keen students. Ring Wyn, G8AWT on Isle of Wight 290188.

■ Pen pal: young man interested in electronics and CB who wants to holiday in Ireland in 1986 for mutual friendship and electronics – discussion. Patk O'Shea, Reahill, Caherciveen, Co Kerry, Ireland.

■ Barlow Wadley receiver, XCR-30 Mk2. Good working order and condition. Edwards G3MBL. Tel: (0284) 60984, Bury St Edmunds, Suffolk.

■ Army wartime wireless set no WS19. Must be working order and complete with ancillary equipment. Will collect reasonable distance from Birmingham. C A Crabb G4HNH, 41 West Drive, Edgbaston, Birmingham B57RR. Tel: (021) 472 3845.

■ Circuit diagrams or workshop manuals for Advance FM/AM signal generator type SG63F and Toshiba stereo music centre model SM2750. Tel: (0526) 20520.

■ Geiger-Müller tube types B6H, or B12H, or CV2886, or MX142, or MX124/01. F Rushworth, 'Chylan', Penwartha, Coverack, Helston, Cornwall. Tel: (0326) 280564.

■ Any Pye MF5 Motafones, prefer mid/high band but any considered. Spares for Motafones, crystals 37MHz or 12MHz for low band Motafones or any accessories for Motafones. Also wanted any cheap 2 metre receiver or transceiver for new SWL awaiting RAE results. I would also like to contact any Atari computer users with interests in amateur or CB radio. Phone me now! Ian G1LSK. Tel: Lincoln (0522) 46145.

■ Racal low frequency adaptor for Racal RA17L, circuit and alignment instructions for Eddystone 670A, Racal preselector for Racal RA17L. Mr H Lear, Flat 86, Block 205, Wensley Road, Reading, Berks.

■ Desynn transmitter potentiometer sought for wind-vane project. There must be one somewhere! Stuart Gibbons, 77 Windlehurst Road, High Lane, Stockport SK6 8AE. Tel: (061) 427 4317.

■ Trio R2000 in good condition. Complete with VC10 converter if possible. Tel: Rochdale 43117 after 6.00pm.

■ CPM, Z80, Microsoft Basic or BBC Basic software listing or on 3in/5¼in disc 40T DD for conversion to Einstein of RTTY, Amtor, CW weather Rx/Tx. Write first with details and price. Graeme, 6 Barby Lane, Rugby, Warks CV21 5QJ.

■ Solartron plug-in units wanted in vgc, CX1448 slow sweep and CX1444 delay sweep. Also boxed new valves 6X4, 6AQ5, 150C4, CV4003, EF184, EF86, ECC88, ECC81, ECF804, ECF82. Tel: (0521) 41681.

■ Unemployed SWL beginner requires cheap HF Rx. Pref something with PSU, ie R107, AR88 etc, or with separate one if you have one, ie R1155 or HRO etc. Must work OK, but tatty set is fine. Would like manual too if you have one, or a Xerox of one. Please write: A Hawkins, 111B Parker's Square, Southgate, Runcorn, Cheshire WA7 2SG.

■ *Practical Wireless, Radio Constructor*, 1960 to 1980, good price paid. J Savage, 7 Weyhill Close Pk, North Swindon, Wilts.

■ Gemini computer boards – want disc controller/Eprom boards. Will consider others like damaged/unworking memory boards. Also software – CP/M, Polydos, etc. 80-bus magazines, manuals, also EWW SC84 boards/computer, also good Z80, Z8000, 68000 books, need old Motorola literature for 68/0, 6828/87, 6871 specs/applications. Does anyone have manuals – Honeywell VIP7385/6 terminal? Will answer all sensible letters/offers. Want old *Wireless Worlds!* Dare Beersellaan, 136, B1620 Drogenbos, Belgium. Tel: (Brussels) 377 8609 (expensive from UK!).

■ Good sig gen, AM, FM. Also LCR bridge, modern scope 20MHz etc, 100pF + 100pF split stator capacitor, ½% resistors, MC meter 50μA of similar manual for Philips VCR 2020. Mr R E White, 29 Nunnery Street, Castle Hedingham, Nr Halstead, Essex CO9 3ND.

■ 117Z3 rectifier valve for Zenith model 8G005TZ1. Swap or p/x Mitsubishi TX65 new portable hi-fi, cordless telephone, telescope, flashgun, darkroom exposure meter for Spectrum interface 1 and microdrive and/or other hardware. Will also swap something for non-working interface 1 or microdrive. Also wanted 2m receiver for slow scan TV. Also I have a complete Sinclair ZX80 with manual power supply to swap. R Mackay, Brochrobbie Brora, Sutherland, Scotland KW9 6NE. Tel: (0408) 21870 evenings please.

■ Xtals. Glass encapsulated. 3.5 to 3.6MHz HC6U holders. Peter Haylett, Vancouver House, Kimberley Road, Bacton on Sea, Norfolk NR12 0EN.

■ Pye Labgear Compac 8 HF SSB 2-9MHz. Fred Pilkington G3IAG, 24 High St, Cheveley, Newmarket, Suffolk CB8 9DQ. Tel: (0638) 730373.

■ Piezo transducer approx 30W pulsed at about 1MHz. Tel: Crudwell, Wilts (06667) 7820.

■ Any information on how to improve the gain on my Codar CR70A receiver. Also can anyone provide help? I wish to receive RTTY using the above receiver and an Amstrad CPC 464 computer. Will refund postage. F Trainer, 69 Wingate Towers, Huyton, Merseyside L36 7YE.

■ SCR300 WW2 American back pack radio. Not necessary to be in working condition. Must have fairly good external bodywork. Mr West, 1 Farwell Road, Sidcup, Kent DA14 4LH. Tel: (302) 6750 evenings.

■ Home-brew design wanted. Single sideband transceiver, or separate receiver/transmitter. Any band considered. Solid state or solid state/valve. Genuine builder enquiry. Must be proven design. G Woodworth, 136 Wepre Park, Connah's Quay, Deeside, Clwyd CH5 4HW. Tel: (0244) 814697.

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ADVERTISERS INDEX

Radio & Electronics World
The communications and electronics magazine

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depth mm x width mm	ad space	1 issue	3 issues	6 issues	12 issues
			series rates for consecutive insertions		
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128 x 186 or 263 x 90	½ page	£305.00	£290.00	£275.00	£245.00
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June 86	10 Apr 86	16 Apr 86	18 Apr 86	8 May 86
July 86	15 May 86	21 May 86	23 May 86	12 Jun 86
Aug 86	12 Jun 86	18 Jun 86	20 Jun 86	10 Jul 86

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MAY SPECIAL OFFER
TELEPHONE 'CHANGE-OVER' KIT – CONTAINING

1 X BT approved master socket + wiring inst	**£2.85**
1 X BT approved secondary socket	**£1.95**
1 X Line Jack cord with plug	**£1.25**
	£6.05
The whole package for	**£4.95** + **VAT**

1 kit available with any order of £10.00 and over

12V RECHARGEABLE UNIT

Apart from the above offer you can also purchase a bank of 'D' types (10 off) encapsulated in a black plastic box complete with inlet and outlet socket (Cannon type MS3102E14S-6S) and fuse holder, this giving you 12V from a very neat and tidy unit Dimensions: Approx 245mm x 75mm x 70mm.

£5.99 Each + **£1.85 P&P**

POTENTIOMETERS

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

4K7-2M2 Single gang log	.40	10/**3.80**
1K-2M2 Single gang lin	.38	10/**3.50**
5K-2M2 Single gang DP switch log	1.05	10/**9.50**
5K-2M2 Double gang log & lin	1.25	10/**10.50**

RESISTORS — CARBON FILM 5%

1/4W 1RO to 10M (E12 Range)	**2p each. 15p/10. 75p/100**
1/2W 1RO to 10M (E24 Range)	**2p each. 15p/10. 75p/100**
1W 10R to 1OM (E12 Range)	**7p each. 40p/10. 3.50/100**
2W 10R to 1OMm (E6 Range)	**8p each. 60p/10. 5.00/100**

RESISTOR KITS — each value individually packed

1/4W pack 10 each value E12 — 10R — 1M 610 pieces	**5.75**
1/4W pack 5 each value E12 — 10R — 1M 305 pieces	**3.35**
1/2W pack 10 each value E12 — 2R2 — 2M2 730 pieces	**7.95**
1/2W pack 5 each value E12 — 2R2 — 2M2 365 pieces	**4.75**
1W pack 5 each value E12 — 1OR — 1OM 365 pieces	**15.00**
2W pack 5 each value E6 — 10R — 1OM 365 pieces	**18.50**

RESISTORS — WIREWOUND Generally 5%

2.5W 0.22 to 270R	**15p each 1.40/10**
4W 1RO to 10K. 1RO to 680R	**14p each**
1K — 3K3	**15p each**
4K7 — 6K8	**18p each**
10K	**22p each**
7W 1RO to 22K. 1RO to 5K6	**15p each**
6K8 — 12K	**16p each**
15K — 22K	**17p each**
11W 1RO to 22K. 1RO — 4K7	**18p each**
6K8 — 10K	**19p each**
15K — 22K	**22p each**
17W 1RO to 22K. 1RO — 10K	**24p each**
15K — 22K	**25p each**
Support pillars for 4W/7W/11W/17W/	**4p each 30p/10**
25W 0.47R — 47OR	**1.48 each 12.50/10**
50W 0.47R — 47OR	**1.85 each 13.00/10**

NEW LINE

ORYX PORTASOL PORTABLE GAS SOLDERING IRON – **£13.90**

Spare Tips 2.4mm/3.2mm/4.8mm. Price each 6 **£4.50**

Powered by ordinary lighter fuel. Adj temp equiv to 10/60 watts. Tip Temps to max of 400°C.

TELEPHONE SPECIAL

BT App Telephone Plug + 3m Lead	1.25
BT App Master Socket Inc. Wiring Instrns	2.85
BT App Secondary Socket	1.95
4 way plug	**0.58ea 10/£5.50**
BT 4-Core Cable per metre	.15
100 metres	12.00
Cable clips for above	**100/75p**

PLUGS & SOCKETS

Metal Co-ax Plug	**0.18**
Plastic Co-ax Plug	**0.14**
Metal Line Socket	**0.32**
Single Junction Socket	**0.80**
Plastic Phono	**0.10**
F M Plugs	**0.20**
PL259 Plugs	**0.38**
Reducer	**0.15**

Terminal Blocks

2 amp 12 way	**£0.20**
5 amp 12 way	**£0.24**
15 amp 12 way	**£0.42**
32 amp 12 way	**£0.88**

NI-CAD

Universal Ni-Cad charger, charges PP3, AA, C.D
Price **£5.10**

RECHARGEABLE BATTERIES

AA (HP7)	**0.95 ea**	10/**0.85 ea.**
C (HP11)	**2.14 ea**	10/**1.98 ea.**
D (HP2)	**2.30 ea**	10/**2.10 ea.**
PP3	**3.75 ea**	10/**3.65 ea.**

ZENER DIODES

400mW Plastic 3V-30V **8p each 10/70p**

1/1.3W Plastic 4.7V-120V **12p each 10/£1.10**

*1.5W Plastic 11V-75V **1.25 each 10/11.50**

*2.5W Plastic 75V-75V **0.75 each 10/7.00**

*15W Plastic 12V-30V **85p each 10/8.00**

*20W Metal 7.5W-68V **1.32 each 10/11.60**

*Only Available while Stocks Last

*Zener Diode Pack-400mW-5 each-value-11 values-individually packed & marked

55 Zener Diodes **3.50 per pack**

VOLTAGE REGULATORS

78L05/08/12/15	**£0.30**
7805/08/12/15/18/24	**£0.45**
7905/12/15/18/24	**£0.50**
LM317K	**£2.40**
LM317T	**£1.25**
LM723	**£0.65**

FUSES

Prices per 10

20mm Quick Blow. 100, 125, 160, 200, 250, 315, 400, 500, 630, 800mA, 1, 1.25, 1.6, 2.5, 3.15, 4, 5, 6.3A **40p. 20mm Time Delay.** 100, 125, 160, 200mA **£1.80.** 250, 315, 400, 500, 630, 800mA **£1.00.** 1, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3A **85p. 1" Mains** 2, 3, 5, 7, 13A **85p.**

CERAMIC CAPACITOR PACK

50V. Ceramic Capacitors – 5 each value
25 values – each value individually marked and packed – 125 total.
£4.75 per pack.

D C MOTORS (Min)

35/086 6-12 volts 25mmx38mm	**75p each**	**10/£6.00**
35/552 9 volts 35mmx42mm	**85p each**	**10/£7.00**
35/129 6-12 volts + m/bracket 25mmx38mm	**80p each**	**10/£6.50**
35/016 6-12 volts + m/bracket 38mmx42mm	**82p each**	**10/£6.70**
SPDC 12 volt Fujiya + Speed Control Board 32mmx38mm	**£2.50 each**	**£10/£22.00**

All prices are subject to change without notice

VALVES

CY802	.95
CV4015	2.80
EABC80	.98
EB91	1.30
ECC81	1.00
ECC82	.90
ECC83	1.00
ECC84	.80
ECC85	.95
ECC86	2.80
ECC88	1.25
ECC198	.85
ECF80	1.20
ECF86	1.70
ECH35	3.75
ECH42	1.20
ECL80	.75
ECL86	1.75
EF80	.75
EF86	1.80
EF91	2.00
EF184	1.00
EL34	3.25
EL84	1.00
EL95	.80
EL509	7.85
EL519	7.95
EM84	1.75
EY86/87	.65
EY500A	2.50
EZ80	.75
GY501	1.40
KT66(GEC)	18.00
KT88(GEC)	19.00
PCC189	.85
PCF80	.95
PCF84	.75
PCF87	.50
PCF800	1.20
PCF802	1.05
PCF805	2.00
PCL82	1.00
PCL84	1.00
PCL86	.90
PCL805	1.05
PD500	2.90
PFL200	1.85
PL36	1.75
PL504	1.40
PL508	2.70
PL519	5.15
PL802	5.50
PY81/800	1.10
PY88	.80
PY500A	2.20

INTEGRATED CIRCUITS

709	0.35
741	0.25
747	0.70
AN214Q	3.80
AN240P	3.42
BTT6218	1.98
CA301AT	2.88
CA58E	0.66
CA810CM	1.20
CA3020	2.10
CA3065	1.80
CA3080E	0.68
CA3130E	0.90
CA3140	0.45
HA1366W	1.59
LA4422	3.20
LC7131	4.90
LC7137	5.40
LM324N	0.45
LM380N8-P	1.15
LM380N14-P	1.80
LM1011N	3.20
LM1458N	0.98
LM3900N	0.85
M51513L	2.30
M51515L	3.18
MC1307P	1.99
MC1327P	1.50
MC1330P	1.60
ML23213	2.10
ML23713	2.30
NE555	0.25
SAA1025	4.00
SAS560	2.50
SAS570	1.85
SAS580	2.85
SN76033N	2.50
SN76131N	1.99
SN76226DN	1.70
SN76227N	1.10
SN7666ON	0.75
SN76666NO	1.40
STK015	6.20
TA7146P	4.60
TA7203P	2.76
TA7204P	1.50
TA7205AP	1.30
TA7222P	2.32
TAA550	0.50
TAA611A12	3.50
TAD100	2.90
TDA120A	0.80
AS/S/SB/T/U	0.80
TDA120B	1.30
SA/SQ/UQ	1.30
TBA520	1.50
TBA530	1.20
TBA540	1.64
TDA560C	1.50
TDA800	0.80
TBA810S	1.20
TBA950/2A	3.05
TCA270SA	4.02
TDA1003A	5.50
TDA1006A	2.45
TDA1035S	2.20
TDA1170S	1.99
TDA1352A	1.80
TDA2002	1.80
TDA2020	4.00
TDA2030	1.90
TDA2140	2.90
TDA2160	2.50
TDA2522	2.75
TDA2530	2.20
TDA2532	2.80
TDA2543	3.20
TDA2581	4.60
UPC57512	1.45
UPC741G	0.95
UPC1156H	2.75
UPC1180	2.75
UPC1218H	1.80
UPC1370C2	2.50
UPC2002H	2.75
UPC2002U	2.75

CMOS

4000	0.19
4001	0.24
4002	0.24
4006	0.68
4007	0.24
4008	0.59
4009	0.44
4010	0.39
4011	0.23
4012	0.24
4013	0.35
4014	0.58
4015	0.58
4016	0.38
4017	0.54
4018	0.59
4019	0.59
4020	0.78
4021	0.58
4022	0.68
4023	0.30
4024	0.49
4025	0.24
4026	0.89
4027	0.44
4028	0.44
4029	0.73
4030	0.33
4031	1.28
4033	1.25
4034	1.40
4035	0.68
4036	2.48
4038	0.73
4039A	2.70
4040	0.58
4042	0.48
4043	0.42
4044	0.48
4046	0.58
4049	0.38
4050	0.34
4051	0.68
4051	0.68
4052	0.58
4053	0.58
4066	0.44
4068	0.24
4069	0.24
4070	0.24
4071	0.24
4072	0.24
4073	0.24
4075	0.24
4076	0.68
4077	0.24
4078	0.24
4081	0.24
4082	0.24
4085	0.58
4086	0.58
4089	1.22
4093	0.37
4094	0.70
4095	0.93
4096	0.98
4097	2.65
4098	0.78
4099	0.75
4161	0.96
4162	0.96
4163	0.96
4174	0.96
4175	1.00
4195	0.99
4501	0.38
4502	0.58
4503	0.38
4507	0.45
4508	1.28
4510	0.54
4511	0.54
4512	0.54
4514	1.10
4515	1.20
4516	0.60
4517	2.70
4518	0.48
4020	0.50
4521	1.10
4522	1.20
4526	0.58
4527	0.64
4528	0.68
4531	1.20
4532	0.64
4536	2.50
4538	0.78
4539	0.80
4541	0.94
4543	0.70
4549	3.98
4553	2.40
4554	1.80
4555	0.34
4556	0.54
4557	2.40
4558	1.10
4559	3.90
4560	1.50
4562	3.48
4566	1.60
4569	1.75
4583	1.00
4584	0.54
4585	0.55
40100	2.10
40101	1.20
40102	1.30
40103	3.95
40104	1.15
40105	2.10

74LS

74LS00	0.24
74LS01	0.24
74LS02	0.24
74LS03	0.24
74LS04	0.24
74LS05	0.24
74LS08	0.24
74LS09	0.24
74LS10	0.24
74LS11	0.24
74LS12	0.24
74LS13	0.33
74LS14	0.48
74LS15	0.24
74LS19	0.44
74LS20	0.24
74LS21	0.24
74LS22	0.24
74LS24	0.28
74LS26	0.24
74LS27	0.24
74LS28	0.24
74LS30	0.24
74LS32	0.24
74LS33	0.24
74LS37	0.24
74LS38	0.24
74LS40	0.24
74LS42	0.50
74LS47	0.79
74LS48	0.85
74LS51	0.24
74LS55	0.24
74LS73	0.30
74LS74	0.33
74LS75	0.44
74LS76	0.38
74LS78	0.38
74LS83	0.68
74LS85	0.82
74LS86	0.35
74LS90	0.48
74LS91	0.90
74LS92	0.54
74LS93	0.54
74LS95	0.60
74LS96	1.20
74LS107	0.40
74LS109	0.44
74LS112	0.44
74LS113	0.40
74LS114	0.39
74LS122	0.68
74LS123	1.00
74LS124	1.25
74LS125	0.52
74LS126	0.50
74LS132	0.60
74LS135	0.26
74LS136	0.42
74LS138	0.44
74LS139	0.58
74LS145	0.93
74LS147	1.64
74LS148	1.28
74LS151	0.70
74LS153	0.70
74LS155	0.55
74LS157	0.45
74LS158	0.58
74LS160	0.62
74LS161	0.68
74LS162	0.70
74LS163	0.68
74LS164	0.74
74LS165	1.10
74LS166	1.50
74LS168	1.48
74LS170	1.40
74LS173	0.98
74LS174	0.75
74LS175	0.70
74LS190	0.82
74LS192	0.98
74LS193	0.98
74LS194	0.75
74LS195	0.74
74LS196	0.84
74LS197	0.96
74LS221	0.85
74LS240	0.80
74LS241	0.80
74LS242	0.94
74LS243	0.94
74LS244	0.80
74LS245	1.20
74LS247	1.00
74LS251	0.75
74LS257	0.73
74LS258	0.75
74LS259	1.20
74LS266	0.55
74LS273	1.20
74LS279	0.70
74LS283	0.80
74LS353	1.10
74LS365	0.50
74LS366	0.50
74LS367	0.50
74LS368	0.50
74LS373	1.00
74LS374	1.00
74LS375	0.70
74LS377	1.25
74LS378	0.95
74LS390	0.60

TRANSISTORS DIODES

Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC127	0.28	BC125	0.14	BC440	0.35	BF158	0.30	BRY56	0.42	BYX10	0.20	TIS43	0.88
AC128	0.30	BC140	0.27	BC441	0.40	BFR160	0.23	BSX19	0.32	BYX36/150	0.40	TIS88	0.50
AC128K	0.34	BC141	0.23	BC461	0.58	BF167	0.32	BSX20	0.30	BYX36/600	0.48	TIS90	0.27
AC141	0.58	BC142	0.24	BC478	0.24	BF177	0.42	BSX59	0.78	BYX48/300	0.70	TIS20	2.45
AC141K	0.38	BC143	0.26	BC516	0.48	BF178	0.26	BSX76	0.65	BYX55/600	0.30	Y728	0.14
AC142	0.56	BC147	0.18	BC547	0.12	BF180	0.27	BSY52	0.35	BYX71/600	1.18	Y969	2.80
AC142K	0.38	BC147B	0.14	A or B	0.10	BF181	0.27	BSY95A	0.25	BYZ 212	0.78	ZE75	0.60
AC151	0.45	BC148	0.10	BC548	0.12	BF182	0.32	BT100A/02	0.90	C106D (400V)	0.48	ZTX107	0.14
AC152	0.45	BC148B	.12	A B or C	0.10	BF183	0.32	BT101/300	2.75	C106F (50V)	0.36	ZTX502	0.22
AC153	0.57	BC149	0.10	BC549	0.10	BF184	0.30	BT101/500	3.25	D40C1	1.08	IN4001	0.04
AC153K	0.46	BC149C	0.14	A or B	0.14	BF185	0.28	BT102/300	3.60	D40N1	1.12	IN4003	0.05
AC176	0.30	BC157	0.10	BC550	0.10	BF194A	0.15	BT106	1.15	E1222	0.30	IN4004	0.05
AC176K	0.38	BC158	0.12	A or B	0.12	BF195	0.12	BT108	1.25	E5024	0.30	IN4006	0.07
AC187	0.28	BC159	0.12	BC557	0.10	BF200	0.30	BT109	1.15	GET872	0.60	IN4007	0.07
AC187K	0.38	B/C	0.14	BC558A	0.10	BF222	0.38	BT116	1.20	GET881	1.70	IN4148	0.04
AC188	0.28	BC160	0.30	BCY70	0.16	BF224	0.16	BT119	3.30	GET882	1.90	IN5400	0.12
AC188K	0.38	BC161	0.30	BCZ10	3.21	BF224J	0.20	BT120	3.50	ITT2001	0.18	IN5402	0.13
ACY22	1.50	BC168B	0.20	BCZ11	2.60	BF240	0.30	BT121	2.99	ITT2003	0.34	IN5405	.16
AD142	0.88	BC169C	0.12	BD124P	0.70	BF241	0.30	BT138/600	1.30	MCR106/5	1.20	IN5406	0.17
AD143	0.88	BC170	0.16	BD129	0.90	BF244	0.34	BT151/560R	0.90	ME0413	0.70	IN5408	0.19
AD149	0.72	A B or C	0.16	BD130Y	0.68	BF244A	0.30	BTY79/400R	2.80	ME6002	0.26	IS44	0.06
AD161/162	1.20	BC171	0.10	BD131	0.36	BF257	0.22	BU100A	2.30	MEU21	0.62	IS920	0.07
AD162	0.52	A or B	0.10	BD132	0.36	BF258	0.26	BU104	1.80	MJ400	0.45	2N1306	1.42
AF114	1.20	BC172	0.10	BD135	0.26	BF259	0.30	BU105	1.20	MJ2955	1.00	2N2122A	0.34
AF115	2.10	B or C	0.12	BD136	0.26	BF262	0.34	BU105/02	1.55	MJ3000	1.80	2N2222	0.30
AF116	2.10	BC177	0.24	BD137	0.28	BF263	0.38	BU108	1.75	MJE340	0.46	2N2904A	0.48
AF121	0.56	A B or C	0.24	BD138	0.30	BF270	0.30	BU124AE	0.98	MJE520	0.44	2N2926G	0.14
AF124	0.42	BC182	0.10	BD139	0.30	BF271	0.28	BU126	1.40	MJE2955	1.60	2N3053	0.30
AF125	0.58	A B or C	0.10	BD140	0.28	BF273	0.22	BU133	1.90	MJE3055	1.40	2N3054	0.60
AF126	0.58	BC182L	0.12	BD142	1.26	BF274	0.34	BU204	1.30	MPSA05	0.30	2N3055	0.65
AF127	0.38	LALDLC	0.12	BD145	1.82	BF294	0.46	BU205	1.30	MPSA12	0.30	2N3703	0.10
AF139	0.40	BC183	0.10	BD150B	0.72	BF336	0.32	BU206	1.50	MPSL01	0.34	2N3773	2.80
AF178	2.28	A B or C	0.10	BD160	1.58	BF337	0.28	BU208	1.40	MPSU05	1.05	2N3904	0.20
AF239	0.50	BC183L	0.10	BD165	0.45	BF338	0.28	BU208A	1.40	MPSU06	1.18	2N3906	0.20
AF279S	1.40	LALBLC	0.10	BD183	0.70	BF355	0.37	BU208/02	2.05	MR502	0.40	2N5294	0.80
AL100	5.40	BC184	0.10	BD201	0.52	BF363	0.35	BU326S	1.75	MR854	0.86	2N6107	0.80
AL102	4.40	A B C L L C L B	0.10	BD202	0.57	BF367	0.24	BU407	1.10	NKT SER18	1.68	2SB337	1.80
ASY80	5.20	BC207	0.15	BD204	0.50	BF371	0.27	BUX80	3.70	OA91	0.07	2SC1098	0.84
ASZ17	2.00	BC212	0.10	BD222	0.80	BF422	0.20	BUY20	2.75	OA210	0.66	2SC1172Y	1.70
AU110	2.80	A B or C	0.10	BD225	0.40	BF450	0.38	BUY69A	2.60	OC26	2.65	2SC1173Y	0.88
AY102	4.32	BC212L	0.09	BD232	0.45	BF457	0.36	BUY69B	1.98	OC35	1.75	2SC1279	0.50
B40C2200	1.03	LALB	0.10	BD234	0.30	BF458	0.37	BY100	0.80	OC36	4.75	2SC1306	0.92
BA110	0.68	BC213	0.10	BD235	0.30	BF459	0.35	BY103	0.50	OC44	0.72	2SC1307	1.50
BA115	0.14	A B or C	0.10	BD236	0.38	BFR51	0.36	BY122	0.60	OC72	0.70	2SC1413A	2.70
BA121	0.40	BC213L	0.10	BD237	0.38	BFR61	0.32	BY126	0.10	OC81	0.68	2SC1449	0.60
BA129	0.38	LALBLC	0.10	BD410	0.76	BFR90	0.86	BY127	0.08	ORP12	0.85	2SC1507	0.60
BA148	0.16	BC237	0.11	BD434	0.58	BFT41	0.68	BY133	0.08	R2008B	1.20	2SC1678	1.00
BA155	0.12	BC238	0.12	BD438	0.58	BFT43	0.86	BY135	0.35	R2010B	1.20	2SC1758	0.68
BA157	0.28	BC251	0.14	BD439	0.85	BFW11	0.84	BY164	0.45	R2010B	1.20	2SC1909	1.20
BB105B	0.30	A B	0.14	BD441	1.00	BFW44	0.88	BY179	0.56	R2540	2.71	2SC1923	0.30
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- T/V loop aerial 75p
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- Philips Neon Lamps for TV sets 5p
- Freeze £1.20
- Foam Cleaner £1.20
- Contact Cleaner £1.20
- Cans of Anti Static, Degrease Cleaner and Anti Corona All at £1.20
- Push Button Mains 75p
- Lorlin Full Remote Relay Switch fit most T/V sets mains 4 tag, 2 tag 12 volt £1.00
- Mains timer, 13 amp – up to 2 hours: easy to use, plugs into socket £3.00
- Sellotape PVC Electric Insultation 50mm x 20M 70p
- Screen locking agent, large can £1.50
- 20 GEC Service Manuals & Rank £5.00
- Red E.H.T. LAED and Anode Cap £1.00
- 10 x G11 Cap 470/250 £15.00
- Woller solder iron 15 watt/25 watt £5.00
- 2 way baby alarm/intercom with long leads £5.00
- Phillips universal battery tester/charger, fuse/bulb tester ... to clear £4.00
- Hitcachi Silver Oxide Battery G13 UCC357 IEC SR44 1.5V 60p
- 70ML Silicone Sealer (clear) £1.00
- 100 Coax Plugs £10.00
- De-solder pump – 2 nozzels Philips £5.00
- Plastic box for i.c.s 6"x3"x½" 50p
- Flat Red LED 12p
- 500gm 60/40 solder reel £7.00
- Clearweld glue pack 30p
- Dual v/u meter −20 - +10db £1.00
- K30 thermistor 232266298009 75p
- GEC Mains Power Supply R.E.G. £3.00
- Frapil moving iron meter, 0-5 amp 0-60v, 0-40 amps 0-250v £2.50 each (cost £16.00)

- 100 W/W Res £1.50
- BF199 20 for £1.00
- 10X20 Turn 100k pots. Rank £2.00
- Thorn 9 volt power supply regulated £3.00
- BF470 20 for £2.00
- 20 Slider Knobs 70p
- 6 Mixed UHF Aerial Isolating Sockets, some with long leads. Fit ITT, GEC, Philips, Pye £1.00

Mixed Packs

- TO66, 12 Power Trans RCA 16182 NPN £1.00
- **Replacement for BD124 and Mounting Kits** £1.00
- £1.00
- 50 Mixed AC series Transistor £4.50
- 15 Panel mount rocket switch 250V/10A £1.50
- 25 Panel Mount Bulbs & Neons £1.50
- 10A £1.50
- Mixed ribbon cables £1.00
- 25 LEB red/yellow/green £1.50
- 201/C Holders £1.20
- 20 Large LED Red £1.00
- 20 Small LED Red £1.00
- 10x20 Turn 100K Pots £1.00
- 100 Transistor £2.50
- 20 Convergence Pots 80p
- 100 Sticks £1.00
- 10 Thermistors 50p
- 20 Slider Pots £1.00
- 30 Presets 50p
- 40 glass reed switch £1.00
- 10 press to make switch 70p
- 40 Pots £1.50
- 10 Gun Switches 50p
- 5 Tube Bases £1.00
- 1,000 Diodes, Condensers, Resistors on Bandolier £2.00
- Lucky Dip 600 gram £1.00
- Jungle Bag 5kg £5.00
- 20 Knobs £1.00
- 40 Pots, ¼" + 6mm spindles for audio/TV £3.00
- 20mm Fuse Holders
- Chassis Mount 20 for £1.00
- IN4001/6 100 mixed £2.50
- EHT Diodes, small 20 for £1.00
- 20 Mixed Switches £1.00
- ITT M5 50p
- Microphone – ITT – Rank 30p
- 400V/4A Triac 10 for £1.00

SENDZ COMPONENTS

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