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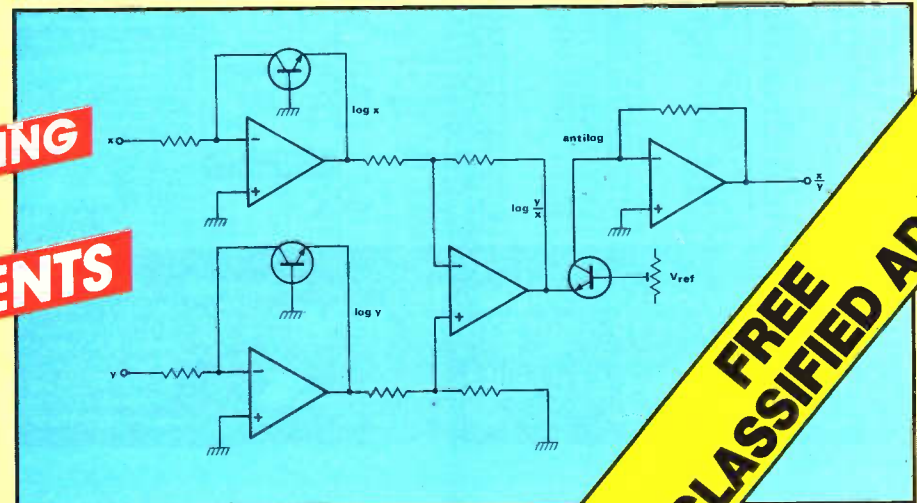
**BUILDING AERIALS —  
OVERCOMING RESTRICTIONS  
OF SPACE & NEIGHBOURS**

**DATA FILE —  
CONCLUDING THE LOOK  
AT SECURITY SYSTEMS**

**27-29MHz CONVERSIONS —  
MODIFYING CB RIGS  
TO AMATEUR REQUIREMENTS**

**ATTENUATORS —  
COMPUTING VALUES  
FOR IMPEDANCE MATCHING**

**NON-LINEAR ELEMENTS  
LOG AND ANTI-LOG**



**FREE  
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# EAST CORNWALL COMPONENTS

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Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)	Type	Price (£)
AC126	0.35	BC108	0.10	BC302	0.32	BD244A	0.65	BF258	0.30	BT101/300	1.15	BYX36/150	0.22	TIP32	0.40
AC127	0.30	AB or C	0.12	BC303	0.32	BD375	0.65	BF259	0.32	BT102/300	1.25	BYX36/300	0.28	TIP32C	0.60
AC128	0.30	BC113	0.14	BC304	0.10	BD410	0.78	BF262	0.30	BT102/500	1.35	BYX48/300	0.72	TIP33A	0.63
AC128K	0.34	BC114	0.14	BC308A	0.14	BD434	0.68	BF263	0.30	BT102/500	1.65	BYX49/300	0.47	TIP34A	0.72
AC132	0.55	BC115	0.12	BC323	0.99	BD436	0.68	BF270	0.30	BT106	1.50	BYX55/350	0.29	TIP42	0.44
AC141	0.26	BC116	0.15	BC327	0.14	BD437	0.76	BF271	0.26	BT108	1.30	BYX55/600	0.33	TIP42A	0.50
AC141	0.26	BC117	0.22	BC328	0.14	BD438	0.75	BF273	0.18	BT109	1.18	BYX71/600	1.18	TIP47	0.60
AC141K	0.40	BC118	0.17	BC337	0.12	BD439	0.68	BF274	0.32	BT116	1.25	BYZ12	0.42	TIP110	0.88
AC142	0.26	BC119	0.20	BC338	0.12	BD507	0.48	BF323	0.92	BT119	3.82	CI06D	0.80	TIP295S	0.60
AC142K	0.48	BC125	0.12	BC350	0.14	BD508	0.55	BF336	0.26	BT120	3.60	CI222	0.40	TIP305S	0.60
AC151	0.45	BC140	0.28	BC340	0.30	BD509	0.54	BF337	0.26	BT121	3.02	E5024	0.30	TIS43	0.32
AC152	0.45	BC141	0.42	BC341	0.32	BD510	0.48	BF338	0.26	BT138/600	1.30	GET872	0.48	TIS88	0.40
AC176	0.28	BC142	0.30	BC341	0.32	BD517	0.56	BF355	0.42	BT151/560R	0.90	ITT44	0.04	TIS90	0.25
AC176K	0.46	BC143	0.30	BC347	0.12	BD520	0.66	BF363	0.82	BT151/300R	1.15	ITT2002	0.11	TIS91	0.28
AC187	0.42	BC147	0.08	BC348	0.12	BD699	1.25	BF367	0.24	BT179/400R	2.80	ME0402	0.20	TIX108	0.12
AC187K	0.48	A or B	0.10	BC349	0.12	BD707	0.88	BF371	0.27	BU100A	2.30	ME0404/2	0.24	ZTX108	0.10
AC188	0.44	BC148	0.08	BC350	0.18	BDX16	2.36	BF422	0.38	BU101	2.00	MEU21	0.60	TIX212	0.22
AC188K	0.50	A or B	0.10	BC350C	0.18	BDX32	2.10	BF450	0.38	BU105	2.20	MJ400	1.25	IN4001	0.05
ACY40	0.88	BC149	0.09	BC357	0.12	BF115	0.32	BF457	0.33	BU105/02	1.56	MJ2955	0.90	IN4003	0.05
AD142	1.10	BC157	0.10	BC358	0.12	BF117	0.54	BF458	0.36	BU108	1.80	MJ3000	1.98	IN4004	0.06
AD143	1.10	BC158	0.10	BC334	0.27	BF119	0.88	BF459	0.44	BU124	1.75	MJ240	0.60	IN4006	0.07
AD143K	0.96	A or B	0.10	BC337A	0.15	BF120	0.32	BF460	0.22	BU126	1.25	MJE340	0.54	IN4007	0.07
AD161	0.42	BC160	0.30	BC377	0.40	BF123	0.40	BF490	0.38	BU133	1.20	MJE370	0.65	CA3085	0.95
AD162	0.42	BC161	0.30	BCY72	0.18	BF125	0.42	BF491	0.22	BU204	1.35	MJE520	0.48	IN5400	0.12
AD161/AD162	0.98	BC168B	0.12	BCY10	1.88	BF127	0.38	BF495	0.30	BU205	1.30	MJE2955	0.99	IN5402	0.15
AF106	0.48	BC169C	0.10	BCZ11	1.45	BF152	0.16	BF496	0.32	BU206	1.70	MJE3055	0.70	IN5405	0.18
AF114	2.10	BC170	0.14	BD124P	0.80	BF154	0.23	BF497	0.28	BU208	1.55	MPSL01	0.28	IN5406	0.16
AF115	2.10	BC170B	0.10	BD130Y	0.40	BF157	0.40	BF498	0.34	BU208A	1.63	OA47	0.10	IN5408	0.20
AF116	2.10	BC171	0.10	BD131	0.34	BF158	0.40	BF499	0.34	BU208/02	2.05	OA90	0.08	IN4148	0.05
AF117	2.10	BC171	0.10	BD132	0.34	BF159	0.24	BF141	0.38	BU326S	1.75	OA91	0.09	IN4001	0.05
AF118	0.85	A or B	0.08	BD133/BD132	0.95	BF160	0.23	BF143	0.36	BU407	1.65	OA95	0.18	2N706A	0.33
AF121	0.62	BC172	0.08	BD135	0.32	BF167	0.30	BFW10	0.79	BU407D	1.80	OA200	0.06	2N2904A	0.28
AF124	0.48	A or B	0.12	BD136	0.38	BF173	0.25	BFW44	0.76	BUX80	3.70	OA202	0.15	2N2906	0.24
AF125	0.48	BC173	0.20	BD137	0.40	BF177	0.40	BFX29	0.17	BUX29	1.75	OC205	2.10	2N2926G	0.10
AF127	0.48	BC178A	0.22	BD138	0.38	BF178	0.38	BFX30	0.30	BUX59A	2.60	OC206	1.70	2N2930	0.10
AF139	0.68	BC182	0.08	BD139	0.38	BF179	0.32	BFX80	3.56	BUX69B	1.98	OC28	1.50	2N3054	0.56
AF178	0.68	A or C	0.09	BD140	0.38	BF180	0.35	BFX84	3.24	DBY101	0.48	OC29	2.47	2N3055	0.48
AF239	0.68	BC182L	0.09	BD144	1.60	BF181	0.35	BFZ85	0.26	BY118	1.10	OC35	1.75	2N3702	0.10
AF293	0.72	A or C	0.09	BD145	1.82	BF182	0.32	BFX86	0.26	BY122	0.68	OC36	1.75	2N3704	0.10
AL100	2.50	BC183	0.10	BD150A	0.51	BF183	0.32	BFX87	0.26	BY126	0.12	OC42	0.72	2N3708	0.10
AL102	5.90	A or C	0.10	BD159	0.61	BF184	0.32	BFX88	0.26	BY127	0.10	OC42K	1.40	2N3712	1.90
AL113	2.20	BC183L	0.06	BD160	1.55	BF185	0.32	BFY50	0.21	BY133	0.16	OC44	0.72	2N3713	2.70
AS980	1.75	A or C	0.12	BD165	0.45	BF194	0.08	BFY51	0.21	BY135	0.25	OC45	0.58	2N3904	0.16
AU110	1.40	BC184	0.10	BD175	0.80	BF195	0.10	BFY52	0.21	BY164	44	OC71	0.50	2N3906*	0.18
AY102	4.32	A or C	0.10	BD182	1.00	BF196	0.10	BFY57	0.90	BY179	0.66	OC72	0.52	2N5294	0.48
BA102	0.10	BC207	0.16	BD183	1.10	BF198	0.10	BFY90	0.90	BY182	0.87	OC73	0.68	2N5407	0.71
BA110	0.67	BC208	0.16	BD184	1.20	BF199	0.16	BFY93S	1.72	BY206/02	2.05	OC80	2.45	2N6126	0.68
BA121	0.40	BC212	0.09	BD201	0.72	BF199	0.16	BR100	1.20	BY187	0.72	OC82	2.20	2SB337	1.60
BA129	0.38	A or C	0.10	BD202	0.48	BR101	0.44	BY189	0.44	BY189	4.75	ORP12	0.85	2SC1172Y	2.90
BA148	0.16	BC212L	0.08	BD204	0.80	BF222	0.48	BR103	0.58	BY198	0.44	R2008B	1.50	2SC1173Y	1.82
BA154	0.08	A or C	0.10	BD222	0.80	BF224	0.48	BR103	1.76	BY199	0.47	R2010B	1.52	2SC1302	0.40
BA155	0.10	BC213	0.09	BD225	0.50	BF224J	0.16	BR103	0.36	BY206	0.24	SHG1 5	0.40	40251	0.95
BA156	0.08	A or B	0.10	BD232	0.45	BF240	0.26	BR103	0.36	BY206	0.24	TAG11/100	0.24	2S3053	0.50
BA157	0.28	BC213L	0.10	BD233	0.60	BF241	0.26	BR161	0.86	BY210/400	0.25	TAG3/400	1.78	40362	0.50
BA164	0.14	A or B	0.10	BD234	0.62	BF244	0.26	BSS17	0.56	BY210/600	0.26	TIC44	0.40	40411	3.72
BB104B	0.52	BC237	0.11	BD235	0.63	BF244A	0.28	BSS27	0.92	BY210/800	0.30	TIC45	0.45	40530	0.80
BB105B	0.30	BC236	0.12	BD236	0.63	BF244C	0.24	BSS19	0.34	BY223	1.20	TIC46	0.48	40673	0.80
BB105G	0.48	BC239	0.14	BD237	0.63	BF245A	0.26	BSS20	0.34	BY227	0.26	TIC47	0.70	40964	1.54
BB119B	0.42	BC251	0.12	BD238	0.56	BF254	0.56	BSS21	0.62	BY229	0.24	TIC106A	5.20	30P	39p
BC107	0.10	A or C	0.14	BD241	0.60	BF256	0.40	BSS26	0.29	BY238	0.68	TIP30C	0.48	35K68	0.66
A or B	0.12	BC301	0.30	BD243A	0.80	BF257	0.32	BT100A/02	0.94	BYX10	0.24	TIP31C	0.54	35K135	5.20

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MC1351P	1.10		
MC13			

# CONTENTS

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## 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 left** - Courtesy of Grosvenor Software

**Top right** - DX-TV (p72)

**Centre left** - 27-29MHz conversions (p29)

**Centre right** - Construction tips (p79)

**Bottom** - Non-linear elements (p57)

## SPECIAL FEATURES

### 16 Cellular mobile radio

Nigel Cawthorne describes an interesting development in the TV bands

### 19 Computing attenuators

Calculate resistance values with a program from Brian Kendal and Jeff Howell

### 23 Small aerials

Allan Grice on coping with problems of space and neighbours

### 29 27-29MHz conversions

Bill Sparks and Colin Horrabin on converting CB equipment

### 37 Data file

The conclusion of Ray Marston's series on security systems

### 49 A beginner's guide to the field effect transistor

James Dick details the uses of this interesting device

### 57 Non-linear elements - log and anti-log

Dr C J D Catto continues his fascinating series

### 61 Computer aided design

A review of the Number One Systems network analysis program, by Simon Karas

### 79 Tips for the constructor

Save money by following Paul Wesley Warren's advice

## REGULARS

### 4 Product news

### 13 News desk

### 35 Amateur radio world

### 63 Latest literature

### 65 Corrections and mods

### 67 Short wave news

### 70 QSO

### 72 DX-TV reception reports

### 76 ATV on the air

### 81 Free classified ads

### 84 Small ads

## READER SERVICES

### 22 Subscription order form

### 62 Amateurs Handbook order form

### 74 Newsagents order form

### 78 Amateur Radio subscription order form

### 80 Back issues order form

### 83 Free classified ad order form

### 86 Advertisers index

### 86 Advertising rates and information

## NEXT MONTH

### 75 What's in store for you

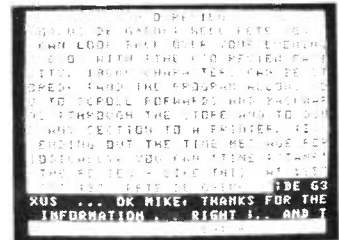
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Second Thursday of the month preceding cover date

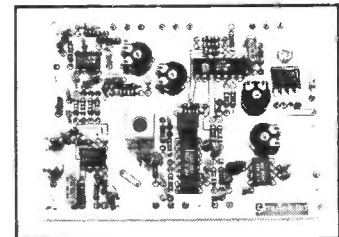
#### Next issue

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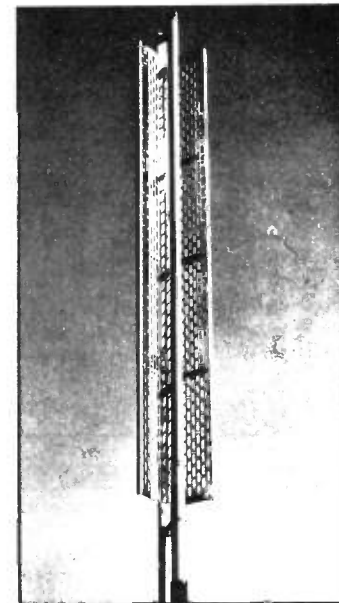
We regret to inform readers that owing to continually rising production costs and to enable us to maintain the high standard of content in **Radio and Electronics World** the price of the magazine will be 99p from this issue.



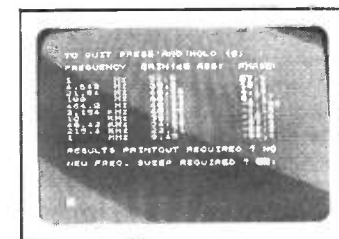
AMTOR for the Dragon - page 4



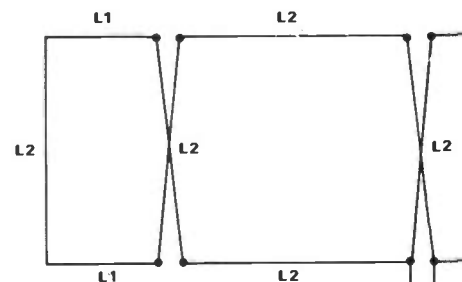
10GHz WBFM back-end - page 10



Radio telephone service - page 16



Network analysis program - page 61



Sterba curtain design - page 76

# 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

## AMTOR FOR THE DRAGON

Grosvenor Software have announced their new AMTOR software, by G4BMK, for the Dragon computers.

The system is a full-feature 'stand alone' program, in that it needs no additional expensive electronics, and it offers a great saving in cost over current alternatives.

The software supports all modes of AMTOR (FEC, ARQ and Listen), with full type-ahead, plus the sophisticated memory and QSO review facilities already a part of G4BMK's RTTY software. The program will also decode commercial TOR/SITOR transmissions and the NAV-TEXT weather report service on 518KHz.

All that is required additionally is a conventional RTTY terminal unit and a crystal controlled 1KHz clock, plus a PTT switching interface for transmission. A suitable clock/PTT unit is available from PNP Communications.

The Dragon AMTOR is the

```
G3XUS DE G4BMK: .. GOOD EVENING
PETE, GLAD TO WORK YOU WITH;
THE G4BMK AMTOR PROGRAM - IT'S
GOOD TO KNOW THAT COPY; WILL BE
100 PERCENT ALL THE WAY THROUGH.
THERE ARE A LOT; OF COUNTRIES
ON AMTOR NOW - AND IT SEEMS SO
EASY TO; WORK DX EVEN WITH VERY
LOW POWER AND MY SIMPLE AERIAL;
BTU ... G3XUS DE G4BMK +?
G4BMK DE G3XUS HELLO MIKE, YES
I WORKED DX3PT LAST NIGHT ;FOR
20 MINS. DESPITE THE QRM - AND
YB2SV IN INDONESIA ;IS ALWAYS
A GOOD SIGNAL ON 14 MHZ.
T 4HMA 18:44 GXUS
```

latest in Grosvenor's range of high-quality software. This range includes RTTY programs for the Vic-20, CBM64, Atom and Dragon, all of which are 100% machine code with split screen operation, fully variable baud rate from 17 to 255, and full type-ahead at all speeds.

Also available are a CW transceiver and a Morse tutor program, the latter being in

machine code for flexibility and life-like, pure-sounding tones.

Full hardware/software details are available; just send a large sae to Grosvenor Software (please state call-sign, if any).

Grosvenor Software, 22 Grosvenor Road, Seaford, E Sussex BN25 2BS. Tel (0323) 893378.

## ALUMINIUM CAPACITORS

Gothic Crellon can supply, ex-stock, Mullard's 122 series of solid aluminium electrolytic capacitors.

The series is ideal for filtering, smoothing, coupling, decoupling and energy storage in consumer, telecommunications, industrial, scientific, medical and automotive equipment.

It is claimed that the 122 range offer the virtues of tantalum products, but are more versatile in their tolerance of reverse voltages and high operating temperatures.

Manufactured in four sizes to accommodate a wide range of values, the 122 series will accept from 6.3 to 40V while capacitance range is from 0.1 $\mu$ F to 68 $\mu$ F.

Up to one third of the rated voltage can be reversed through the capacitor without damage. Rated voltages apply up to 125°C.

Also available from Gothic Crellon are RCA's new COM-FETs, devices particularly suited to high voltage, high power applications.

COMFETs (Conductivity Modulated Field Effect Transistors) offer advantages over conventional power MOS-FETs, whose significant  $R_{DS}$  (ON) values frequently result in excessive voltage drops and power losses. COMFETs, whilst similar in specification to bipolar power transistors, do not require expensive high power drivers.

Typical turn-on time is less than 100nS, and turn-off has been measured in the range of 5 to 20 $\mu$ S.

Gothic Crellon Ltd, 380 Bath Road, Slough, Berks Tel (06286) 4300.

## 3in MICRO DISC DRIVE

The D321 is fully plug and signal compatible with 5 $\frac{1}{4}$ in floppy disc drives, but uses a standard 3in disc.

The basic unit, including electronics, measures only 90mm wide x 40mm high, offering a large space saving over 5 $\frac{1}{4}$ in units.

System designers can mount 4 drives in the space of one standard 5 $\frac{1}{4}$ in disc drive by housing the electronics separately.

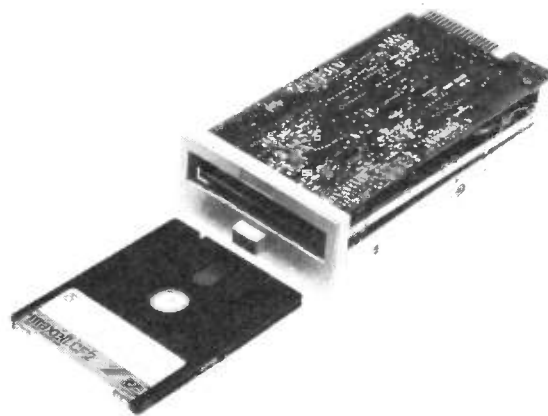
The mechanics only version measures 82.5mm wide x 35mm high.

Data is recorded double density, double sided and uses 40 tracks on each side to provide 500K bytes per disc. Average access time is 148mS.

Track to track access time is 10mS.

One-off price is £105.00, 50 off price is £99.00 each.

DED, Mill Road, Lydd, Kent TN29 9EJ Tel (0679) 20636.



## BLOCK DOWNCONVERTER

Following the success of their satellite receiving system introduced last year, the Dutch company Tratec have introduced the EDC 750 Block Downconverter.

With a typical noise figure of only 1.9dB (2.7dB max), the unit has an input frequency of

10.95-11.7GHz and output of 950-1700MHz.

Gain is 54dB and image rejection better than 45dB, with 3rd order intermodulation of -60dB at -20dBm output level (two carriers).

Each unit is delivered with an individual test report concerning gain and noise.

The compact size, 12 x 6 x 4cm at a weight of 0.5kg, is matched by an equally compact price. The unit is available from SPT Video.

SPT Video, Heybridge Industrial Estate, Holloway Road, Heybridge, Maldon, Essex CM9 7XS.



## NEW BROTHER PRINTER

The recently introduced budget priced M-1009 dot matrix printer from Brother has been selected by Rapid Terminals as a worthwhile addition to their 'Winners' product range.

The 50 characters per second M-1009 is intended for use with personal and home computers, and will offer serious competition to other manufacturers in this area of the marketplace.

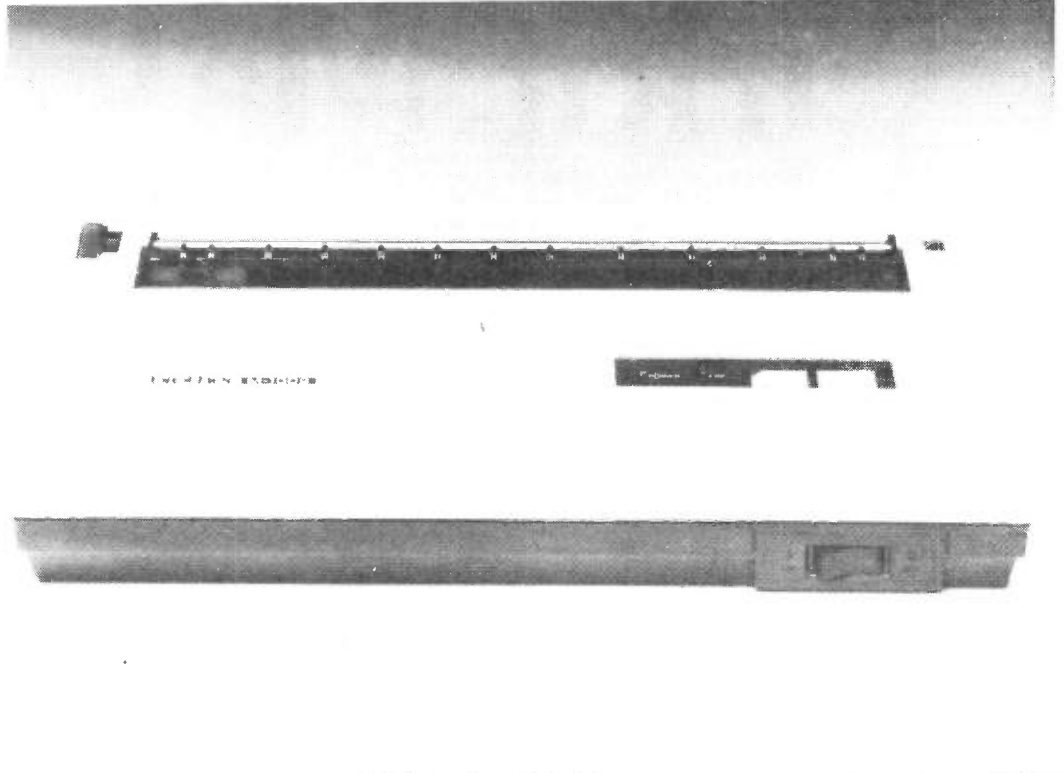
It has a nine-pin head with a life in excess of twenty million characters.

There is a 96 character set, plus super and subscript capability, and the ability to produce bit image graphics with either 480 or 960 dots horizontally.

The printer will handle 80 column cut sheet, roll or fanfold paper and will print an original with up to two copies.

The character set is standard Pica style and can be printed normally, condensed or enlarged, at 66, 80, 132 or 40 characters per line respectively.

The standard interface is parallel (Centronics) with RS232 available as an option. Other options include a paper roll holder and a pin feed unit.



The M-1009 measures 333 x 191 x 70mm, weighs 3kg and costs £199 (including VAT).

*Rapid Terminals, Rapid House, Denmark Street, High Wycombe, Bucks HP11 2ER Tel (0494) 26271.*

## SOLDERING STATION

Litesold have introduced an entirely self-contained fume extracting soldering station which removes soldering fumes at source - right from the tip of the bit.

The Litesold ETC-4/FX features a control unit with a built-in diaphragm vacuum pump, and fully variable elec-

tronic temperature control, with digital display of soldering iron temperature.

The iron is fitted with a one-piece stainless steel fume extractor tube, with its chamfered front end located right above the tip of the soldering bit.

A burn-proof silicone tube

connects the extractor tube to a quickly detachable large capacity filter chamber clipped to the rear of the control unit.

The sintered-polythene filter element unscrews for washing in solvent.

Cost and complication of central extractor systems are avoided, together with attendant problems of loss of heated air and pipework cleaning.

The Litesold ETC-4/FX is completely portable. Temperature control is by IC and transistor switching of the dc supply to the 40W iron, which contains a thermocouple sensor.

Control is entirely free from spiking and RFI and the iron is static and leakage free.

*Light Soldering Developments Ltd, Spencer Place, 97/99 Gloucester Road, Croydon CR0 2DN. Tel: 01 689 0574.*

## HOME MICRO CABLES

Scotchflex flat cable/connector assemblies for linking micro-computers to peripheral equipment are to be made available to the home computer market ex-stock.

Being BBC compatible, the harnesses will fit most micro-computers and are being offered by 3M at competitive prices. Two versions are available, for interfacing with a parallel printer and a disc drive.

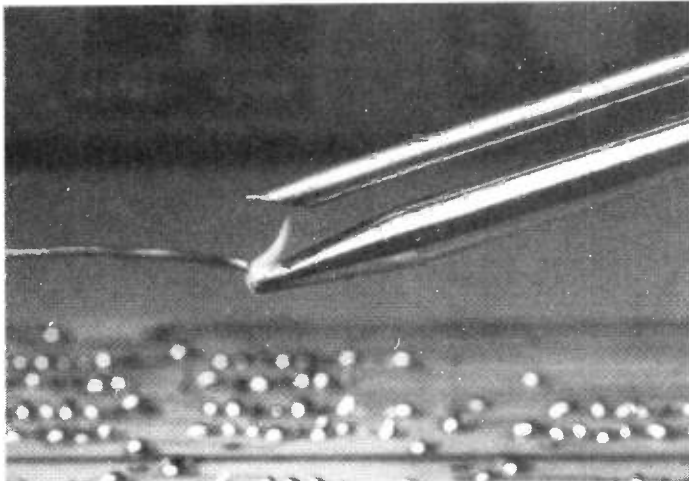
Scotchflex Printer Cable No HA500P comprises a 36-way Delta ribbon connector (Centronics-type) and a 26-way socket linked by a 1250mm length of flat grey cable.

The socket is fitted with built in strain relief.

Scotchflex Disc Drive Cable No HA501D also features a 1250mm long cable terminated at either end with a 34-way card edge connector and a 34-way socket with strain relief.

The new assemblies allow home computer users to benefit from the proven quality and reliability of the 3M Scotchflex flat cable/connector system. Both products are UL recognised and are 100% visually and electrically tested.

*Electronic Products Group, 3M United Kingdom PLC, 3M House, PO Box 1, Bracknell, Berks RG12 1JU Tel (0344) 58509.*



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## Cirkit Kits

### CIRKIT ELECTRONICS TOOL KIT

Contains: 15W Soldering Iron 2 spare bits, heat shunt, solder, pliers, cutters, and screwdriver 40-00007 15.56

### AUDIO FUNCTION GENERATOR

Versatile waveform generator with sine, triangular and square wave outputs. On board mains PSU 41-01302 27.00

### STEREO 40W AMPLIFIER

Single board 40W per channel stereo amplifier 41-01301 38.00

### STEREO VU METER

5 LED per channel stereo VU meter for use with stereo amplifiers 41-01401 11.50

### 5W AUDIO AMP

A very compact audio output stage for use in a wide range of equipment 41-01406 4.60

### UNIVERSAL AMP

A universal audio pre-amp with a gain of 10 41-01604 6.45

### MONO REVERBERATION UNIT

Single channel, spring line reverb unit to add echo effects to tape recording etc. 41-01602 10.00

### 10MHz DFM

8 Digit LED digital frequency meter and period measurement 41-01603 10.45

### 50MHz PRESCALER

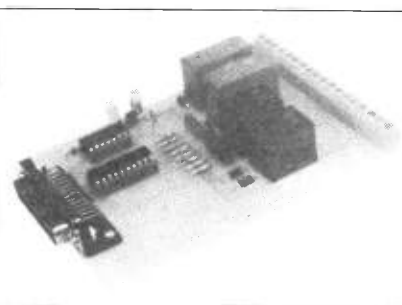
Extend the range of the 10MHz DFM to 50MHz 41-01501 8.55

### 1-5MHz PRE AMP

Low frequency pre-amp and waveform shaper for the 10MHz DFM 41-01502 5.13

### 1-30V 1mA-2A PSU

Adjustable 1-30V Power supply with pre-settable current limit from 1mA-2A 41-01600 37.46



Centronics Interface

### 5-12V 1A PSU

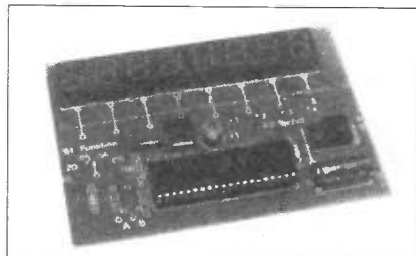
Adjustable PSU from 5-12V with current protection, 1 amp max output 41-01504 6.45

### 1-30V 1.5A PSU

1-30 volt adjustable PSU with protected output up to 1.5 Amps 41-01402 10.45

### 3 DIGIT LED DVM

DVM to read up to 99.9 volts or configured as an ammeter to read up to 9.99 amps 41-01403 17.00



10MHz DFM

### INFRA RED LINK

Single channel IR Link with relay output 41-01300 9.60

### TEMPERATURE SENSOR

Thermistor based temperature sensor with relay output 41-01303 6.20

### LOCOMOTIVE SOUND GENERATOR

Realistic steam sound and whistle for model railways 41-01304 9.20

### LAMP DIMMER

Control lamps and drill speed 41-01305 5.70

### WATER LEVEL ALARM

Alarm to indicate high water level or flooding 41-01601 2.70

### 3 NOTE CHIME

Doorbell chime with adjustable tones 41-01503 7.00

### 2M PRE AMP

Miniature low-noise MOSFET pre-amp for the 2m amateur band 41-01307 3.91

### 2M CONVERTER

Low noise 144MHz-28MHz amateur band converter 41-01306 17.35

### 2M POWER AMP

20W - 10dB gain - power amplifier for the 2m band. Automatic TX switch over, RX pre-amp, robust construction 41-01404 32.87

### 70cm PRE AMP

Low noise, miniature pre-amp for the 70cm amateur band 41-01506 4.78

### 70cm CONVERTER

70cm to 144MHz low noise converter featuring pre-aligned helical filter, schottky diode mixer and low noise transistors 41-01405 21.50

### 70cm PA

10W Power amp to boost the output of handheld and portable 70cm transceivers 41-01505 33.82

### CRYSTAL CALIBRATOR

Crystal reference calibrator for alignment of receivers, outputs at 4, 2, 1MHz, 100, 50 AND 10KHz 41-00801 4.32

### CB NOISE SQUELCH

Improves to mute performance of the majority of CB rigs 41-01605 5.40

### CENTRONICS INTERFACE

Connect your personal computer to the outside world via the Centronics printer output 41-01406 22.50

To: Cirkit Holdings PLC, Park Lane, Broxbourne, Hertfordshire. EN10 7NQ.  
I enclose 85p. Please send me your latest catalogue and 3 x £1 discount vouchers!  
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## Nicad Batteries & Chargers

High quality nickel cadmium rechargeable batteries. Equivalent in size with popular Dry Cell sizes e.g. HP7 (AA), HP11 (C), and HP2 (D). Minimum life 600 (300 PP3 size) full charge/discharge cycles. Batteries must be charged from a constant current source only. All batteries are supplied only with a residual charge and should be charged before used.

### DATA & PRICES

Type	V(nom)	Capacity	Stock No.	1-9	10-49
AA	1.2V	500mAh	01-12004	0.80	0.74
C	1.2V	1.2AH	01-12024	2.35	1.99
D	1.2V	1.2AH	01-12044	2.00	2.00
PP3	8.4V	110mAh	01-84054	3.70	3.50

### CH/4/50

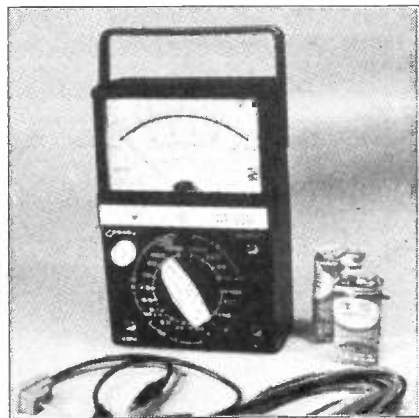
To recharge up to 4 AA size NiCads.  
Size: 112 x 71 x 37mm 01-00409 4.95

### CH1/22

To charge PP3 type NiCads.  
Size: 70 x 50 x 32mm 01-00159 4.30

### CH8/RX

Will recharge AA, C, D and PP3 size cells with automatic voltage selection. Will recharge following combinations: 4xD, 4xAA, 4xC, 2xPP3, 2xD + 2xC, 2xD + 2xAA, 2xD + 1xPP3, 2xC + 2xAA, 2xC + 1xPP3, 2xAA + 1xPP3. Charge rate: 11mA for PP3, 45mA for AA size, 120mA for C and D size, for 16 hrs. Power: 240V 50Hz. Output Voltage: 2.9V for AA, C and D size, 11.0V for PP3 size. Weight: 0.475kg. Size: 199 x 109 x 55mm. 01-02204 9.45

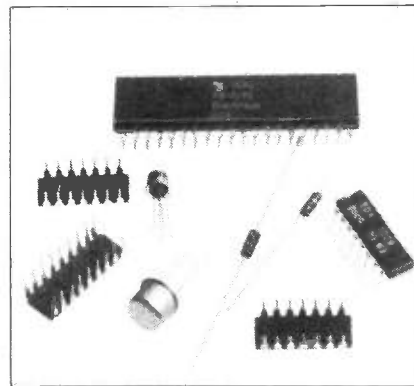


## HT320

High quality, high specification meter at a reasonable price. In addition to the usual ranges, facilities are provided for measuring transistor parameters such as I<sub>ceo</sub> and H<sub>fe</sub>. Meter movement fully protected against overloads. 3-colour mirrored scale in robust case. Supplied complete with comprehensive instructions, test leads, transistor test leads and batteries (2 x HP-7, 1 x PP3).  
DC Volts: 0.1V, 0.5V, 2.5V, 10V, 50V, 250V, 1kV (20kΩ/V). AC Volts: 10V, 50V, 250V, 1kV (18kΩ/V).  
DC current: 50μA, 2.5mA, 25mA, 250mA.  
Resistance: 2k, 20k, 2M, 20MΩ. AF Output: -10dB to +22dB for 10VAC (0dB/0.775V, 600Ω). Leakage (I<sub>ceo</sub>) 15μA, 15mA, 150mA. H<sub>fe</sub>: 0-1000 (Lc/Tb).  
Weight: 410gms. 56-83201 14.00

## RF Generator LSG17

A stable wide-range generator for the hobbyist, service technician, schools, colleges, etc.  
Frequency range: A/100kHz-300kHz, B/300kHz to 1MHz (Harmonics 96-450MHz) C/1MHz-3.5MHz, D/3.0MHz-11MHz, E/10MHz-35MHz, F/32MHz-150MHz. Accuracy: ±1.5%. Output greater than 100mV (no load). Ext. xtal osc for 1 to 15MHz crystal. Power required: AC100, 115 or 230V 3VA.  
Size & Weight: 150(H) x 238(W) x 130(D)mm, 2.5Kg approx. 56-90017 115.00



## Linear ICs

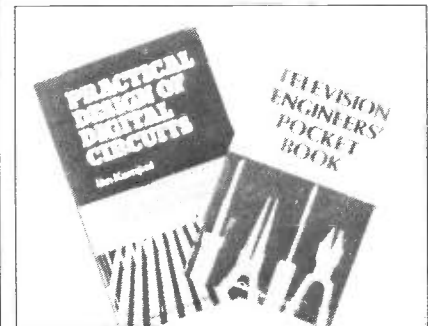
		Stock No.	Price
LF351	Bi-FET op amp	61-03510	0.49
LF353	Dual version of LF351	61-03530	0.81
LM380N	IW AF power amp	61-00380	1.45
LM381	Stereo pre-amp IC	61-00381	3.27
NE544	14 pin DIL servo driver IC	61-00544	1.80
NE555N	Multi-purpose low cost timer	61-05550	0.21
uA741CN	DIL low cost op-amp	61-07411	0.42
TDA1062	RF oscillator and mixer system for 1-200MHz	61-01062	1.95
TDA1083	Portable radio AM/FM audio in one IC	61-01083	1.95
HA1388	18W PA from 14V	61-01388	2.75
MC1496P	Double balanced mixer/modulator	61-01496	1.25
TDA2002	8W into 2 ohms power amp	61-02002	1.25
ULN2283	1W max 3-12V power amp	61-02283	1.00
CA3089	FM IF amp, detector, mute, AFC, AGC system	61-03089	2.84
CA3130E	BIMOS op amp	61-31300	0.80
CA3140E	BIMOS version of 741	61-31400	0.46
MC3359	Low current dual conversion NBFM IF and det	61-03859	2.95
LM3900	Quad norton amp	61-39000	1.20
LM3909N	8-pin DIL LED flasher	61-39090	0.68
KB4412	Two balanced mixers IF amp with AGC for AM/SSB	61-04412	1.95
ICM7555	Low power CMOS version of 55 timer	61-75550	0.98
HA11225	Low noise FM IF	61-11225	1.45
HA12017	83dB S/N phono preamp 0.001% THD	61-12017	0.80
MC14412	300 baud MODEM controller (Euro/US specs)	61-14412	6.85

## Selected Lines

PB2720	80dB Piezo Buzzer	43-27201	0.55
10M15A	10.7 Filter	20-10152	2.10
10M08AA	10.695 Filter	20-11152	3.49
FC177	LCD Freq. Meter	39-17700	20.00
CM161	Min LCD Clock	40-80161	8.25
BBC to Centronics Cable		03-10019	7.25
Dragon to Centronics Connect Cable		03-10017	7.25
C12 Computer Cassette Tape		21-00012	0.55
8 x 0.3"	IC socket	28-00800	0.12
14 x 0.3"	IC socket	28-14000	0.13
16 x 0.3"	IC socket	28-16000	0.13
6V	KUIT-A Relay	46-80000	0.48
9V	KUIT-A Relay	46-80001	0.48
12V	KUIT-A Relay	46-80002	0.48
CX120P	COAX Relay	46-90120	11.96
CX520D	COAX Relay	46-90520	26.98
CX540D	COAX Relay (BNC)	46-90540	26.98

## Books

Beginners Guide to Amateur Radio	02-11262	4.50
Beginners Guide to Electronics	02-04134	4.50
Active Filter Cookbook	02-21168	12.70
CMOS Cookbook	02-21398	11.85
TTL Cookbook	02-10358	11.00
Design of Active Filters	02-21539	10.15
Design of Op-amp Circuits with experiments	02-21537	9.30
Effectively Using the Oscilloscope	02-21794	9.30
The ZX Spectrum	02-00100	5.95
Practical Design of Digital Circuits	02-11831	10.45
Electronic Projects for Home Security	02-05351	3.80
Electronic Telephone Projects	02-21618	7.60
55 Timer Applications Sourcebook	02-21538	6.40
Television Engineers Pocket Book 7th Ed	02-21313	8.50
Electronics Pocket Book	02-21309	7.50
99 Practical Electronic Projects	02-21635	5.90
More Electronic Projects in the Home	02-21307	3.80
The Radio Amateurs Question and Answer Reference Manual	02-02157	5.95
Basic Programming on the BBC Microcomputer	02-06640	5.95
Using Microprocessors and Microcomputers: The 6800 Family	02-98728	11.05
Z-80 Microcomputer Design Projects	02-21682	12.70
Z8000 Microprocessor: A Design Handbook	02-37345	16.10



68000: Principles and Programming	02-21853	12.70
8085A Cookbook	02-21697	13.55
Handbook of Electronic Tables Formulas	02-21532	11.00
Popular Circuits: Ready Reference	02-04585	13.95
Semiconductor Data Book 11th Edition	02-04797	9.00

## PRODUCT NEWS

### LOW COST RADIO MODEM

Previously known for their more expensive, high quality AMTOR and RTTY terminal units, ICS have now introduced a new, versatile low cost terminal unit for the beginner, experimenter or

VHF operator.

Requiring 12 volt dc input at 150mA, the RM-1 connects to a home computer via either TTL or RS232 level interfaces (both are supplied as standard). It can be used to send and receive RTTY or AMTOR

at up to 100 bauds.

Also available are CW send and receive and wide band ASCII communications at up to 1200 bauds. European IARU tone standards are supported and the wide band receive mode can be used for receiv-

ing commercial 425, 850Hz shift RTTY, as well as data transmissions from the UoSAT series satellites.

A range of software and cable packages for the RM-1 is available from ICS for many of the more popular home micro computers. Most other RTTY software on the market can also be used with the RM1. It is plug compatible with other ICS terminal units.

Packaged in an attractive screen printed enclosure, with a comprehensive manual, the UK made RM-1 lacks the extensive filtering of ICS's more expensive terminal units, but is ideal for most medium to strong signal applications.

The RM-1 is available for £60.00 plus VAT and £1.50 p&p.

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



### D-SUBMINIATURE CONNECTOR

H & T Components, the Swindon based manufacturer of IDC connectors, are launching a new 4600 series D-subminiature connector at Internecon.

The 4600 series, an all metal shell insulation displacement type connector, has all the advantages of a very low profile, rugged construction and improved RFI/EMI protection, coupled with the efficient 0.05in pitch IDC termination technique as used on all of the other connectors in the range.

The D-subminiature is offered in 4 contact configurations, 9, 15, 25 and 37, for both plug and socket, and will mate with all other D-subminiatures available.

The finish on the standard connector is yellow chromate to match most existing solder style connectors; however, a bright tin finish is available (to special order) for high level EMI/RFI protection.

Several other new connectors are in final stages of development and are intended to be launched in the autumn.

*H & T Components Ltd, Dunbeath Road, Swindon SN2 6EA.*

*Tel (0793) 693681.*

### TAU SPC-3000

After the success of their unique SPC Transmatch ATU in kit form, launched at the RSGB exhibition in Birmingham earlier this year, TAU Systems are now set to launch a further development.

At Leicester Amateur Radio Show on 26-27 October, TAU will be showing their new SPC-3000 ATU, essentially the SPC Transmatch in a robust, high quality cabinet.

With its roller coaster tapered pitch inductor, the

SPC-3000 offers continuously variable tuning from 1.5 to 29.35MHz, and the unit has a built-in 1KW 4 to 1 impedance ratio balun. The spaced-plate capacitors of the series/parallel capacitance (SPC) format are rated at 5KV (tested to 7KV), and there is a five position antenna switch for five input/outputs. Twin meters give SWR and power readings.

Due to the success of the Transmatch kit, TAU have recently been able to reduce

its price, and are introducing the new SPC-3000 at a lower price than was originally thought possible.

The SPC-3000 is solidly built (in Britain) to traditional precision engineering standards, and will last a lifetime.

It is available direct from TAU, or from selected retailers, for £349.95 inc VAT.

*TAU Systems Ltd, 51 Greenhey Place, East Gillibrands, Skelmersdale WN8 9SA. Tel (0695) 24662.*







## From I.C.S. The RM-1 Radio Modem



- 170Hz shift IARU tones for RTTY/AMTOR at up to 100 Bauds
- 800Hz shift IARU tones for ASCII data transfer at up to 1200 Bauds (Can also be used to demodulate 425, 850Hz shift RTTY and UoSat satellite data)
- CW demodulator with keyer output.

Two interfaces are built in:

TTL  
RS232  
switchable

12 Volt D.C. input  
Connects to PTT/MIC and SPKR lines of your transceiver.

It can be used for high speed computer data exchange or standard RTTY or CW (with suitable programs).

The RM-1 is compatible with the following I.C.S. software:

RTTY/CW/ASCII, for VIC-20 or CBM-64.....	£33.91
AMTOR/RTTY/CW/ASCII for VIC-20 or CBM-64 (MBA-TOR).....	£60.00
RTTY/CW (Tx) for BBC model B.....	£33.91
Add P&P.....	£1.00

The RM-1 can also be used with any other ASCII terminal emulation or RTTY software. Plug compatible with almost all American RTTY software.

Maximum Versatility; Maximum Ease of Use and Minimum Price, the RM-1 is suitable for a wide range of medium to strong signal applications.

Professionally built in a screen printed metal enclosure with extensive documentation by I.C.S. - the data communications specialists.

Price.....	£60.00
P&P.....	£1.50

Please add VAT @ 15%  
Callers by appointment

CONTACT US FOR DETAILS OF OTHER RADIO DATA COMMUNICATIONS SYSTEMS FOR USE WITH HOME COMPUTERS.

**ICS ELECTRONICS LTD**  
**PO BOX 2, ARUNDEL**  
**WEST SUSSEX BN18 0ND**  
**PHONE; 024 365 590**



  
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in Gt. Britain

**TAU SYSTEMS LTD**  
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ENGLAND  
Phone: 0695 24662

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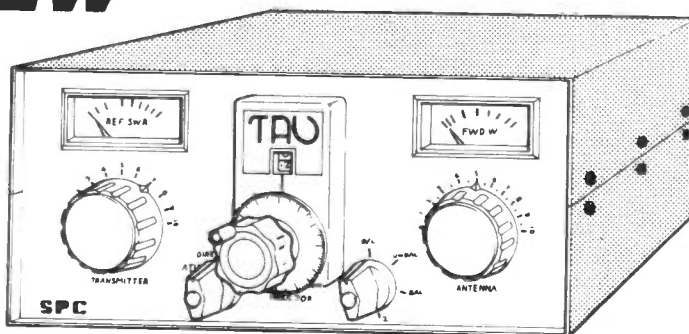
**FULL COVERAGE, TUNES 1.5 CONTINUOUS TO 29.350 Mcs**

### Special Features

- 1 Renowned "SPC" transmatch circuit
- 2 TAU innovative composite design®
- 3 Large spaced Capacitors rated 5kV, tested to 7kV
- 4 Roller Coaster Inductor infinitely variable
- 5 Balun built in, 1Kw, 4 to 1 impedance ratio
- 6 Transmitter switch, thro ATU or direct to antenna
- 7 Five position antenna switch to 5 input/outputs
- 8 Twin Meter automatic readout of SWR & Power
- 9 unsurpassable transmission strength and clarity
- 10 Solid, traditional precision radio engineering
- 11 Heavyweight, long-life construction
- 12 Superb ultra-compact cabinet design with tilt feet
- 13 Superlative finish and looks — compatible with all rigs
- 14 Will tune any Transmitter/Aerial combination to optimum
- 15 Lifetime Investment — will never need replacing

**NEW**

model SPC 3000



cabinet dimensions, wide 313mm, high 147mm, deep 380mm  
unpacked weight 9.7 kilos of solid quality engineering

**£349.95** including UK VAT  
ex works, carriage extra

UNDOUBTEDLY THE FINEST ATU AVAILABLE — NOBODY MATCHES UPTO US! TAU SYSTEMS LTD

## PRODUCT NEWS

### 10MHz OSCILLOSCOPE

The Goodwill GOS 3310 is a low cost single trace 10MHz oscilloscope with features found on more expensive scopes, including internal and external TV line or frame triggering, 5mV/div sensitivity and an internal calibrator.

The basic Y sensitivity is 5mV/div. The signal can be attenuated in decade steps to provide switched ranges from 5V/div down, and an uncalibrated variable control is provided.

The 3% accuracy can be checked with the built in 0.25V 1KHz calibrator, as can the time-base, with sweep speeds from 10mS to 0.1 $\mu$ S/div

switched in decades and extended using a variable control.

In X-Y Mode the X deflection has a fixed sensitivity of 0.1V/div.

The unit is housed in a folded steel case, and the electronics are mounted on a glass fibre printed circuit board.

The price of this oscilloscope is £149.00 + VAT, and it will find many applications in field servicing and education, and especially with the hobby market.

*Estatech Ltd, PO Box 11,  
Bishop's Stortford, Herts  
CM23 2XA Tel (0799) 21489.*



### GUNN DIODE BACK END

muTek limited's new GDIF 107ub back-end processing system makes the completion of a 10GHz WBFM transceiver much easier.

It contains all the necessary audio and IF processing to turn a good quality intruder alarm module (eg Solfan type) into a 10GHz WBFM system – just add an antenna, microphone, loudspeaker and a few controls!

The receiver intermediate frequency is 10.7MHz. With

typical modern Gunn diodes this is sufficiently high so as not to incur sensitivity limitations due to oscillator side-band noise.

A low noise integrated circuit head amplifier (the Plessey SL560) takes the signal from the microwave head mixer diode, and drives a passband-defining ceramic filter.

Following the filter, a multi-function integrated circuit provides limiting, demodulation, muting, drive for signal

level and centre-zero meters, and AFC and dc voltage reference outputs for the Gunn power supply circuitry. An audio power amplifier completes the receive signal path.

The power supply is short-circuit protected and has been designed to allow limited tuning of the Gunn oscillator by supply voltage pushing. Typical oscillators will have a tuning rate of about 10MHz/volt within the range 5-8 volts.

With the imminent amendment to the 10GHz bandplan putting WBFM operation between 10370 and 10400MHz, this is obviously quite adequate without recourse to any mechanical tuning methods.

Voltage tuning allows the provision of frequency modulation and AFC by means of power supply modulation – this is all done by the GDIF 107ub.

The GDIF 107ub contains both an AGC controlled microphone preamplifier and a tone oscillator for initial setting up of contacts.

The GDIF 107ub comes as a ready assembled, aligned and tested printed circuit board with full instructions and helpful hints on how to get the whole system together. It is priced at £49.65 including VAT, plus £1.50 post and packing.

*muTek limited, Bradworthy,  
Holworthy, Devon EX22 7TU  
Tel (040924) 543.*

### TAPE MECHANISM

Condor Electronic Developments Ltd have announced that, following the success of their take-over of production of the widely used

DG4199 key operated top loading tape transport mechanism from Thorn EMI Ferguson, they have now commenced production of the solenoid operated

version.

This has been designed primarily for use with light touch or remote units, ie training equipment, telephone answering machines, cassette recorders.

A cue and review facility is incorporated, and there is also auto-stop sensing for all modes provided by a magnet and acoustically damped reed.

A relay circuit has been developed which enables the current required to hold the solenoids in the required mode to be substantially reduced after the initial thrust.

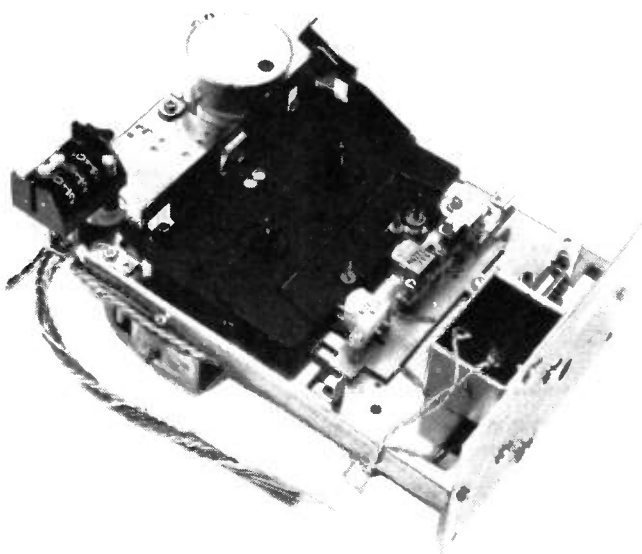
A good back-up service is assured with spares readily available, and enquiries are welcomed for any quantity from one to a thousand.

*Condor Electronic  
Developments Limited,  
Woodman Works, 204  
Durnsford Road, London  
SW19 8DR Tel (01) 947 9511.*

### TATUNG EINSTEIN

This computer, mentioned in last month's Product News, is not available to the general public direct from the manufacturers, whose address we printed.

The carriage-inclusive offer is made by the distributors of the computer, Northern Communications, 299-303 Clarendon Road, Clarendon, Halifax, West Yorkshire HX3 6AW. Tel: (0422) 40792.





## MICRO PROFESSOR

Pelco Electronics has been appointed UK distributor for the Micro Professor.

This complete microprocessor-based learning system provides simple step-by-step instruction to allow the user to become proficient in the use of a single-board microcomputer based on the Z80 chip.

The Micro Professor allows the student to gain hands-in experience of the internal operation of an 8-bit microcomputer. It comes complete with three user manuals, and a student workbook is also available.

The basic MPF-1P Micro Professor includes the Z80 processor with 4K bytes of random access memory and 8K bytes of read only memory. It has its own built-in power supply, a 49-key keyboard and a bright 20-digit alphanumeric display.

The 8K bytes of read only memory house an advanced interactive monitor which responds to a comprehensive set of self-prompting, single-key commands. The monitor incorporates a line assembler which allows the student to key in programs by using mnemonic codes, and a disassembler which lists the Z80 machine code and prints the code in mnemonic form with symbolic labels on the optional 20-character wide printer.

The monitor also includes an interface to the optional Basic and Forth interpreters, which are available on plug-in 8K EPROMs with their own manuals.

Forth is so simple to use for control applications that it can be used successfully by students with very little experience of programming, while Basic is the most widely used language for general computational tasks.



The Micro Professor's Basic interpreter allows it to carry out floating point arithmetic to simplify the solution of many complex

problems.

*Pelco Electronics, Spring Gardens, Romford, Essex RM7 9LP Tel (0708) 61911.*

## DIY GLUE GUN

An electronically controlled glue gun, the GlueFix 2000, utilising a highly versatile adhesive to fix virtually any type of material, is available from Steinel (UK) Ltd.

GlueFix 2000 is a low-cost, thumb-operated glue gun ideally suited to domestic, craft and DIY use. There are numerous applications where a strong, permanent joint is required quickly without having to wait several hours for glue setting.

In addition, the gun can be supplied with a range of different nozzles to control the flow rate of the glue and the width of the glue string.

GlueFix 2000 is comfortable and cool in use and has a built-in work-top stand. Steinel manufactures its own heater and glue control components, ensuring long life and high reliability.

Transparent, all-purpose glue sticks are available in a number of different sized packs, and are suitable for glueing most materials including leather, stone, metals, ceramics, plastics, wood and cardboard.

Setting time is from about 30 seconds, depending on the materials, and the glue is also suitable for use as a sealant around non-pervious mater-

ials such as glass window panes. The melting point of the adhesive is approximately 180°C, so a high degree of permanence is ensured.

*Steinel UK Ltd, 17 Reddicap Trading Estate, Sutton Coldfield, W Midlands Tel (021) 378 2820.*

## NEW BROCHURE

Light-sensor ICs and Hall-effect sensor ICs are the subjects of a new 20-page A4 brochure from Sprague Electric.

The light-sensors described are an ultra-low cost opto-electronic switch, and precision replacements for photocells and phototransistors.

Hall-effect devices detailed cover digital switches and linear-output sensors, and are preceded by a 5-page introduction on the application as well as the origins of these precision magnetic components.

Entitled 'Sensors', the brochure is available free, on application to Sprague Electric.

*Sprague Electric (UK) Limited, Salbrook Road, Salbords, Surrey RH1 5DZ Tel Horley (02934) 5666.*

## OSCILLOSCOPES LEAFLET

New from Gould Design & Test Systems is an 8-page full colour leaflet on the 4030 and 4035 20MHz dual-trace digital storage oscilloscopes.

Fully illustrated, the leaflet provides a comprehensive guide to both instruments.

Also included is a section

on applications as well as a detailed technical specification and a list of optional accessories.

The leaflet is available free of charge on application.

*Gould Design & Test Systems Division, Roebuck Road, Hainault, Ilford, Essex.*

## SEALED FLATPACK RELAY

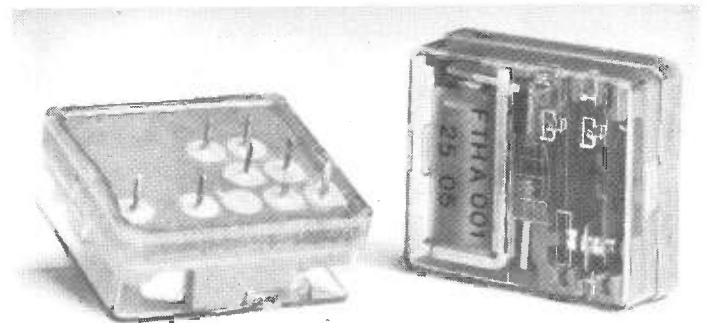
A sealed version has been added to the range of Feme FTA flatpack relays available from Quiller Components Ltd.

The new relay, type FTH, is completely sealed with inert gas and has been designed to allow for minimum possible spacing between printed circuit boards. It features a single-pole C/O contact capable of switching 10A at 240Vac.

Contact material is silver cadmium oxide; maximum switching power with a resistive load is 2200VA.

Sealed FTA flatpack relays offer 4KV-8mm insulation as standard, and are ideally suited for flow soldering and immersion washing applications.

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



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LM317T Plastic TO220 variable	£1.00
LM317 Metal	£2.20
7012 Metal 12v 1A	£1.00
L036 T03 Metal 12 L037 15v	ea 50p
7805/12/15/24 plastic	50p
7905/12/15/24 plastic	50p
CA3085 T099 Variable regulator	£1.00
LM723 14 dil	50p

## EPROMS/MEMORIES

27128-300nS	£18.00
2764 INTEL/FUJITSU 300ns £6.50 250nS	£7.00
2716 EX EQUIPMENT £2	10/£17.00
2732A-3 NEW £3.50 EX EQPT	£2.50
2102 500ns AMD 80p	10/£6.00
2114 EX EQPT 80p 4116 EX EQPT	60p
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2N3055 Ex eqpt tested	4/£1.00
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R22 1R0 3R0 6R8 56R 62R 100R 220R 270R 390R 680R	
1K 1K8 10K	

W24/ sim 12 watt 4 OF ONE VALUE for	£1.00
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270R 400R 620R 820R 1K	
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2N5777	50p 100/£26.00
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# NEWS DESK

## Robotics Workshop

Robotics Workshop is to open at 121 Ifield Road, London, SW10 as a showroom for the many emerging small robots which, of course, are primarily used in education and training. There will also be other robotic devices and some components. The hope is that it will become a meeting place for those interested generally in robotics.

The Workshop is sponsored and funded by The Entryphone Company Ltd, and their managing director, Gordon Ashbee, will be taking a very keen interest. He is especially looking for all those designers of robots and other devices that they are developing, be it in their factory, garage, or kitchen! Do ring him on 01-373 8571, or go along and take a look.

## LADOR

As a follow-up to RJ Redding's Modems article in last month's *Radio & Electronics World*, the ideas below should prove stimulating to anyone who found his proposals for local data transmission of interest.

To encourage participation, particularly in the writing of suitable programs and the development of simpler hardware, the following outline of the intentions of a group in the Thames Valley is made available and comments are invited.

This note outlines the intentions and projection for trials of a local data service for experimental use on amateur frequencies.

### 1. Object

Local Area Data on Radio (LADOR for short) is a radio operated service for receiving local news by simple apparatus, either at home or in a motor vehicle with only limited or no interaction. It appears to differ very considerably from normal data transmission of the 'one-to-one' type - where security and accuracy are vital. A practical demonstration on amateur frequencies could lead to an application for Band I or III frequencies for a

social and/or commercial system.

We need to evolve and prove an operating system, and a main purpose of this note is to get the necessary software explored and produced.

### 2. Basic Philosophy

For an 'open' system of freely available information or data of interest only to certain users, passwords and access or security arrangements can be avoided. Reception into a memory for subsequent perusal or printing offline avoids format problems, and allows high speed operation, eg 1200 baud, which in turn means that repeated transmission can confirm accuracy without the need for two-way communication. The concept of LADOR should exploit these and avoid ties with any computer language.

The transmission would be from and to callsigns plus an unknown audience including 'mobiles' in an area, eg 10 mile radius. We should refrain from the term 'broadcast' because it poses legal and licence questions, but if it can be shown to work by amateurs, it could extend to local broadcasting stations, etc, and claim the status of a service.

Practical success and experience could justify the allocation of frequencies vacated by TV in Bands I and III, and this should be a prime aim of the exercise.

### 3. Procedure

It is suggested that LADOR be transmitted as a series of blocks, eg 256 characters complete with a checksum. The first will be the title and index and therefore have a lot of blank space, and the last one may not be full but would end with the sender's callsign.

Receiving software could then use the checksum and note which blocks are correct. Two full transmissions could be standard procedure and a purpose of the software would be to assemble from the two transmissions the best copy for perusal, and to list the blocks which are

incorrect.

Back-transmission if available, or a telephone, could be used for queries or responses to the contents if essential. An identification system for the blocks, as used on tapes and floppies, would be advantageous for queries and cross referencing.

### 4. Hardware

Initially the system would use 300 and 1200 baud modems and a computer with serial interface, but it is worth noting that there is considerable scope for novel items of hardware, eg a unit to take the audio signal and put it into the memory of the machine in a simple manner, particularly for the individual who only wants to receive and has a word processor in his display unit.

Similarly reception of data requires little more than a direct conversion chip and a crystal for receiver tuning.

## US Navy buys British

The United States Navy has placed a contract with Marconi Communication Systems Ltd of Chelmsford, UK, valued in excess of US \$1 million to upgrade and add receiving facilities to the containerised ship communication system that the company supplied to the US Navy 18 months ago.

This containerised system has been used for trials both ashore and afloat as part of the US Navy High Frequency Radio programme. The success of these trials was instrumental in Marconi receiving a recent contract for ICS 3 communications equipment, now designated AN/URC-109, for the new US Navy LHD-1 amphibious assault ship.

The new facilities provided by this latest contract will allow further more advanced trials to take place, with the containerised equipment operating as a reference system.

## Mobile data system

Plessey Controls have announced an order for an innovative system to significantly improve communica-

tions associated with the running of the Control Terminal at Port Rashid, Dubai.

The system is based upon mobile data terminals which are to be installed in straddle carriers, and which communicate with the central operations computer directly by sending and receiving data over the port's radio system.

Previously, all container movements on and off ships, in and out of the storage park, and in and out of the dock gates were recorded by means of the driver calling details of box numbers and locations over a voice radio transceiver, or by paper exchanges.

Increased container throughput has put pressure on the latter methods, and Plessey Controls were able to offer a flexible and competitive solution to make the control of vehicles and computer record updating virtually instantaneous.

The compact mobile terminals are capable of sending and receiving routine coded messages, formatted text messages and even graphic maps and diagrams.

Message transactions take less than one second, and sophisticated error correction techniques ensure that information is received first time, every time, without the mistakes that always arise in voice and written messages.

This is of vital importance to efficient container yard operations, where the experience of mislaying boxes can be expensive and embarrassing.

The system in Dubai will be enhanced further by the use of compatible hand-portable data terminals working on the radio system, with increased computer access facilities to permit operational troubleshooting by senior personnel.

Successful mobile data systems are already in service in North America, Hong Kong, Sweden and the United Kingdom, with further applications due to go into service shortly in Belgium and Australia.

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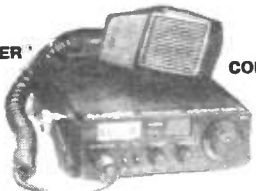
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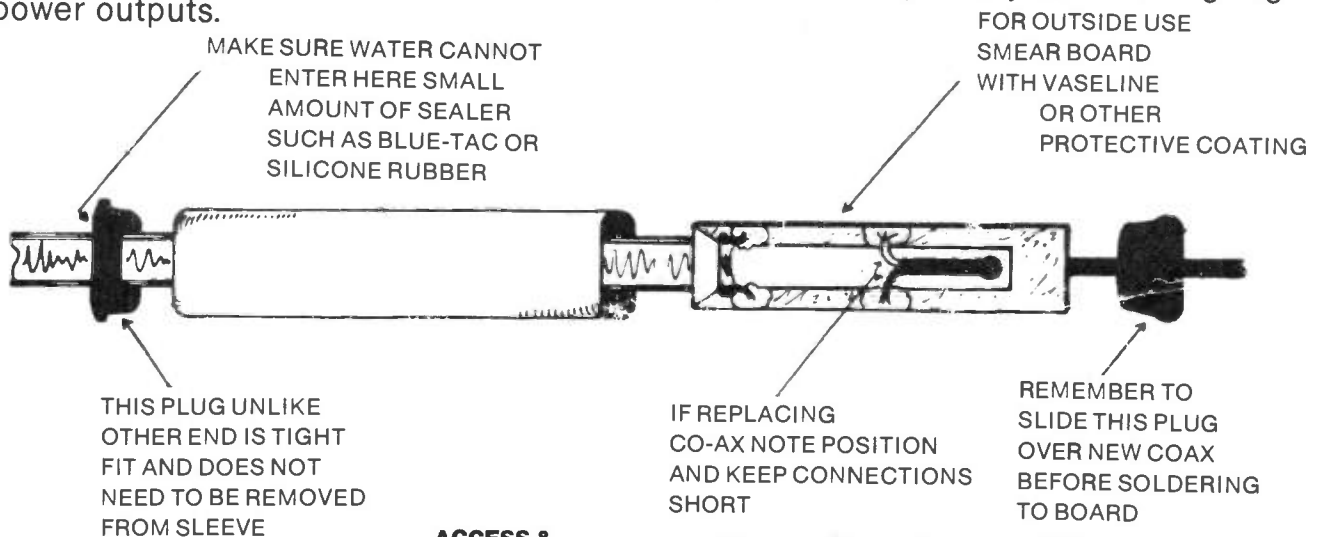


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**Please note:** Coax plugs and connections account for many faults in antenna installation, it is therefore advisable to use a V.S.W.R. bridge when connecting a new antenna for the first time. The travelling Jim is primarily intended for portable low power use, where damage to the rig is unlikely. However, it is important to remember that objects in close proximity to a radiating element can cause an increase in V.S.W.R. This and or other influences can be harmful to equipment especially when using higher power outputs.



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# MOBILE RADIO

## ON THE MOVE!

Nigel Cawthorne G3TXF details the changes that will result from the coming TV band closures

**V**HF and UHF in the UK will never be the same again! Changes in the use of frequencies that are taking place in 1984 will make this year a significant one in the history of the UK's radio frequency spectrum.

A full 60MHz of bandwidth at around 900MHz has been designated for the new cellular radio mobile service. Lower down the spectrum, the closure of the Band I and III TV transmitters in the UK will liberate about 70MHz of spectrum to civil users. Much of this too, will go to the mobile service. Professional mobile radio operators and users in the UK have never had it so good!

The closing of the Band I transmitters will also, hopefully, bring some benefits for amateurs too, by way of a full and permanent allocation at around 50MHz.

### Cellular radio

'Cellular radio' is not the name of a new local radio station serving the area around Wormwood Scrubs, but is a technique for solving the problems of frequency congestion for public mobile telephone service users.

Traditional mobile radio telephone services use a central transmitter which covers a large area. One transmitter might cover a whole town. The numbers of frequencies available are limited and, in practice, the demand for the service has exceeded the availability of working channels.

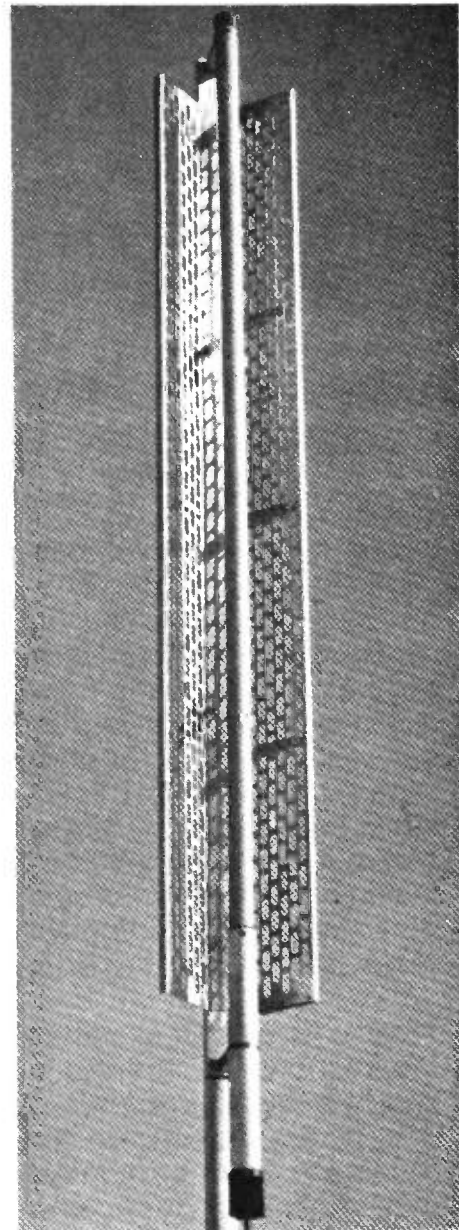
A mobile subscriber wanting to make a call has had to wait for what might seem to him a long time before getting the

dialling tone. Once a frequency or pair of frequencies are occupied by the mobile and fixed station, the same frequencies cannot be re-used in the same area until the conversation is finished and the mobile subscriber 'hangs up'.

Cellular radio will go some way to solving this problem by using a large number of small transmitters. Each transmitter will cover one 'cell'. The transmitters will be interconnected and controlled by computer so that a mobile station travelling from one cell to another will be automatically connected to the transmitter in the next cell.

To create a mobile telephone system in which the user (the person making the telephone call from his car) can hold a normal telephone conversation while transmitters and receivers are changing frequencies, requires a complex computer controlled operating system. The Mobile Telephone Switch Office (MTSO) will house the controlling computer for a number of cell sites.

The great advantage to be gained from the cellular technique is that because the cell sizes are small (typically a few km across in a town area) the same frequency can be re-used by different cells that are sufficiently far apart so as not to cause any interference to each other. This in turn means that more users can be making telephone calls from their cars without suffering the problem of frequency congestion, which for the user means having to wait for a line. Cellular radio leads to a more efficient use of the radio spectrum.



### Cellular frequencies and antennae

The frequency bands allocated to cellular radio are just beyond the high end of the UK's UHF TV service (Figure 1). Mobiles will be transmitting in the band 890-915MHz and base stations will be transmitting 45MHz away, in the band 935-960MHz.

Mobile antennae for these frequencies will be very compact. For 925MHz, the corresponding wavelength is about 32cm, which means that a  $\lambda/4$  whip will be a mere 5in high! A 900MHz cellular radio

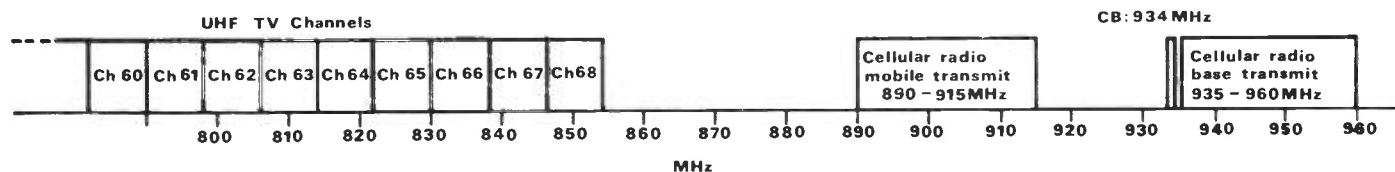


Fig 1 Showing the new cellular radio bands in relation to the high end of the UHF Band V TV channels

$\frac{5}{8}\lambda$  whip is only about a foot high.

Cell transmitter stations will be using directional arrays made from high-gain collinears. A typical cellular radio base station antenna is about 3 metres in height and has about 17dB gain over a dipole, with a beamwidth of 60 degrees (see photo).

Each cell station has to be individually designed and engineered to give the correct coverage; this requires detailed computer radio path predictions and study work to get the correct antenna configuration. At these higher frequencies propagation is more restricted to pure line-of-sight than that at the lower VHF frequencies. Highly directional antennae of reasonably compact size become practical.

The UHF CB channels at 934MHz are situated within the 20MHz space between the two cellular radio bands and will experience very similar propagation conditions. The cellular radio frequencies lie midway between the 435MHz (70cm) and the 1300MHz (23cm) amateur bands.

### Cellular operators

Two groups of companies are competing to install the first working cellular radio system in the UK. They are Cellnet, which is a consortium of British Telecomm and Securicor, and Racal's special cellular radio company called Racal-Vodac. The Government has granted each operator a licence which stipulates that they must be on the air by March 1985, and that they must provide a service coverage for 90% of the population by 1990.

The Government has deliberately licensed two cellular radio operating groups in order to generate competition. Each group, although working to a common specification, is finding different technical solutions. Cell sizes and cell antenna configurations are important to the design of the system. Cellnet

and Racal are each adopting slightly different techniques both as to the sizes of their cells as well as to the antenna configurations used.

### System compatibility

The two operating companies will have compatible systems, but their cell stations will be separate. Both groups are installing their first cell stations in and around the London area, as well as along the major motorways in southern England and Wales.

The installation programme will continue for several years, as each group increases its coverage area, but the initial rush is to get on the air with a working system as quickly as possible. The propaganda 'coup' of being the first operating group to have a true cellular radio system working will be considerable, even though the second team won't be far behind!

Cell size and the location of the cell stations are important to the design of the system.

A good deal of secrecy surrounds the exact location of cell stations, because each operating group has not only to find its own sites, negotiate access, and plan the antennae installations, but also get planning permission.

In London there will eventually be a large number of cell sites. Cell 'splitting' will be a technique used. An original cell of say 5km across may be divided into 6 further cells of about 1km each. This splitting technique will be used as the amount of traffic on the system increases. Each of the smaller cells will be using lower powered transmitters than the original cell. Expansion of the network will include adding new stations where none previously existed, as well as splitting existing cells down into smaller cells.

The commands from the cell site and the requests from the mobile station will be transmitted as data over the radio link.

This will not be audible to the user. As well as establishing working frequencies, mobile identification sequences and exchanging number information, the data transmitted to the mobile will include a command that sets the power level of the mobile according to the signal strength being received at the cell site.

Keeping the power radiated to the minimum necessary for satisfactory communication is also an important factor in being able to re-use frequencies in other cell areas. The power output of the mobile station is remotely adjusted by the base station in 8 steps of 4dB. The radiated power of a 10dBW mobile can be reduced by 32dB down to -22dBW or about 50 milliwatts when operating very close to the cell site.

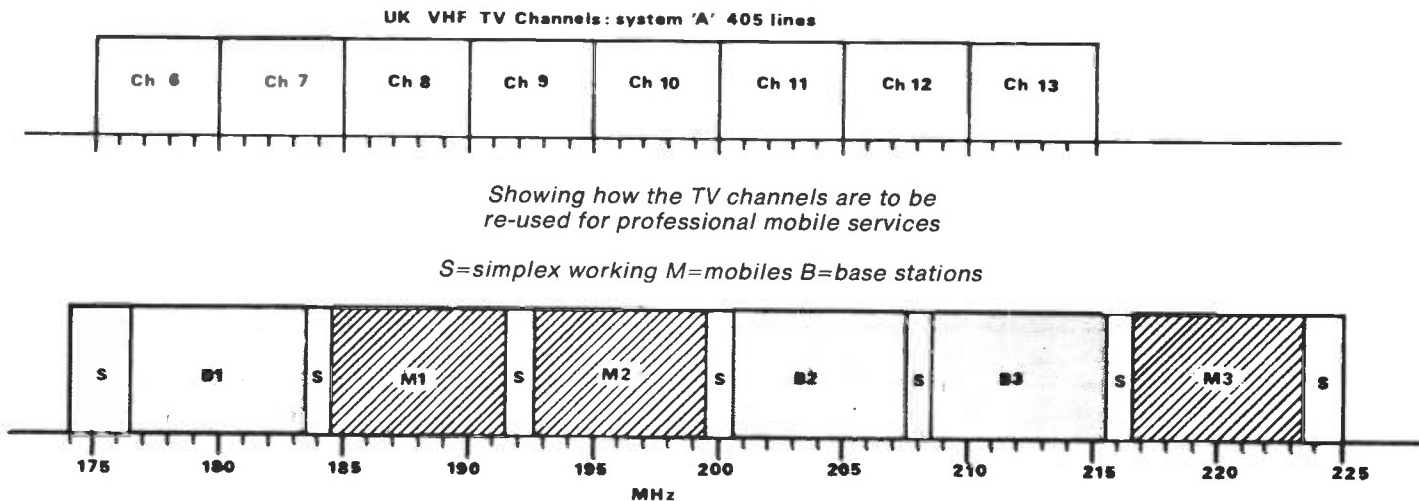
### Cellular growth

Predictions (or are they just optimistic sales projections?) indicate that there could be up to 500,000 cellular radio users by the end of the decade. Whatever the number of end-users of cellular radio networks, the frequencies between 890 and 960MHz will be subject to a level of professional mobile radio activity never seen before!

While some mobile radio manufacturers are getting ready for the 900MHz cellular expansion, others are looking at the equally significant changes that are about to take place at the lower end of the spectrum. At the end of 1984, Band I and III TV transmitters will close down in the UK, leaving two large pieces of spectrum (41-68MHz and 174-225MHz) without any UK TV signals after nearly three decades of continuous transmission in these bands.

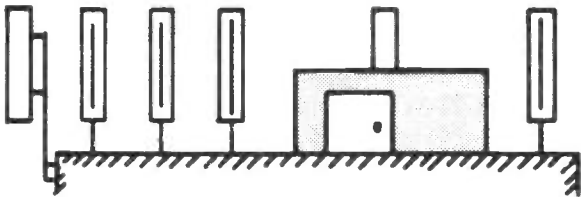
New mobile services will take up most of the liberated Band III TV frequencies (Figure 2). Special precautions will be necessary on these ex-TV frequencies because many of the UK's neighbours will still be transmitting TV signals in

Fig 2





# MOBILE RADIO



Elevation showing how some of the nine cellular radio stations might be placed on the roof of a building. The transmitter and receiving equipments are housed in a small roof mounted cabin.

these bands for years to come. Problems of possible mutual interference between mobile users in the UK on these frequencies and the television broadcast services in other countries are being carefully studied by the DTI and overseas broadcasters.

### Transmitter turn-off

The BBC and IBA will be turning off their transmitters on these frequencies for the last time around the end of 1984. These new frequencies are eagerly sought by mobile radio interests in order to relieve some of the congestion suffered by private and utility mobile radio systems at present using VHF.

The release of Band III for the mobile radio service will allow the FM broadcast Band II to be cleared of mobile radio services operated by the Home Office and the utilities (eg Gas and Electricity Boards, the AA etc) that are currently using part of what is otherwise a broadcast band. By 1995, the whole of Band II 87.5-108MHz will be an exclusive broadcast band in the UK.

The Government published several proposals for re-use of the Band I and III frequencies in a green paper in May 1984. The DTI has received an enormous number of replies and submissions as a result of this consultative document, which are now being studied by the Radio Regulatory Department.

Fingers are being kept crossed that a full and permanent six metre band will eventually be allocated to UK amateurs

Plan showing approximate antennae layout. At this cell site nine high co-linear antennae are used. Reception is using space diversity.

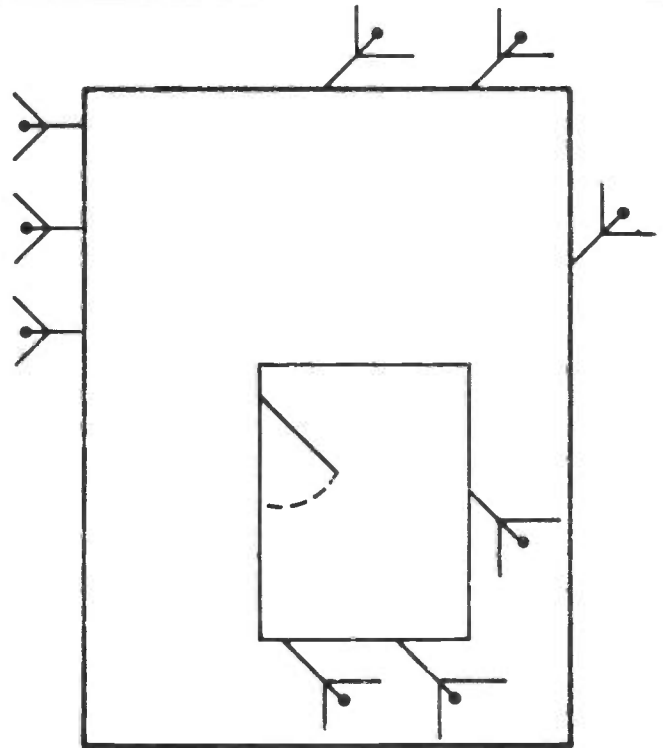


Fig 3 Layout for a cell site station. The exact layout and antenna configuration will vary with each cell site

in the range 50-54MHz. The RSGB will have submitted a major document to the DTI in response to the Green Paper, and it can only be hoped the UK amateurs will soon be able to join the many other amateurs worldwide that are privileged to have a six metre band.

With so much activity on other frequency ranges, the professional mobile radio users are not showing so much interest in the Band I frequencies as in Band III. Propagation at these frequencies is more subject to long distance effects than in the higher bands. Sporadic-E, or F2 conditions, which to the professional mobile radio user are nothing but a nuisance, mean 'DX openings' for the amateur!

Frequency is very much like time.

Nature provides everyone with the same amount of it but countries make different uses of their frequency spectrum, in the same way that people make different use of the 24 hours of the day. The amount available is the same for everyone, only the uses to which they are put differ!

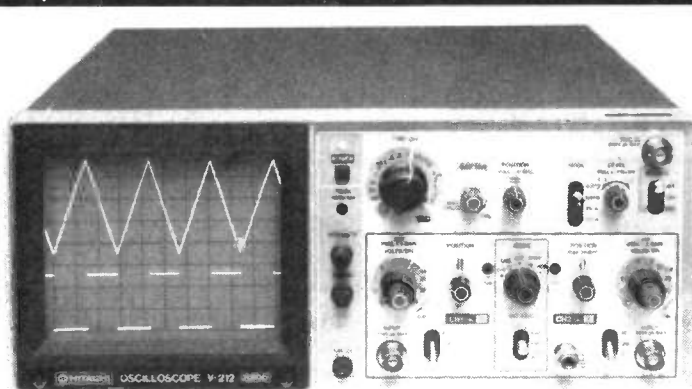
The uses of major parts of the UK's VHF and UHF spectrum are about to be changed, changes that are brought about by the closure of TV transmitters and the ensuing re-allocation of frequencies as well as the introduction of a national cellular radio network. Although these two events are spaced at over 600MHz apart, they are both very important and significant events for professional mobile radio and all other VHF/UHF users in the UK!

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# COMPUTING

# ATTENUATORS

By Jeff Howell G4BXZ and Brian Kendal G3GDU

One of the simplest circuits regularly used in electronics is the resistive attenuator. In its simplest form this only uses three, four or five resistors, yet it may be used either to reduce a signal level or to match two circuits of unequal impedance.

There are two common types of attenuator: the 'T' and the 'PI', each of which may be constructed in unbalanced or balanced configuration.

In low power circuits there is little to choose between the alternative forms of attenuator, but at higher power levels the dissipation of the resistors must be considered.

In such circumstances the T would be the preferred configuration, since in the PI the majority of the input power would be absorbed by the single input resistor, whilst in the T circuit this will be shared by the input resistor(s) and the centre

parallel resistor.

Resistive attenuator circuits are not frequency conscious, but two factors should nevertheless be considered.

Firstly, wire wound resistors possess inductance and should therefore be avoided whenever possible; certainly in RF attenuators.

Secondly, at high frequencies the intercomponent capacity will cease to be negligible and, unless careful layout and screening is employed, the signal may partially bypass the attenuator.

### Impedance matching

By choice of suitable resistor values, a PI or T network may also be used to match two circuits.

As may be expected this is a very lossy method of matching, but in many circumstances this may not be important. The higher the impedance ratio required, the greater will be the loss.

If, however, the impedance ratio is low, say 75 to 50ohms in an RF circuit, the losses may be sufficiently low to be compensated by the preceding or following stages.

Either PI or T networks may be used in series. This is particularly useful where a high attenuation or wide ratio matching is required, for it is then preferable to achieve the desired result in two or more stages.

### Single resistor

In such cases it is common practice to use a single resistor to act as both output resistor in one circuit and input resistor to the next. This must obviously be of a

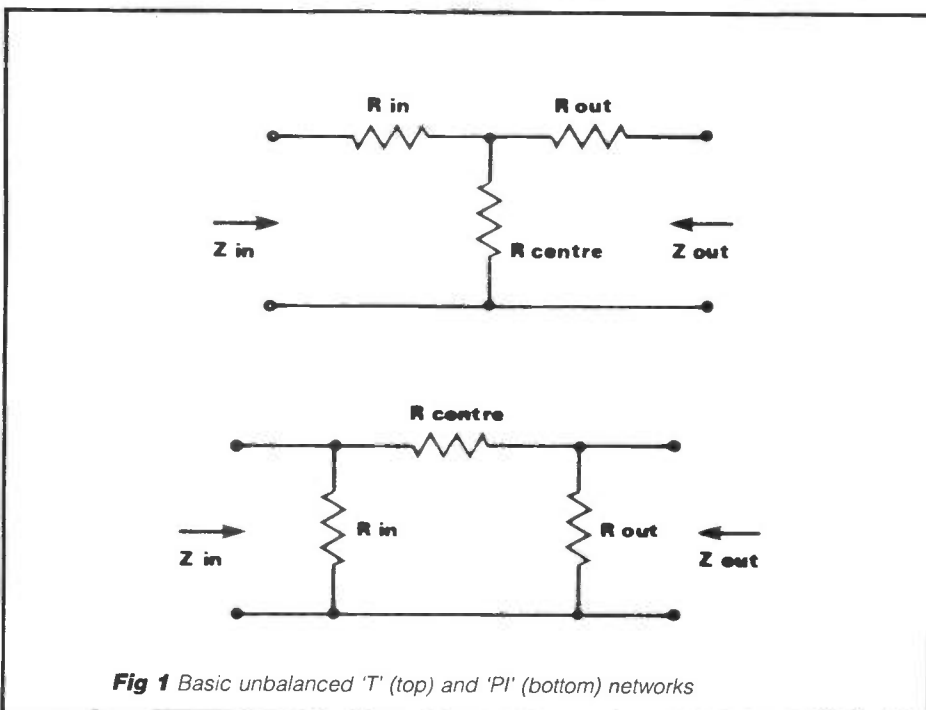


Fig 1 Basic unbalanced 'T' (top) and 'PI' (bottom) networks

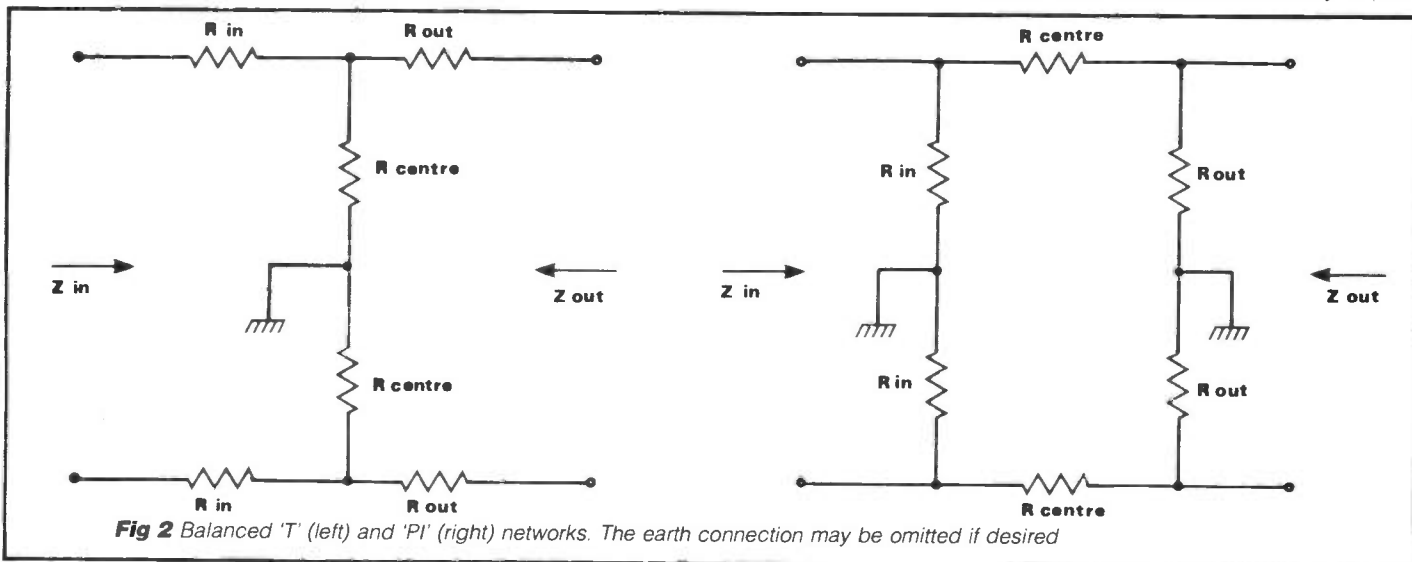


Fig 2 Balanced 'T' (left) and 'PI' (right) networks. The earth connection may be omitted if desired

# COMPUTING ATTENUATORS

value corresponding to the combination of the resistors which it replaces.

## Using the program

This program calculates the necessary resistor values to construct impedance matching T or PI networks of various predetermined attenuation values, and prints the results in tabular form.

The first action of the program after entering RUN is to cause a menu to appear on the screen. This invites the user to select the desired network from:

- 1 Unbalanced T
- 2 Unbalanced PI
- 3 Balanced T
- 4 Balanced PI

This complete, the user is then required to enter the input and output impedances of the required network, this being followed by:

ENTER DB RANGE LOW, STEP, HIGH, which defines the lowest required attenuation, the steps in the table and the highest required attenuation.

For example: if the table is required to give resistor values for 6,9,12,15, 18 and 21dB, this would be entered as: 6,3,21.

The screen then clears and the table is printed, the heading of which reminds the user of the values of input and output impedances for which the resistor values given are valid.

Should it not be possible to provide the impedance match defined with the attenuation requested, the legend 'CONFIGURATION NOT POSSIBLE' will appear in the table.

Below the table will appear the invitation to re-run the program which, if accepted, will return the program to the beginning.

## The program

The first unusual feature of this program are the lines 30, 40 and 50. There is no deep meaning in these—their task is merely to save typing later in the program. An excellent example of this is line 560:

```
PRINT '1.UN'; B$; '-T'; N$
```

which will appear on the screen as:

```
1 UNBALANCED-T NETWORK
```

These are followed by line 60, whose purpose is to limit the resistor values given in the tables to one place of decimals.

Line 90 sets up the heading of the menu, while lines 110-130 cause the remainder of the menu to be printed by use of subroutines at 560, 580, 600 and 630. The appropriate selection is requested at line 140 and entered at line 150, and line 160 checks that a valid selection has been made. If the choice is outside the limits of 1 to 4, the program returns to 70 and restarts.

If a valid selection has been made, the screen is cleared at line 170 and the input and output impedances of the required network are requested at line 190 and entered at line 200.

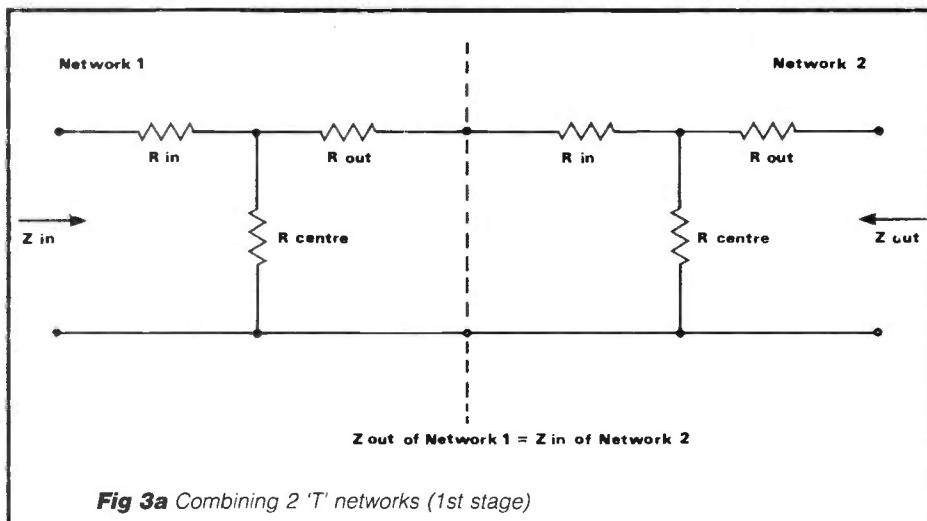


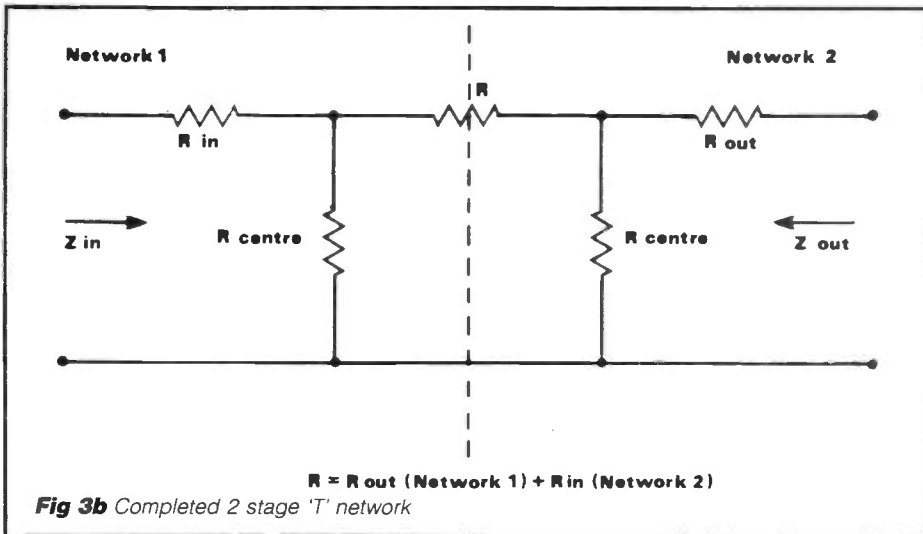
Fig 3a Combining 2 'T' networks (1st stage)

```

10 REM ATTENUATOR PROGRAM
20 REM J.M.HOWELL JULY 1984
30 B$="BALANCED"
40 N$="NETWORK"
50 O$=" OHMS "
60 DEF FNA(R)=INT(10*R+.5)/10
70 CLS
80 PRINT
90 PRINT TAB(3); "ATTENUATOR NETWORK DESIGN PROGRAM"
100 PRINT
110 FOR I=1 TO 4
120 ON I GOSUB 560,580,600,630
130 NEXT I
140 PRINT TAB(3); "SELECT NETWORK 1-4"
150 INPUT D
160 IF INT(D)<>D OR D<1 OR D>4 GOTO 70
170 CLS
180 PRINT
190 PRINT "ENTER INPUT AND OUTPUT IMPEDANCES-"; O$
200 INPUT ZI,ZO
210 IF ZI>0 AND ZO>0 THEN 240
220 PRINT "IMPEDANCE MUST BE POSITIVE"
230 GOTO 180
240 PRINT
250 PRINT "ENTER DB RANGE LOW,STEP AND HIGH"
260 INPUT A1,A2,A3
270 CLS
280 PRINT
290 ON D GOSUB 560,580,600,630
300 PRINT
310 PRINT "ZIN= "; ZI; O$; "ZOUT= "; ZO; O$
320 PRINT
330 PRINT "ATTN"; TAB(6); "INPUT R"; TAB(14); "OUTPUT R"; TAB(24); "CENTRE R"
340 PRINT " DB"; TAB(7); O$; TAB(15); O$; TAB(25); O$
350 PRINT "-----"
360 LET R=ZI/ZO
370 IF D<3 THEN 400
380 ZI=ZI/2
390 ZO=ZO/2
400 FOR A=A1 TO A3 STEP A2
410 IF A=0 THEN 490
420 N=SQR(10^(A/10)*R)
430 H=N^2+R
440 I=N^2-R
450 ON D GOSUB 660,700,660,700
460 IF R1<0 OR R2<0 OR R3<0 THEN 490
470 PRINT ; A; TAB(8); FNA(R1); TAB(16); FNA(R2); TAB(25); FNA(R3)
480 GOTO 500
490 PRINT ; A; TAB(6); "CONFIGURATION NOT POSSIBLE"
500 NEXT A
510 PRINT
520 PRINT "RUN AGAIN? (Y/N)"
530 INPUT A$
540 IF A$="Y" THEN 70
550 STOP
560 PRINT "1. UN"; B$; "-T"; N$
570 GOTO 640
580 PRINT "2. UN"; B$; "-PI"; N$
590 GOTO 640
600 PRINT "3. "; B$; "-T"; N$
610 GOTO 640
620 RETURN
630 PRINT "4. "; B$; "-PI"; N$
640 PRINT
650 RETURN
660 R3=ZI*N^2/I
670 R2=ZO*H/I-R3
680 R1=ZI*H/I-R3
690 RETURN
700 R3=ZO*I/2/N
710 R2=1/(H/I/ZO-1/R3)
720 R1=1/(H/I/ZI-1/R3)
730 RETURN

```





Line 210 checks that the impedances selected are both positive; if not the request is repeated with the warning 'IMPEDANCES MUST BE POSITIVE'.

A valid impedance selection permits the program to progress to line 250, where the limits and step of the attenuation table are entered as described earlier.

The screen is then cleared and lines

280 - 350 cause the printing of the heading to the table.

At line 370, the program looks at the original menu selection to determine whether a balanced or an unbalanced network has been chosen. In a balanced network, certain impedances are half those of an equivalent unbalanced network, this being taken account of at lines 380 and 390.

Between lines 400 and 500, the required resistor values for the table are calculated within a 'FOR - NEXT' loop, the calculation being repeated until all the requested values have been calculated.

The formula used in this calculation will cope with any input/output impedance ratio. However, in certain circumstances this could lead to answers including negative or infinite resistance values.

Lines 410 and 460 are therefore included to eliminate such impracticalities, and indicate this by printing 'CONFIGURATION NOT POSSIBLE'.

When the table has been printed, the choice of a further calculation is offered at 520.

The remainder of the program comprises subroutines which have been mentioned previously.

### Postscript

This is the third of our 'engineering' programs. By using this, you will never again have to delve through the textbooks to find component values for a resistive attenuator or matching network, for the accuracy of the circuits constructed will be limited only by that of the resistors used.

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# SMALL AERIALS

By Allan Grice G4PJK

It is a fortunate radio amateur indeed who can erect his antenna(e), without having to be concerned overmuch with planning consent and the feelings of his neighbours. The vast majority of us have to face and try to overcome various problems when dealing with what is probably the single most important area of the amateur station.

Many of us are severely hampered regarding type and choice of antenna because of the kind of accommodation we occupy. The amateur who lives in a ground floor block of flats with no garden or roof access is probably the worst off, while at the other extreme there are a few lucky individuals with acres of land at their disposal to play around with.

Somewhere in between these is 'Mr Average' with either a house or flat with some access to a garden/patio space.

I was stirred to put pen to paper and write this because of the restrictions abounding at my own location which have caused me to spend many hours, albeit pleasant ones, at the drawing board attempting to devise the ideal antenna for my situation; a situation which is, no doubt, similar to that experienced by many others.

## Ample

I occupy the whole ground floor or a large Edwardian house, which with the first floor comprises a building converted into two flats. My shack is in the cellar and the overall garden size is about 11 x 6 metres, with some additional 6 metres of narrow earth strip adjoining the path. I therefore have a continuous run of about 17 metres: quite narrow, but ample space, as will be described, to enable the erection of a wire aerial provided end supports can be found – but more on that later.

The area in which I live has many properties with leases and deeds which prohibit even the erection of external TV antennas, and my lease is no exception! In addition, the general layout of houses and gardens makes concealing aerials virtually impossible.

When faced with such handicaps, and being conscious of the need to cultivate and maintain good relations, amateur radio-wise, with neighbours, it is easy to become despondent and turn one's thoughts to hobbies which can be pursued without the neighbours knowing!

At this point it is as well to take heart from the thousands of other amateurs who have managed to overcome location problems and often work exotic DX at all hours, unknown to the outside world.

You have got to realise at the outset that you cannot have everything. Try to

settle for those areas of interest which most interest you or which can be combined in some way. Three or four antennae in close proximity to neighbours' houses, especially in a small garden, is courting disaster in the form of receiving blame for any interference going, and in finding the planning officer at your door. Remember that while verticals, dipoles, masts and towers may conjure up in your mind visions of choice morsels of juicy DX, to your non-enthusiastic neighbour they will only be an eyesore, probably reminding him of Daventry Radio Station or suchlike.

My main interests lay with 80/20 metres, with a mixture thus of inter-G and the working of more exotic stations.

My requirement was for an antenna which would enable me to work on these bands and yet be generally low in visual impact.

A conventional 80 metre dipole would hardly fit in the space available even if greatly bent.

A trapped version for 80/20 would not fare much better, and in any case the resulting feeder would have been hanging directly outside a neighbour's bedroom window! In addition I would have needed two permanent supports.

## Satisfaction

A trapped vertical would present no major problems, but I didn't relish laying out the sort of money on one of sufficient size and efficiency to reduce the obvious bandwidth problems when on 80 metres. In any case I wanted the 'real amateur's' satisfaction of building my own aerial.

So, after consulting many references, I came to the conclusion that an 80 metre quarter wave in an inverted 'L' configuration would best suit my needs. By means of an ATU I would also be able to get some results on 20m.

Because of the overriding requirement

to lessen the aerial's visual impact, I reasoned that if the vertical portion could be made capable of tilting over then the whole setup could be lowered when not in use.

## Kind neighbour

It is worth mentioning here that my upstairs neighbour had kindly agreed to my scaling a ladder (his!) to allow me to hammer a masonry nail into his wall just below the guttering. This allowed me to connect a length of fine nylon cord which supports the horizontal top wire of the inverted 'L'.

Those with less luck would have to consider lashing some bamboo canes or similar unobtrusive rods together to support this part.

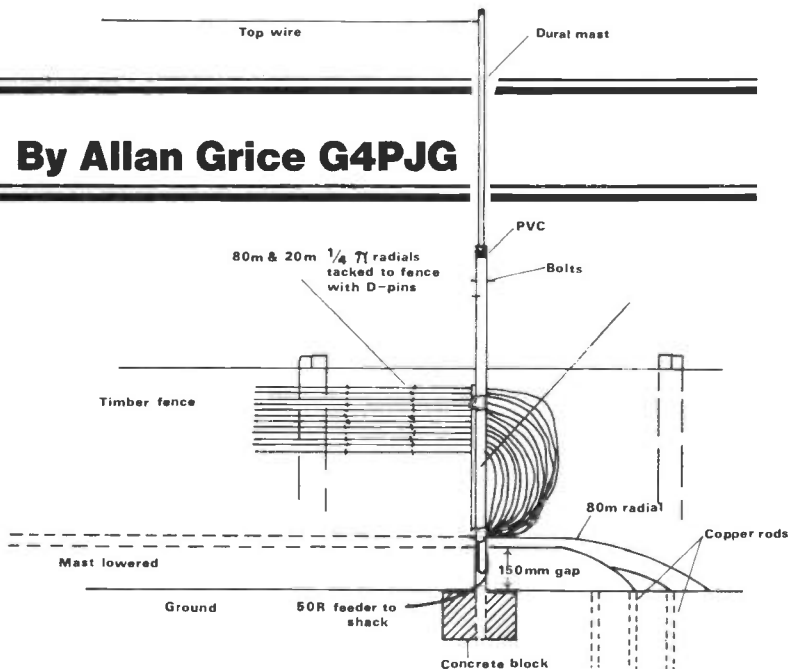
For the vertical section of the antenna, which should be as tall as possible for best DX results, I purchased two 4 metre sections of 10 gauge (.125in) dural tube measuring approximately 35mm and 37mm respectively.

These tubes were drilled (use an electric drill as hand drilling 10 gauge dural seems to take all day), to allow for a .60 metre overlap, and the overlapping sections were polished with a round file and wire brush to ensure good electrical contact.

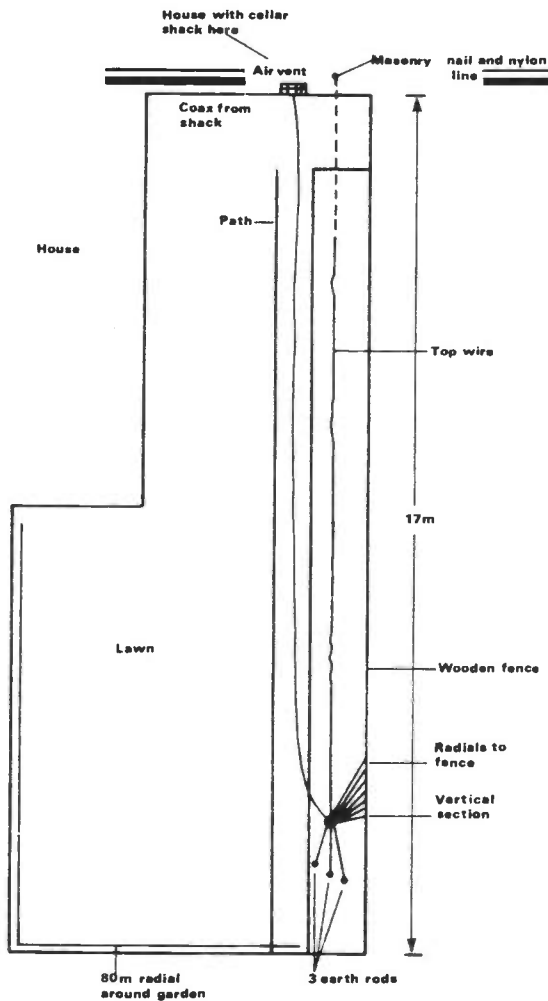
To further ensure a snug fit, shims cut from old and lightweight alloy tubing were hammered into the overlaps, which had previously been bolted together with coach bolts.

The alloy shims were cut long enough to allow 50mm or so to protrude over the tubing below. This protrusion of shim was then 'trapped' under a suitable jubilee clip, and this ensures further RF current continuity along the vertical section. All joints, bolts and overlaps were then liberally bound with plastic electrical insulating tape.

In order to support the mast safely,







Aerial Plan

considering it would be unguied, it was decided to use a separate 3 metre piece of galvanized scaffold pole concreted into the ground.

A hole of about .75 x .75 metres and .60 metre deep was dug into the far end of the earth strip. The scaffold pole was then driven into the base of the hole to about .30 metre depth, using a 6 kilo sledgehammer whilst standing on top of a step ladder (take care here and get someone to foot the ladder).

I used a spirit level here to ensure this pole was vertical.

### Concrete base

Then I mixed up three bags of pre-mix concrete and poured this into the hole around the scaffold pole. The top of this pole was then plugged to keep out the weather and the hole covered with PVC sheeting and allowed to set for a couple of days.

The total weight of the concrete mixture is about 70-80 kilos and so provides ample support for a 7.5 metre (23/24ft) vertical mast of the gauge used.

Once the concrete had set, two swivel scaffold clamps were attached to the scaffold pole as shown. At appropriate points on the base tube of the mast I applied thick insulation to insulate the

dural radiator from the metal clamps. For this, condemned PVC garden hose was cut into long strips and wrapped spiral fashion around the tube, then secured with PVC tape. This should be done to at least 9mm thickness.

The bottom insulated part of the mast was next placed in the lowest clamp and tightly fastened.

Eight quarter-wave radials for 80m and two for 20m had been previously measured and cut from 18 swg copper wire. These were soldered to the outer braid of a 50ohm coaxial cable (running from the cellar shack via an air grille and then along the earth strip). They were tacked to the adjacent wooden fence with plastic headed drawing pins and were bent to fit the space. Each radial was spaced on the fence vertically about 25mm apart.

### Conductor

The previously bared centre conductor of the coax was then secured via the underside of a jubilee clip. The dural tube is best polished at this point to ensure good contact electrically. The jubilee clip should be tightened as much as possible and then the whole area should be liberally taped.

Because one of the main causes of inefficiency of quarter wave verticals is a poor ground (high resistance) system, every effort has to be made to reduce this resistance. The radials will certainly help to do that, but popular theory has often suggested earth rods also. Consequently I hammered three 22mm x 1 metre long copper plumbing pipes into the ground near the base of the vertical section.

I had earlier soldered to the outer braid the ends of three heavy duty automobile starter cables. These can be obtained with a nut and clamp ready attached, and this enables a good connection to the copper pipes. All joints were again liberally taped with good quality PVC.

Next the top loading wire which is used to bring the antenna to resonance on 80m was cut to about 13.5 metres (44ft), which with the 7 metres vertical section totals about 20.5 metres, or 68ft. This length is slightly over quarter wave, but the extra length compensates for the bend when using an inverted 'L' shape.

One end of this was attached to the nylon supporting line and the other end bared and secured by a jubilee clip to the topmost section of the vertical. This again should be polished and liberally taped as with the feeder connection.

All that remains is to put a ring spanner for the top clamp nut in your pocket and walk up the mast. Even though the aerial is relatively light the 10 gauge mast will feel heavy until the mid point is reached, so ensure a good grip and that the base clamp is tight, and the base so positioned that about 150mm clearance will be present above the ground once raised.

Once upright it will look to be about 30 metres high, but this is not the time to be faint hearted - instead pull over the clamp and swiftly tighten the nut as tight as possible. Provided your measurements of the top wire/nylon are correct you should have a nice neat Marconi type inverted 'L' with just a shade of slack on the top wire.

### Results

Results with this aerial have been very satisfying, especially on 80m. CW is used exclusively, and this helps considering that the output power seldom exceeds 5-25 watts - this is to reduce the interference risk, particularly to my upstairs neighbour.

599 reports have been regularly logged from all over G and GM, and average for 'near' Europeans has been 56/589. Best DX on 80m so far has been with UA9, when 579 was given for my 15 watts output.

The layout of the garden means that all the radials but one run in the same direction. It is felt, in line with popular theory, that this makes the antenna somewhat directional.

Indeed, this directivity seems to be towards NW England, especially Lancashire and the Fylde coast whence 599 reports are regularly received from as low as 3 watts output.

Considering the QRM/QRN on this band, it cannot be denied that such is an excellent result and does appear to confirm the radial directivity theory.

On 20m with an ATU the results are down when compared with a good groundplane or dipole. Nevertheless, W has been worked with 5 watts output, and 559 received from the east coast of America. So all in all this is a useful little antenna. When transmissions have ended it is a simple matter to release the top clamp and slowly lower the mast.

The greatest strain on raising and lowering is at the overlaps, so it is recommended that no less than 10 gauge dural and good quality coach bolts are used if much raising and lowering are contemplated.

### Conclusion

In conclusion then, this project can produce a useful antenna which is relatively low in cost, simple to build and needing only a day or so to prepare. More importantly for those amateurs who are handicapped by small gardens, it can provide a useful means of 'getting out' to both local and more distant stations.

Finally, because of the 'tilt over' facility, it is extremely practical for those who live in areas where any sort of aerial is frowned upon. Such a facility *must* be useful in increasing the good name of amateur radio, and this is a most important point when public relations and the long term future and credibility of our hobby are considered.

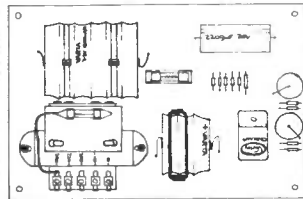
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Z909 Another board which escaped the clutches of the flow solder machine - 103 x 39mm, this is an RF panel with a TDA1200 FM/IF chip & UPC1176C noise canceller + R's & C's inc. tanks. Chips cost around £8 together. Price for panel **£2.50**

Z910 139 x 39mm, this panel has soldered in components - TCA4500A and TBA651R. AM radio with IF amp. Probably complete RF section of radio as IF's and trimmers are on board. - R's C's etc **£2.50**

Z911 L shaped board 125 x 35mm, looks like RF section of radio - BF194-5 etc + trimmers & IF's, but tuner is absent. **£1.00**

Z912 Same as Z909, only components have been soldered. **£2.50**

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TDA440	2.25	UPC1182	2.95
TDA1001	1.95	UPC1185H	2.95
TDA1002A	1.95	UPC1185H	2.95
TDA1003A	3.25	UPC1185H	2.95
TDA1004A	3.25	UPC1185H	2.95
TDA1006A	2.50	UPC1185H	2.95
TDA1010	2.15	UPC1185H	2.95
TDA1035	2.50	UPC1185H	2.95
TDA1037	1.95	UPC1185H	2.95
TDA1044	2.15	UPC1185H	2.95
TDA1170	3.95	UPC1185H	2.95
TDA1190	2.15	UPC1185H	2.95
TDA1270C	1.95	UPC1185H	2.95
TDA1327	1.70	UPC1185H	2.95
TDA2002	1.95	UPC1185H	2.95
TDA2003	2.95	UPC1185H	2.95
TDA2010	1.95	UPC1185H	2.95
TDA2020	2.95	UPC1185H	2.95
TDA2030	2.80	UPC1185H	2.95
TDA2140	3.95	UPC1185H	2.95
TDA2151	1.95	UPC1185H	2.95
TDA2160	2.95	UPC1185H	2.95
TDA2190	2.95	UPC1185H	2.95
TDA2521	3.25	UPC1185H	2.95
TDA2522	1.95	UPC1185H	2.95
TDA2523	2.95	UPC1185H	2.95
TDA2524	1.95	UPC1185H	2.95
TDA2530	1.95	UPC1185H	2.95
TDA2532	1.95	UPC1185H	2.95
TDA2540	2.50	UPC1185H	2.95
TDA2541	2.15	UPC1185H	2.95
TDA2560	2.15	UPC1185H	2.95

**SEMICONDUCTORS**

AA124	0.25	BC178	0.15	BD237	0.40	BFW92	0.85	TI300C	0.43
AC126	0.45	BC182	0.10	BD238	0.40	BFX29	0.30	TI303C	0.55
AC127	0.20	BC182LB	0.10	BD242	0.75	BFX84	0.26	TI323C	0.42
AC128	0.28	BC183	0.10	BD246	0.75	BFX85	0.32	TI333B	0.75
AC128K	0.32	BC183L	0.09	BD376	0.32	BFX86	0.30	TI344B	0.78
AC141	0.28	BC184LB	0.09	BD410	0.65	BFX88	0.25	TIP41A	0.45
AC141K	0.34	BC204	0.10	BD434	0.65	BFY90	0.21	TIP41C	0.45
AC142K	0.30	BC204L	0.13	BD437	0.75	BFY91	0.21	TIP42C	0.47
AC176	0.22	BC208B	0.13	BD438	0.75	BFY92	0.28	TIP47	0.85
AC176K	0.31	BC212	0.09	BD438	0.75	BFY90	0.77	TIP120	0.60
AC187	0.25	BC212L	0.09	BD530	0.65	BLY48	1.75	TIP125	0.55
AC187K	0.28	BC212LA	0.09	BD538	0.65	BR100	0.26	TIP142	1.75
AC188	0.25	BC213	0.09	BD597	0.95	BR101	0.49	TIP146	2.75
AC188K	0.37	BC213L	0.09	BD701	1.25	BR103	0.55	TIP161	2.95
AD142	0.78	BC214	0.09	BD702	1.25	BR303	0.95	TIP295S	0.80
AD142K	0.90	BC214L	0.09	BD707	1.00	BR303	0.95	TIP295S	0.80
AD149	0.70	BC214L	0.09	BDX32	1.50	BR303	0.95	TIP443	0.55
AD161	0.39	BC237B	0.09	BDY57	1.85	BT100A/02	0.85	TIS91	0.20
AD162	0.39	BC238	0.09	BF115	3.15	BT106	1.49	TIV106/2	1.50
AD161/2	0.90	BC239	0.12	BF117	0.65	BT116	1.20	ZRF0112	16.50
AF106	0.50	BC251A	0.12	BF154	0.20	BT119	3.15	2N1100	6.60
AF114	1.95	BC252A	0.15	BF158	0.22	BT120	1.85	2N1711	0.30
AF121	0.90	BC254	0.25	BF160	0.27	BU105	1.22	2N2110	4.50
AF124	0.85	BC258A	0.39	BF167	0.27	BU108	1.60	2N2219	0.28
AF125	0.35	BC284	0.30	BF172	0.22	BU112S	1.25	2N2905	0.40
AF126	0.32	BC300	0.30	BF173	0.22	BU126	1.60	2N3054	0.59
AF127	0.40	BC301	0.30	BF177	0.22	BU204	1.85	2N3055	0.52
AF139	0.40	BC303	0.28	BF178	0.28	BU205	1.30	2N3072	0.12
AF150	0.60	BC307B	0.09	BF179	0.39	BU208	1.39	2N3703	0.12
AF178	1.95	BC327	0.10	BF180	0.29	BU208A	1.52	2N3704	0.12
AF239	0.90	BC329	0.10	BF181	0.29	BU208B	1.88	2N3706	0.12
AU106	4.50	BC330	0.10	BF182	0.29	BU209	1.70	2N3708	0.12
AU107	3.50	BC338	0.09	BF183	0.29	BU326S	1.60	2N3708	0.12
AU110	2.00	BC347A	0.13	BF184	0.29	BU407	1.24	2N3733	9.50
AU102	2.95	BC461	0.35	BF185	0.22	BU500	2.25	2N3773	2.75
BC107A	0.11	BC478	0.20	BF195	0.11	BU526	1.90	2N3792	1.35
BC107B	0.11	BC527	0.20	BF196	0.11	BU807	2.25	2N4280	3.50
BC108	0.11	BC547	0.10	BF197	0.11	BUY29	2.18	2N4297	0.65
BC108B	0.12	BC549A	0.10	BF198	0.16	BUY59B	1.70	2N4444	1.15
BC109	0.10	BC550A	0.14	BF199	0.14	MJ3000	1.98	2N5294	0.42
BC109B	0.12	BC557	0.08	BF200	0.40	MJE340	0.40	2N5296	0.48
BC109C	0.12	BC557B	0.08	BF241	0.15	MJE350	0.48	2N5298	0.60
BC114	0.15	BC558	0.10	BF245	0.30	MJE520	0.48	2N5496	0.65
BC116A	0.11	BC639/10	0.30	BF257	0.28	MJE2955		2SA329	0.95
BC117	0.19	BCY35A	1.90	BF258	0.28	MPSA13	0.29	2SA715	0.80
BC119	0.24	BD111	0.20	BF259	0.28	MPSA92	0.30	2SC495	0.80
BC125	0.25	BD116	0.60	BF271	0.26	MRF453	17.50	2SC498	0.80
BC139	0.20	BD124P	0.59	BF273	0.18	MRF454	23.50	2SC91D	0.95
BC140	0.31	BD131	0.42	BF337	0.29	MRFA45	12.50	2SC1096	0.60
BC141	0.25	BD132	0.42	BF338	0.32	MRFA45	23.50	2SC1106	2.50
BC142	0.21	BD133	0.40	BF335	0.37	MRFA45	23.50	2SC1172	2.20
BC143	0.24	BD135	0.30	BF362	0.38	MRFA45	23.50	2SC1173	1.15
BC147	0.09	BD137	0.30	BF363	0.35	OC23	1.50	2SC1206	0.60
BC148A	0.09	BD138	0.32	BF371	0.25	OC23	1.50	2SC1364	0.50
BC148B	0.09	BD139	0.32	BF394	0.25	OC29	2.25	2SC1449	0.50
BC149	0.09	BD140	0.30	BF422	0.25	OC36	2.25	2SC1678	1.25
BC153	0.30	BD144	1.10	BF423	0.25	OC42	0.55	2SC1909	1.45
BC157	0.12	BD150C	0.28	BF457	0.32	OC44	0.75	2SC1945	2.65
BC158	0.09	BD150	0.28	BF458	0.36	OC45	0.55	2SC1953	0.95
BC159	0.09	BD156	0.30	BF467	0.65	OC70	0.45	2SC1969	1.95
BC160	0.28	BD166	0.55	BF467	0.65	OC71	0.55	2SC2028	1.15
BC161	0.28	BD179	0.75	BF467	0.65	OC71	0.55	2SC2029	1.95
BC170B	0.15	BD182	0.70	BF467	0.65	OC71	0.55	2SC2029	1.95
BC171	0.09	BD201	0.83	BF467	0.65	OC71	0.55	2SC2029	1.95
BC171A	0.10	BD202	0.85	BF467	0.65	OC71	0.55	2SC2029	1.95
BC172	0.10	BD203	0.78	BF467	0.65	OC71	0.55	2SC2029	1.95
BC172B	0.10	BD222	0.48	BF467	0.65	OC71	0.55	2SC2029	1.95
BC172C	0.10	BD223	0.59	BF467	0.65	OC71	0.55	2SC2029	1.95
BC173B	0.10	BD225	0.48	BF467	0.65	OC71	0.55	2SC2029	1.95
BC174	0.09	BD232	0.35	BF467	0.65	OC71	0.55	2SC2029	1.95
BC174A	0.09	BD233	0.35	BF467	0.65	OC71	0.55	2SC2029	1.95
BC177	0.15	BD234	0.35	BF467	0.65	OC71	0.55	2SC2029	1.95

**DIODES**

AA119	0.08	BY210-800	0.33	1N23B	2.95
BA115	0.13	BY223	0.90	1N23C	2.95
BA145	0.16	BY298-400	0.22		



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A174	11.50	EB41	3.95	EL153	12.15	M8100	5.50	QV003-50A	50	U41	6.95	ZC21	1.00	6A35	1.00	12CA5	1.95	6064	2.20
A198	11.50	EB91	2.50	EL183P	3.50	M8136	7.00	QV003-20B	32.00	U82	1.95	ZC39A	2.50	6A36	1.85	12C6B	1.20	6158	3.50
A234	11.50	EB341	1.95	EL360	6.75	M8137	5.00	QV006-40A	37.00	U91	0.70	2C40	35.00	6A38	0.80	12DWA	3.50	6688	6.50
A263	6.50	EB81	1.50	EL500	1.40	M8161	6.50	QV007-50	23.95	U93	0.65	2C42	20.50	6A39	2.00	12EWT	17.50	6870	11.50
A269	37.50	EB30	1.50	EL509	5.20	M8162	6.50	QZ03-20	42.50	U95	0.75	2C51	32.00	6A40	2.50	12G14	28.00	6887	9.50
A292	17.50	EB91	0.50	EL519	6.95	M8186	4.50	QZ06-40A	45.25	U96	0.75	2C53	32.00	6A41	2.50	12G17	4.50	6875	4.50
A302	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ09-40A	45.25	U97	1.00	2C54	32.00	6A42	2.50	12G18	4.50	6876	4.50
A303	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ10-40A	45.25	U98	0.60	2D21W	2.50	6A43	2.50	12G19	4.50	6877	4.50
A304	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ11-40A	45.25	U99	0.60	2E26	7.95	6A44	2.50	12G20	4.50	6878	4.50
A305	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ12-40A	45.25	U99	0.60	2E26	7.95	6A45	2.50	12G21	4.50	6879	4.50
A306	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ13-40A	45.25	U99	0.60	2E26	7.95	6A46	2.50	12G22	4.50	6880	4.50
A307	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ14-40A	45.25	U99	0.60	2E26	7.95	6A47	2.50	12G23	4.50	6881	4.50
A308	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ15-40A	45.25	U99	0.60	2E26	7.95	6A48	2.50	12G24	4.50	6882	4.50
A309	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ16-40A	45.25	U99	0.60	2E26	7.95	6A49	2.50	12G25	4.50	6883	4.50
A310	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ17-40A	45.25	U99	0.60	2E26	7.95	6A50	2.50	12G26	4.50	6884	4.50
A311	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ18-40A	45.25	U99	0.60	2E26	7.95	6A51	2.50	12G27	4.50	6885	4.50
A312	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ19-40A	45.25	U99	0.60	2E26	7.95	6A52	2.50	12G28	4.50	6886	4.50
A313	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ20-40A	45.25	U99	0.60	2E26	7.95	6A53	2.50	12G29	4.50	6887	4.50
A314	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ21-40A	45.25	U99	0.60	2E26	7.95	6A54	2.50	12G30	4.50	6888	4.50
A315	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ22-40A	45.25	U99	0.60	2E26	7.95	6A55	2.50	12G31	4.50	6889	4.50
A316	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ23-40A	45.25	U99	0.60	2E26	7.95	6A56	2.50	12G32	4.50	6890	4.50
A317	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ24-40A	45.25	U99	0.60	2E26	7.95	6A57	2.50	12G33	4.50	6891	4.50
A318	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ25-40A	45.25	U99	0.60	2E26	7.95	6A58	2.50	12G34	4.50	6892	4.50
A319	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ26-40A	45.25	U99	0.60	2E26	7.95	6A59	2.50	12G35	4.50	6893	4.50
A320	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ27-40A	45.25	U99	0.60	2E26	7.95	6A60	2.50	12G36	4.50	6894	4.50
A321	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ28-40A	45.25	U99	0.60	2E26	7.95	6A61	2.50	12G37	4.50	6895	4.50
A322	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ29-40A	45.25	U99	0.60	2E26	7.95	6A62	2.50	12G38	4.50	6896	4.50
A323	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ30-40A	45.25	U99	0.60	2E26	7.95	6A63	2.50	12G39	4.50	6897	4.50
A324	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ31-40A	45.25	U99	0.60	2E26	7.95	6A64	2.50	12G40	4.50	6898	4.50
A325	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ32-40A	45.25	U99	0.60	2E26	7.95	6A65	2.50	12G41	4.50	6899	4.50
A326	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ33-40A	45.25	U99	0.60	2E26	7.95	6A66	2.50	12G42	4.50	6900	4.50
A327	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ34-40A	45.25	U99	0.60	2E26	7.95	6A67	2.50	12G43	4.50	6901	4.50
A328	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ35-40A	45.25	U99	0.60	2E26	7.95	6A68	2.50	12G44	4.50	6902	4.50
A329	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ36-40A	45.25	U99	0.60	2E26	7.95	6A69	2.50	12G45	4.50	6903	4.50
A330	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ37-40A	45.25	U99	0.60	2E26	7.95	6A70	2.50	12G46	4.50	6904	4.50
A331	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ38-40A	45.25	U99	0.60	2E26	7.95	6A71	2.50	12G47	4.50	6905	4.50
A332	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ39-40A	45.25	U99	0.60	2E26	7.95	6A72	2.50	12G48	4.50	6906	4.50
A333	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ40-40A	45.25	U99	0.60	2E26	7.95	6A73	2.50	12G49	4.50	6907	4.50
A334	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ41-40A	45.25	U99	0.60	2E26	7.95	6A74	2.50	12G50	4.50	6908	4.50
A335	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ42-40A	45.25	U99	0.60	2E26	7.95	6A75	2.50	12G51	4.50	6909	4.50
A336	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ43-40A	45.25	U99	0.60	2E26	7.95	6A76	2.50	12G52	4.50	6910	4.50
A337	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ44-40A	45.25	U99	0.60	2E26	7.95	6A77	2.50	12G53	4.50	6911	4.50
A338	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ45-40A	45.25	U99	0.60	2E26	7.95	6A78	2.50	12G54	4.50	6912	4.50
A339	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ46-40A	45.25	U99	0.60	2E26	7.95	6A79	2.50	12G55	4.50	6913	4.50
A340	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ47-40A	45.25	U99	0.60	2E26	7.95	6A80	2.50	12G56	4.50	6914	4.50
A341	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ48-40A	45.25	U99	0.60	2E26	7.95	6A81	2.50	12G57	4.50	6915	4.50
A342	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ49-40A	45.25	U99	0.60	2E26	7.95	6A82	2.50	12G58	4.50	6916	4.50
A343	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ50-40A	45.25	U99	0.60	2E26	7.95	6A83	2.50	12G59	4.50	6917	4.50
A344	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ51-40A	45.25	U99	0.60	2E26	7.95	6A84	2.50	12G60	4.50	6918	4.50
A345	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ52-40A	45.25	U99	0.60	2E26	7.95	6A85	2.50	12G61	4.50	6919	4.50
A346	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ53-40A	45.25	U99	0.60	2E26	7.95	6A86	2.50	12G62	4.50	6920	4.50
A347	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ54-40A	45.25	U99	0.60	2E26	7.95	6A87	2.50	12G63	4.50	6921	4.50
A348	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ55-40A	45.25	U99	0.60	2E26	7.95	6A88	2.50	12G64	4.50	6922	4.50
A349	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ56-40A	45.25	U99	0.60	2E26	7.95	6A89	2.50	12G65	4.50	6923	4.50
A350	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ57-40A	45.25	U99	0.60	2E26	7.95	6A90	2.50	12G66	4.50	6924	4.50
A351	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ58-40A	45.25	U99	0.60	2E26	7.95	6A91	2.50	12G67	4.50	6925	4.50
A352	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ59-40A	45.25	U99	0.60	2E26	7.95	6A92	2.50	12G68	4.50	6926	4.50
A353	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ60-40A	45.25	U99	0.60	2E26	7.95	6A93	2.50	12G69	4.50	6927	4.50
A354	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ61-40A	45.25	U99	0.60	2E26	7.95	6A94	2.50	12G70	4.50	6928	4.50
A355	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ62-40A	45.25	U99	0.60	2E26	7.95	6A95	2.50	12G71	4.50	6929	4.50
A356	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ63-40A	45.25	U99	0.60	2E26	7.95	6A96	2.50	12G72	4.50	6930	4.50
A357	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ64-40A	45.25	U99	0.60	2E26	7.95	6A97	2.50	12G73	4.50	6931	4.50
A358	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ65-40A	45.25	U99	0.60	2E26	7.95	6A98	2.50	12G74	4.50	6932	4.50
A359	24.00	EB33	0.50	EL802	3.85	M8195	4.50	QZ66-40A	45.25	U99	0.60	2E26	7.95	6A99	2.50	12G75			

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BC547/8/9 – 8p	BD135,136 – 25p	BSX20 – 15p
BC557/8/9 – 8p	BD137,138,139 – 25p	2N2926 – 7p
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10/16,10/25,22/6 – 20P.15/25,22/16,33/10.....	30p

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100/50 – 12p. 100/100 – 14p. 220/16 – 8p. 220/25, 220/50.....	10p
470/16, 470/25 – 11p. 470/35 – 12p. 470/40 – 15p. 1000/16.....	15p
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# 27-29MHz CONVERSIONS

by Bill Sparks G8FBX and Colin Horrabin G3SBI

During the last few years, a variety of techniques have been published incorporating suggested methods of converting the frequency ranges of relatively cheap FM CB transceivers from the CB frequencies to the 29.3-29.7 amateur FM allocation. The large increase in occupancy of the 144/146MHz band has meant that the availability of a further band capable of reliable short range communication, such as local ragchew nets or short range mobiles, would be an advantage.

In the present condition of the sunspot cycle the 28MHz band meets the above requirements admirably, and with the occasional opening offers an added impetus to the adventurous. The FM allocation is normally 29.3-29.7MHz, but the use of 29.3-29.5 as a satellite downlink band means that most activity is centred on the 29.5-29.7 region. The use of modified, cheaply available CB transceivers, together with the associated ancillary fittings such as aerials, etc, offers a simple and inexpensive method of taking advantage of this situation.

## Two approaches

The techniques advocated have developed into two broad avenues of approach.

Firstly, variation to the switched count range applied to the PLL, so that the decoded signal can be varied outside the

normally accepted range and thus give extended coverage. This extension can be achieved by either:

- (i) Modifying the count range by switching, or by wiring alterations to the code line.
- (ii) The use of binary adders to pre-load the count line.
- (iii) Variations to the offset frequency.

Alternatively, substitution of a dedicated device by a binary controlled PLL, and by using an Eprom in the normal BCD program line to convert to a straight binary code. In the case of FCC-coded switch lines, the Eprom can also be programmed to by-pass the guard channels and to take out the channel 22/23 switch around.

The common form of straight binary input PLLs have one shared characteristic: the 'divide-by-N' counter on the program lines usually has a limited count range and is incapable of counting faster than about 2.5 MHz.

This is the reason for, the mixing technique adopted where the 10.240MHz reference frequency is firstly divided by 1024 to give the 10KHz channel separation control, and also by two to give a 5.12MHz output. The 5.12MHz output is then multiplied to 15.36MHz, and this so-called 'offset frequency' is then mixed with the VCO operating in the 17MHz region to give an output around 1.6MHz. This 1.6MHz is applied to the counter and

divided down to 10KHz before comparing with the 10KHz reference.

The 17MHz is then mixed with the 10.240, which has had 455KHz offset added to it by suitable count variation controlled by the Tx/Rx switch, to give a 10.695 + 17MHz mix for the transmit frequency, or the 17MHz only is used as first oscillator injection to give a 10.695 first IF, which is then mixed in the second oscillator with 10.240MHz from the reference crystal to give a 455KHz second IF. To convert to 29.3MHz, the 15.36MHz frequency could possibly be altered to 16.9, which will cause the VCO to be shifted to 19MHz and thus give 29MHz operation (in the case of 27.6/27.99 equipment).

## Prevention

To prevent the normal CB fan from converting his set to operate outside the 26.950/27.450 range, the FCC required that all PLLs be non-transferable, resulting in a new family of devices being created in which the count range in the chip could not be varied. The count range was pre-programmed into a Read Only Memory, and activation or access to this memory was only made possible by a dedicated program input in BCD, not by a straight binary. Any other inputs were illegitimate and were considered by the device to be a miscode.

The program used on the LC7137 device currently in use in the UK for sets is shown in Figure 1 (note Tx is to be multiplied by 10).

Many forms of this dedicated device were produced, and this type of circuit meant that the transceivers were no longer capable of being transferred to different frequency ranges without replacing the complete synthesiser network, a technique widely adopted in the UK to convert former pirate sets to the licensed range set up by the British Home Office (27.601-27.991MHz).

## ROM

In effect this means that the divide-by-N value is no longer determined by the program lines, but by the ROM. The program lines act only as an instruction to the ROM to release a certain group of numbers from its store, this group of numbers being the required discrete count or divide ratio. Since a 6-bit binary coded decimal line is used the limit is to a count of 40, so variation to the input cannot be a practical possibility. Any other code input is read as a miscode and ignored by the ROM in any case.

Fig 1 Showing program data and division code

Ch No	Program Code						Rx(x5) (TR = 1)	Tx (x10) (TR = 0)
	D1	D2	D3	D4	D5	D6		
1	1	0	0	0	0	0	3381	2760
2	1	1	0	0	0	0	3383	2761
3	0	1	0	0	0	0	3385	2762
4	0	1	1	0	0	0	3387	2763
5	0	1	1	0	0	0	3389	2764
6	0	1	1	0	0	0	3391	2765
7	1	1	1	0	0	0	3393	2766
8	1	0	0	1	0	0	3395	2767
9	1	0	0	1	0	0	3397	2768
10	0	0	0	0	1	0	3399	2769
11	1	0	0	0	1	0	3401	2770
12	0	1	0	0	1	0	3403	2771
13	1	1	0	0	1	0	3405	2772
14	0	0	1	0	1	0	3407	2773
15	1	0	1	0	1	0	3409	2774
16	0	1	0	0	1	0	3411	2775
17	0	1	1	0	1	0	3413	2776
18	0	0	0	1	1	0	3415	2777
19	1	0	0	1	1	0	3417	2778
20	0	0	0	0	0	1	3419	2779
21	1	0	0	0	0	1	3421	2780
22	0	1	0	0	0	1	3423	2781
23	1	1	0	0	0	1	3425	2782
24	0	0	1	0	0	1	3427	2783
25	1	0	1	0	0	1	3429	2784
26	0	1	1	0	0	1	3431	2785
27	1	1	1	0	0	1	3433	2786
28	0	0	0	1	0	1	3435	2787
29	1	0	0	1	0	1	3437	2788
30	0	0	0	0	1	1	3439	2789
31	1	0	0	0	1	1	3441	2790
32	0	1	1	0	0	1	3443	2791
33	1	1	0	0	1	1	3445	2792
34	0	0	1	0	1	1	3447	2793
35	1	0	1	0	1	1	3449	2794
36	0	1	1	0	1	1	3451	2795
37	1	1	1	0	1	1	3453	2796
38	0	0	0	1	1	1	3455	2797
39	1	0	0	1	1	1	3457	2798
40	0	0	0	0	0	0	3459	2799

NOTE:  
All odd numbers



# 27-29 MHz CONVERSIONS

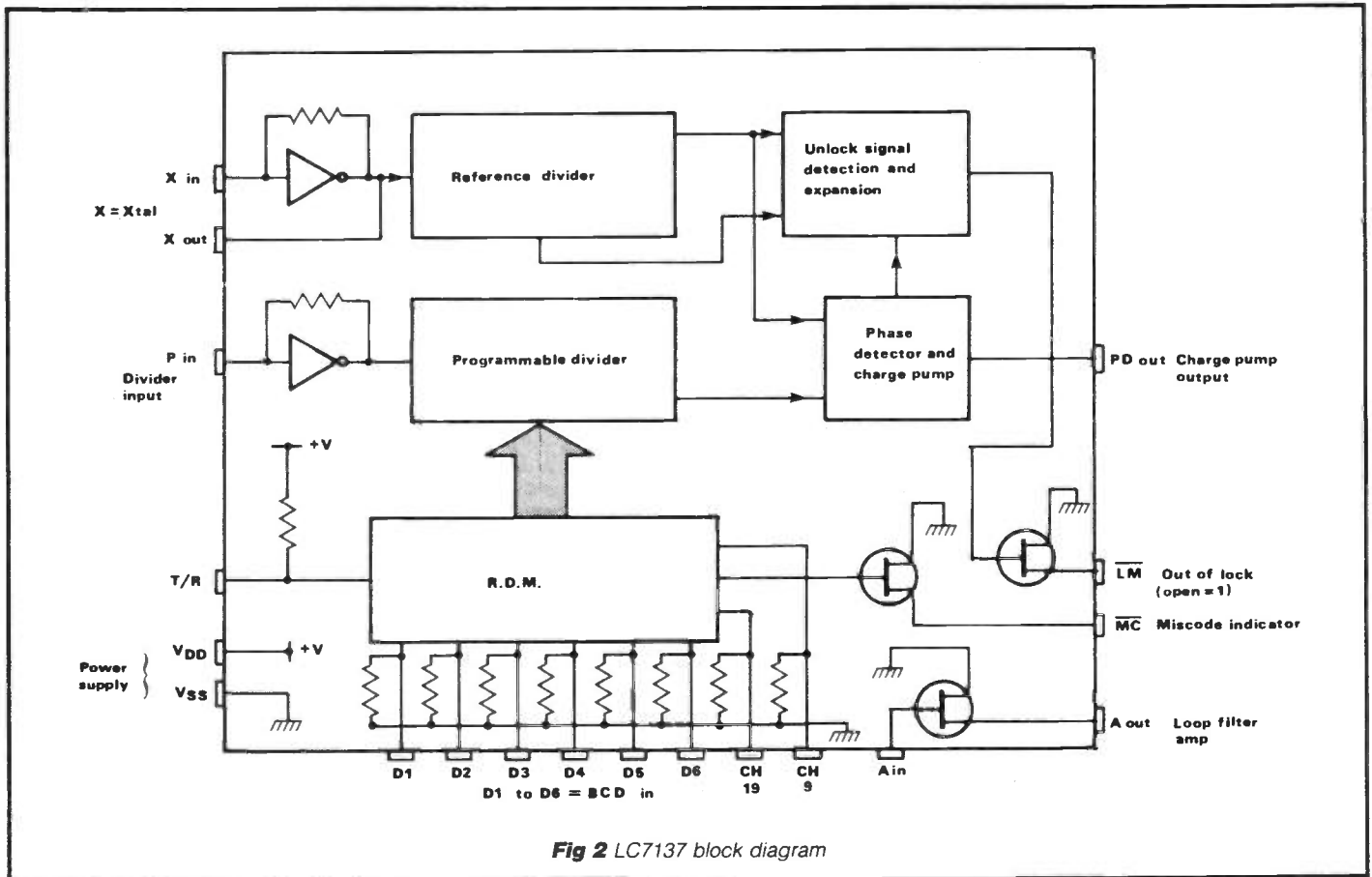


Fig 2 LC7137 block diagram

Examination of the structure of the device (Figure 2) shows some interesting features. Firstly the divide-by-N section, which is controlled by the ROM in its instruction phase, is now capable of dividing up to a 22MHz count range and is therefore capable of reading the VCO input directly. Whilst this offers certain advantages, which will become apparent later, the obvious disadvantage is that methods of varying the offset are no longer applicable.

One other interesting point is that the divider ranges operate at two levels (Figure 1), meaning that the VCO will be operating at quite different frequencies in the transmit and receive modes. The frequency arrangements used on receive are in multiples of two and are in an odd number sequence, whereas the Tx codes are in single number progression.

The actual arrangements chosen in the 7137 are to divide the VCO frequency directly by a discrete number, giving a 10KHz value on lock, whereas the VCO on receive operates on a frequency of 'Required frequency - 10.695MHz', but is counted in 5KHz steps using two steps per division. Since the desired frequency after division is 10KHz for reference, and the second IF is 455KHz, ie  $45.5 \times 10$ , then it is apparent that 45.5 is not a realisable count value and  $45.5 \times 2 = 91$  is used. In order to bring the odd 5KHz

back into the 455, the frequency is offset by the odd number used in the count chain.

From the discussion to date it would appear impossible to vary the frequency range covered by the device, since the phase lock circuit uses a 5 or 10KHz comparison frequency, as the circuit requirements dictate. The only possible variable is the VCO input, and here advantage may be taken of the wide lock-up range of the device.

### Outside control

As mentioned earlier, the input range of the divide-by-N or programmable counter extends to some 22MHz (specification states in excess of 16MHz, but all samples checked so far have gone in excess of 21MHz). The method of attack adopted was to influence the device into operating in a different frequency range by bringing a degree of outside control onto the programmable counter.

Assuming that a further divide-by-2 is introduced into the 1024 fixed reference divide, so that the reference frequency is now 5KHz, and that the incoming VCO frequency is the determinant value, the procedure adopted is to present the programmable counter with a frequency which, when divided down, would not give a 5KHz frequency to the phase comparator. The comparator senses an out-of-phase situation and creates a

correction voltage which is applied to the VCO, varying the VCO frequency until the divided value is exactly 5KHz, i.e. until the circuit is in lock.

If some method of varying the VCO frequency between leaving the VCO and arriving at the phase detector in its divided form could be derived, the possibility of misleading the device into operating on a different frequency range could be created.

The sequence of operations of the frequency count in the programmable divider is for the divider gate to be opened for a certain period of time, and a train of pulses to be loaded into its register. These stored pulses are then counted down by division at a programmed rate, and the resultant passed to the comparator. The gate time period is set by the 10.240MHz crystal, so it is a fixed time which cannot be varied inside the device.

In order to present a difference in output, variation in the input frequencies must occur. If wide variations are required the range may exceed the electrical parameters of the device, since a certain limited range of lock-up is characteristic of any one device. The only method of variation is to control the programmable counter gate opening time from an outside source, thus varying the number of pulses allowed to enter.

The method adopted was to institute a

# 27-29MHz CONVERSIONS

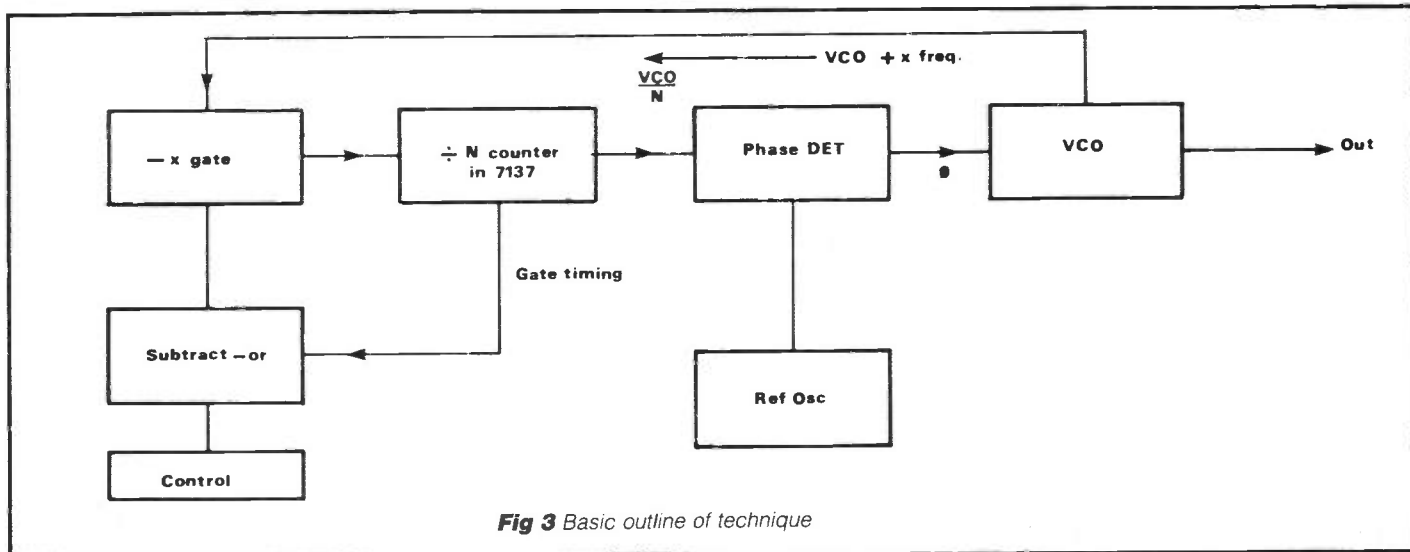


Fig 3 Basic outline of technique

CB Ch	Rx Division	Tx Division	Rx Local Osc Freq	Tx Output Freq
31	3441 (x 5KHz) If we prevent 340 pulses from entering device we effectively increase count by 340	2790 (x 5 x 2KHz) If we prevent 170 pulses from entering device we effectively increase count by 170	17205KHz (3441 x 5)	27900KHz (2790 x 5 x 2)
29MHz range	3441 340 <hr/> 3781 x 5 18905 10695 + (IF) <hr/> 29600	2790 170 <hr/> 2960 x 5 = 14800 x 2 = <hr/> 29600	18905KHz	29600KHz

Fig 4 Values adopted for the UK variation of the 7137

form of subtraction in which the incoming frequency to the divider was apparently reduced in value, thus causing the phase detector to take corrective action by increasing the VCO frequency to compensate for the amount subtracted.

For example, if the VCO was running in lock at 17MHz and the VCO frequency actually fed to the divider was only 16MHz, then the phase detector would increase the VCO frequency to 18MHz so that the expected 17MHz frequency would then be applied to the comparator. In principle, what then happens is that a lock situation can only be achieved when a 17MHz program number creates an 18MHz VCO frequency, ie zero voltage on the PD output line. Basically, the phase detector is being fooled into believing that it is reading and controlling a 17MHz signal, whereas in fact it is controlling an 18MHz oscillator.

The simple technique is outlined in Figure 3, and it can be seen that the method used is to close the input to the programmable counter for a finite fraction of the permitted gate opening time,

thereby only permitting the VCO frequency to be stored in the memory of the divider for a controlled fraction of the gate opening time.

This means that the actual number of pulses available for counting in the period is now reduced in proportion to the reduced time of the gate opening period. By varying the open time throughout the actual available time, a degree of control over the precise frequency measured is established, and by incorporating varying times a wide control of frequency variation can be introduced. An indication of the numerical values adopted for the UK variation of the 7137 is shown in Figure 4.

To introduce the required Tx offset for repeater use, it is only necessary to change the 170 pulse stop to 160 so that the transmit frequency is reduced to 29500KHz, or to 180 for 29700KHz.

### Technical problems

The approach as suggested is simplicity itself, but the creation of the required circuitry presented many technical difficulties. Obviously mixing techniques can be ruled out in face of the impossible

task of filtering out unwanted products, and a simple arithmetical subtractive technique had to be developed.

### Timing

One essential feature was the timing of sequences. Since the synchronization of gate opening times and initiation of subtract frequency generation was vital, the problem of propagation delay or varying transit times in the circuitry involved created difficulties. High speed logic circuitry operational at the frequencies involved was not available initially, and eventually a system was developed in which the incoming train of pulses from the VCO was stopped at a logic gate until sufficient time had elapsed to permit a pre-determined number of pulses to be generated in a separate but synchronized encoder.

The time permitted as a gate closure time was that period of time necessary for a skip-ten counter and associated circuitry to count down from the loaded pre-determined value to zero. At this point the gate opened and the programmable counter in the LC7137 took over. By this means only the remaining

# 27-29MHz CONVERSIONS

portion of the VCO train, ie the total originally available less the count in the loaded counter, was presented to the PLL.

The simple form of this operation is shown in Figure 4 in crude form. To further elaborate on the technique, Figure 5 shows the more detailed approach, and is the block diagram of the final solution to the problem.

The initiation of a train of pulses into the 7137 triggers the external counter, and immediately clocks the variable division generator and closes the gate. When the external counter has reduced the values stored in the encoder to zero, the gate is opened and the remaining time is used by the LC7137 to count the pulses arriving from the VCO.

Obviously the time is insufficient for a complete count, and the shortened number causes the phase detector to take corrective action and increment the VCO. The circuit technique adopted (Figure 6), was to use a count-by-ten skip counter which is controlled by a pulse derived from the 7137 starting signal. Whilst running, this counter will maintain a logic 'one' at its output.

## Pulses

The starting signal was originally derived from the phase detector output to the VCO, which was found to have sharp pulses on the line (Figure 7). These are normally filtered out in the loop filter but can be detected at the PD output from the device.

The pulses are used to switch a counter set with a divide ratio of either 34, 17 or 16 depending on the function required, this selection being made by the Tx/Rx or repeater offset switch. This counter is set to count down from the loaded values and at each count a pulse is applied to the free running divide-by-ten counter. Upon the low range counter reaching zero, the divide-by-ten counter stops and its output reaches a logic 'zero'.

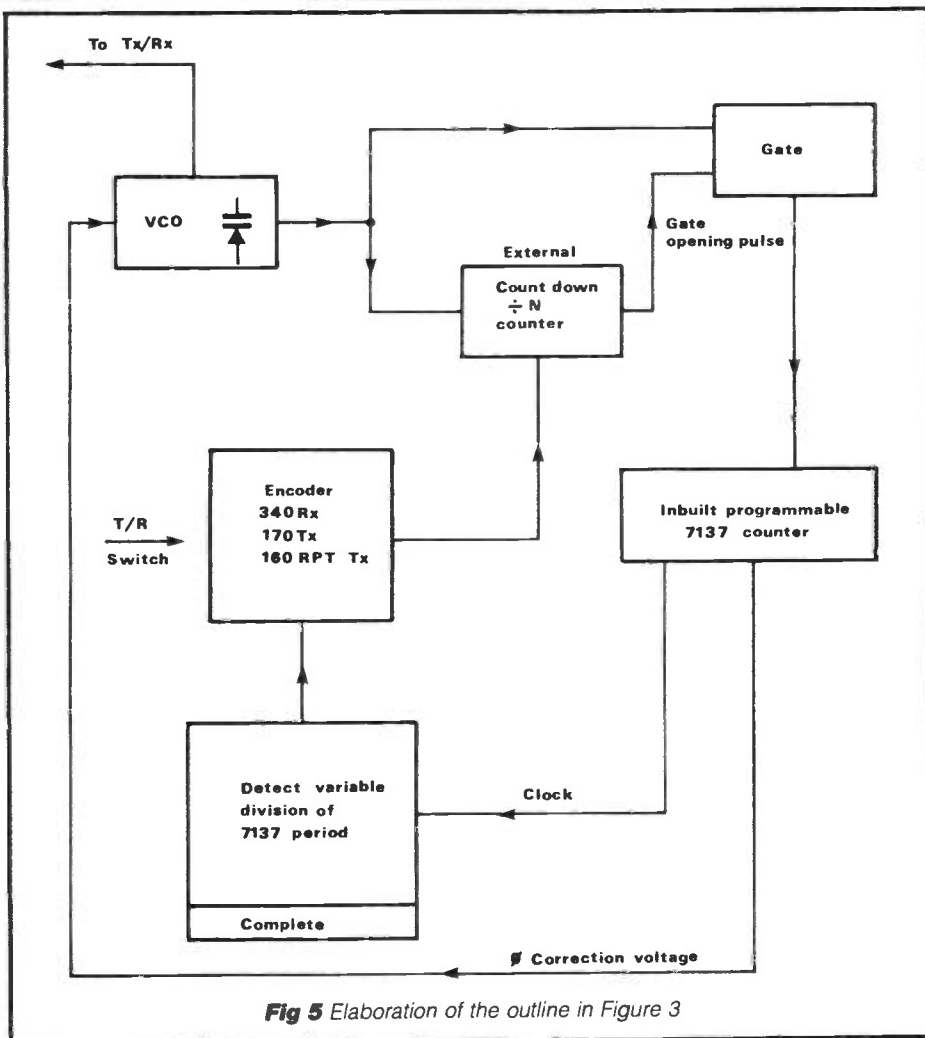


Fig 5 Elaboration of the outline in Figure 3

The output from the divide-by-ten counter controls a gate in the VCO feed to the 7137 so that the gate is closed when the 34 x 10 or 17 x 10 sequence is in operation, but opened immediately the zero is reached. The gate opening period only permits a reduced number of pulses to be registered by the 7137 before the

next cycle commences, and consequently the phase detector takes corrective action.

The problems encountered were mainly with the signalling of the initiation. The pulse polarity met at the PD output was not constant, so a discriminator has to be incorporated. The loop filter

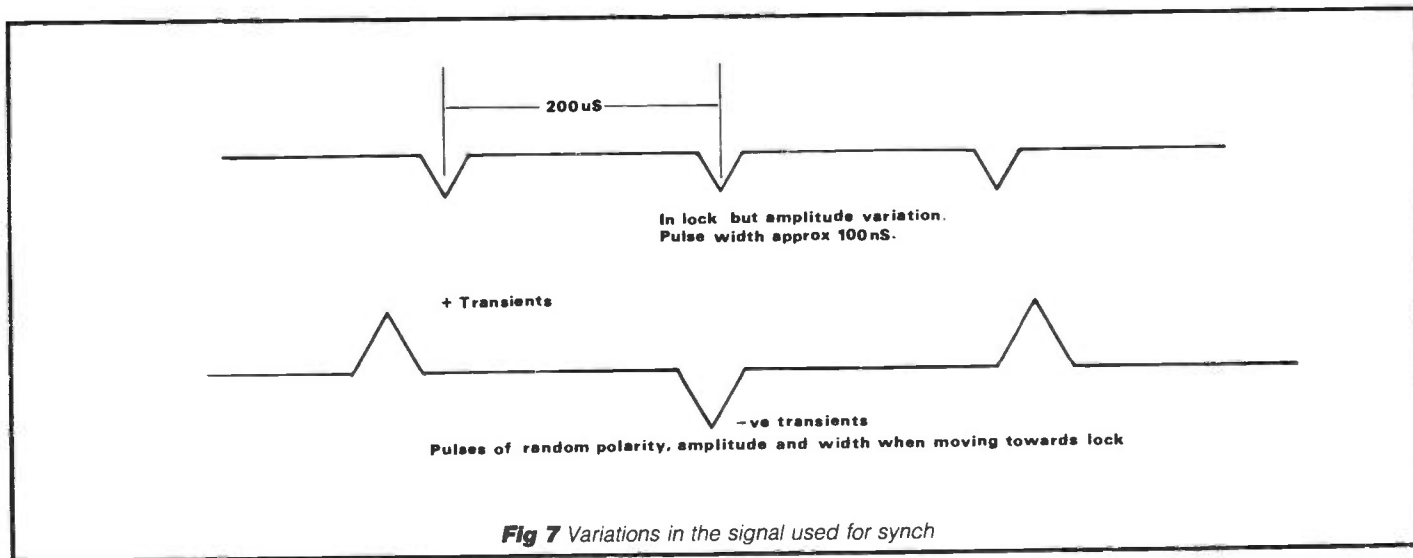


Fig 7 Variations in the signal used for sync





# 27-29MHz CONVERSIONS

circuits in common use were not adequate and required a considerable enhancement in performance, since the lock-up time is proportional to the loop frequency limit, and it was found necessary to reduce this limit considerably. A later technique (not shown on circuit) was to extract the pulse from the reference frequency oscillator.

Further investigation permitted the use of the 10.240KHz reference crystal oscillator as a clock.

The system has been used on a number of UK FM CB transceivers with successful results. Repeater stations in the US and Germany have been activated and good DX contacts made from mobile CB type aerials and either barefoot or with a modified 25watt CB linear.

## Sequence

Following the circuit diagram the actual sequence is as follows:

- (a) To stop 340 pulses it is necessary to stop 34 x 10 pulses. Using the circuit as shown this means that IC1, IC2 and IC3a have to operate at speeds near the limit of the logic family chosen, yet even so gate propagation times are borderline.
- (b) The incoming VCO frequency is applied to IC1a. The 2K2 resistor raises the gate into its linear region so that the amplitude of the input wave is increased and the input is to a certain degree squared up. The output of IC1a becomes the master clock for the skip-ten counter section, via IC3a.
- (c) In the absence of a load pulse at IC2 pin 9 (low), IC2 counts until a carry appears at pin 15 (high). This is inverted by IC1d which disables the count enable (pin high - count, low - disable). The counter stays in this state (15) until a load pulse appears.
- (d) Whilst the carry is high IC1c allows VCO pulses to pass to the LC7137 variable divider input. When the input to IC1c is low no pulses will pass.
- (e) The logic diagram in *Figure 8* shows the operation of the skip-ten counter. It will be noticed that the QC output is used to decrement the number-of-tens counter. Eight clock intervals (400nS) are available for IC5 and IC6 to settle before IC3a detects if another skip-ten count is required.
- (f) IC3a generates a low load pulse for one clock period only if IC2 carry is present, and if the J input is high. The J input only goes low and stays low if the number-of-tens counter reaches zero. A trigger from IC3b is needed (total countdown complete) to load a non-zero value into IC5. IC6 (Rx 34, Tx 17 or 16).  
Note that the input weighting D = 8, C = 4, B = 2, A = 1 is used (*Figure 9*).
- (g) The transistor buffers the Tx/Rx signal from the LC7137 Tx = O, Rx = 1. The gate IC4c inverts this signal and

DEC	QD	QC	QB	QA	
15	1	1	1	1	Waiting for low at pin 9. IC1c passing VCO frequency. Low received (J on IC3a high next clock Q low further clock Q high).
15	1	1	1	1	
5	0	1	0	1	Number of tens counter decremented.
6	0	1	1	0	
7	0	1	1	1	
8	1	0	0	0	
9	1	0	0	1	
10	1	0	1	0	
11	1	0	1	1	
12	1	1	0	0	
13	1	1	0	1	Two pulses allowed through from VCO. If tens counter not yet zero then another skip ten cycle begins.
14	1	1	1	0	
15	1	1	1	1	
5	0	1	0	1	Total count of tens now complete. The removal of, say (Rx = 340 counts) in a 5KHz reference period is now complete. Another cycle is initiated by the next pulse detector trigger pulse.
15	1	1	1	1	

**Fig 8** Skip 10 counter operation with number of tens counter

Function	DEC	IC5	IC6
		DCBA	DCBA
Receive	34	0010	0010
Transmit	17	0001	0001
Repeater Tx	16	0001	0000

**Fig 9** Loading of IC5 and IC6

the connections used to the 'set' inputs of IC5 and IC6 (IC6 is the least significant counter) give the binary equivalents to 34, 16 or 17.

- (h) IC3b is used as a 100nS monostable for each count complete signal at its input.
- (i) The overall action is therefore as follows:  
LC7137 variable divider count complete, load a value into IC5 and IC6, skip-ten counter operates until IC5 and IC6 reach zero, no further pulses stopped until LC7137 variable divider count is complete, when cycle is re-initiated.

## Problems

One problem encountered was the occasional spasmodic operation of the initiating pulse circuitry due to the random nature of the polarity of the pulse (*Figure 7*), and also variations in the pulse width. Considerable variations to the loop filter proved that this could be overcome, except in odd versions of the LC7137. A modified circuit has already been mentioned in which the pulse was extracted from the reference oscillator, and this completely removed the problem.

The actual conversion is a relatively simple operation since only one track break is required, then five connections to the board are made and the installation is complete.

Board design demanded an adequate earth plane, and separation of certain

circuit sections was essential. By adopting careful layout no screens were required, but good earths are essential.

## FM quality

The quality of FM produced was quite good when the normal CB modulator circuits were used. In cases where conversion of an AM is required, a board containing a suitable modulator with built-in processor together with a 455KHz discriminator is available, and this mod is capable of very high quality transmission and excellent reception.

The above techniques may be used in a variety of circumstances and are not limited only to CB conversions.

In the case of the guard channels in the FCC arrangement of frequency allocation, it is suggested that channels 21 - 40 are used and the only variation is then the switch at channel 23, ie 29.500 - 29.700 = ch 21 - 40.

The installation does require a certain degree of care since the high frequencies involved are sensitive to strays. Normal installation technique is to mount the board perpendicular in its short length to the main board, and to install it with the earth face of the board to the rear of the transceiver.

## Further development

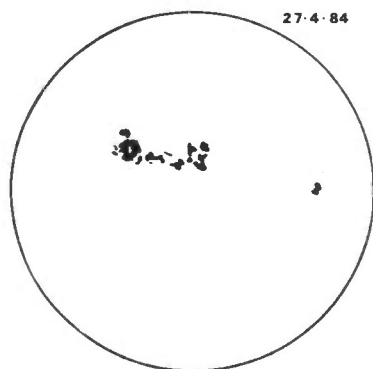
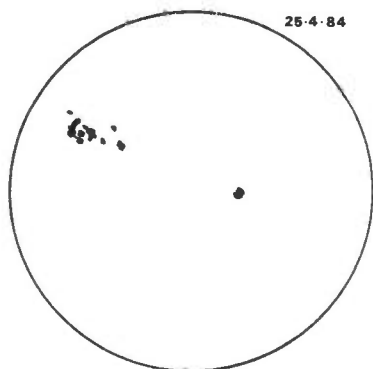
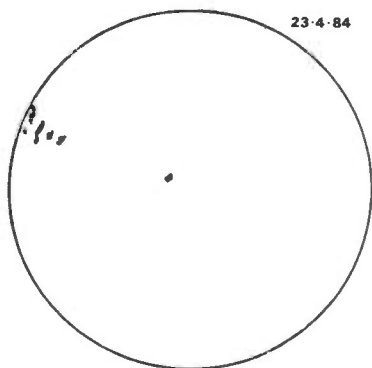
The above discussion leaves a considerable field of further development to the keen experimenter and the writers would be interested in suggestions for other applications.

REW

# AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

We mentioned in these notes in the August issue that a very large group of sunspots had appeared over the limb of the sun around the 23rd of April. Records from various sources have since shown that this group turned out to be one of the most active ever recorded.



As we are just about half-way through the present solar cycle, the appearance of such an active group may well have been thought to be very unexpected. However, as we said in the August notes, secondary solar activity peaks such as this one have been observed in previous sunspot cycles.

Amongst the effects noted by radio amateurs during the passage of this group were very high levels of solar noise on the 2 metre band. Over the weekend April 28/29, it was reported as being up to S9! Auroral propagation on the 2 metre band was observed and conditions on the HF bands were adversely affected.

The writer keeps a record of solar activity, routinely observing sunspots, and his records for the period are shown here.

As can be seen, the group of sunspots appeared about the 23rd, peaking around the 27th and disappearing around the 3rd May, which correlated very well indeed with the radio effects observed and the time of their occurrence. Since this spurt of activity the lowest solar flux levels of the present cycle have been experienced.

## Expedition to Greenland

*Amateur Satellite Report* gives details of an interesting expedition to Greenland last August. The amateur radio station IK0CAK/OX formed part of this expedition with operation on Oscar 10.

A ten-turn helix was used for the 435MHz uplink and a pair of ten-element crossed Yagis for the 2 metre downlink. A very interesting feature of this station

was that solar cells were used to power it, the transmitter running 30 watts.

The expedition, called STAUNING '84, is part of a scientific research program to study the ionosphere at high latitudes. Some impairment of satellite operation is expected from auroral scattering. Listener reports on the effects of auroral reflection on the uplink signals were requested.

## Amateurs Handbook

It is estimated that several thousand recruits to amateur radio have been obtained from the ranks of the CBers in the last year or so. These new radio amateurs lack the traditional background which the older radio amateurs acquired from earlier experience as SWLs and so on.

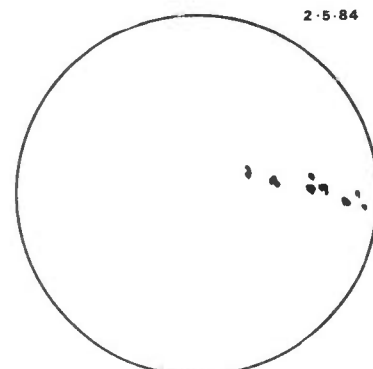
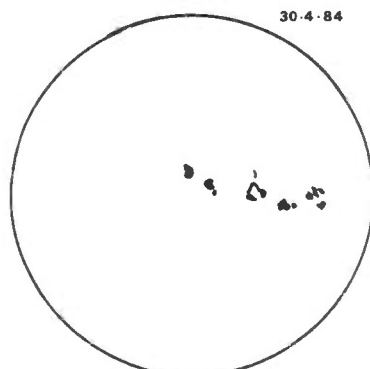
These new recruits to the hobby are finding it difficult to come to terms with traditional amateur radio procedures and know-how. One is constantly being asked for sources of the required information.

One of the most useful recently produced publications in this respect is the *Amateurs Handbook*, published by *Radio & Electronics World* for £2.50, which includes post and packing.

This is a three part handbook, now available as a complete set.

The first part has a very good section introducing amateur radio to those new to the hobby. It really does tell you what you want to know.

It describes the radio frequency bands allocated for amateur radio transmission and gives their propagation characteristics excellently.



There is a good section on operating an amateur station, and the various modes of communication are very well dealt with. There is a most useful, up-to-date 'countries list' and Part 1 concludes with a great circle distance table and a table for local time conversion.

Part 2 deals with getting a licence, various amateur radio activities, signal reporting systems, radio zones, a maps section and the Radio Amateur Examination syllabus.

Part 3 covers SW broadcasting very comprehensively indeed. This is a good section for the SWL.

There is an up-to-date list of Slow Morse Practice transmissions which are arranged by the RSGB. This is very useful for those learning Morse code.

The UK Beacon Station Network is well detailed and there is also a comprehensive list of UK repeater stations. The UK HF and the VHF/UHF Band Plans are also well set out.

Meteor scatter QSO procedure is explained and the Licence Regulations are dealt with in detail.

As you can see, you will find a mine of information between the covers which you can refer to easily and conveniently. It's a must for all radio shacks.

## UoSAT-Oscar-11

The final stages of commissioning UoSAT 2 took place on the 24th July. Following several days of final preparations and rehearsals, the gravity gradient boom was successfully deployed under control of the on-board 1802 computer at 1035 GMT, during orbit 2113.

The spacecraft had been closely aligned to the geomagnetic field by means of the automatic magnetorquer during the previous few weeks, and the residual wobble of the spacecraft had thereby been reduced to a very low value.

When things looked right, control was sent to the 1802 computer to terminate the magnetorquer routine and deploy the boom. Subsequent data indicated that the boom deployment had pro-

RSGB/AMSAT-UK OSCAR 10 NEWS BULLETINS					
1984		GMT/UTC	Range Km	Elevation	Azimuth
14th	October		No transmission		
21st	October	1730	36.875	49	153
28th	October	1230	40.075	10	83
4th	November	2000	37.544	41	225
11th	November	1500	37.812	37	122
18th	November		No transmission		
25th	November	1700	37.197	47	190
2nd	December	1130	38.336	22	100
9th	December	1930	38.908	25	247
16th	December	1400	37.006	44	153
23rd	December	0930	40.680	37	92
30th	December	1630	37.856	36	221

gressed satisfactorily and the spacecraft was under successful gravity gradient stabilisation.

The most obvious effect of gravity gradient stabilisation is that the spacecraft will now maintain the communication aeriels and the camera pointing towards earth.

This stabilisation is the culmination of many months of preparation and many weeks of activity, most of which has not been apparent to the outside world. Only those members of the UoSAT team involved in the procedures required know just how demanding the effort was. The experimental programmes can now begin, which will of course include the much awaited commissioning of the CCD camera.

## Oscar 10 News Bulletins

These news bulletins are broadcast on Sundays by AMSAT-UK from taped text compiled from news input to the RSGB and AMSAT-UK. They are on the Oscar 10 H2 channel of 145.962MHz downlink, and are broadcast during 'social hours' for Region 1 IARU, ie for Europe and Africa. Any radio amateur or AMSAT-UK group wishing to input news items into the service which are of interest to Region 1 members or other AMSAT-UK groups, should send this information in English to RSGB HQ or AMSAT-UK before the

Thursday prior to the Sunday bulletin. Dates and times for the next three months are as in the table.


A meeting was recently held in Cheltenham between some of the well known builders of amateur radio satellites to consider future projects. A proposal was initiated to consider a Phase-4 Geosynchronous Amateur Satellite System.

This would comprise, basically, of three geosynchronous spacecraft launched together on a common carrier module, each carrying at least one Mode-L transponder. The three spacecraft would be placed at 120 degrees around the equator, covering the USA, Europe and Asia.

A launch opportunity might be available early in 1987.

Dr Martin Sweeting, Satellite Control Centre, University of Surrey, Guildford, GU2 5XH, would be interested to hear what response there might be to such a project, for, as he says, it would be quite an undertaking.

## Recommended QSL card size

An interesting proposal at the IARU Region 1 Cefalu 1984 Conference was that in order to facilitate handling, both by machine and human sorters, the standard size for QSL cards should be 9 x 14 cm or 3½ x 5½ inches. 

# FREQUENCY COUNTERS

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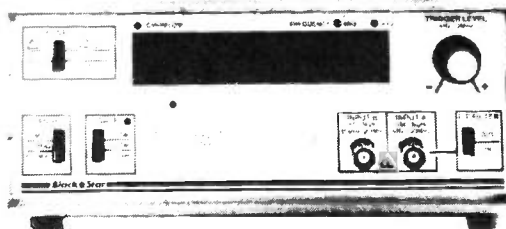
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# DATA FILE . . .

Ray Marston concludes his survey of electronic security system principles and practice by looking at miscellaneous circuits for use in the home or car.

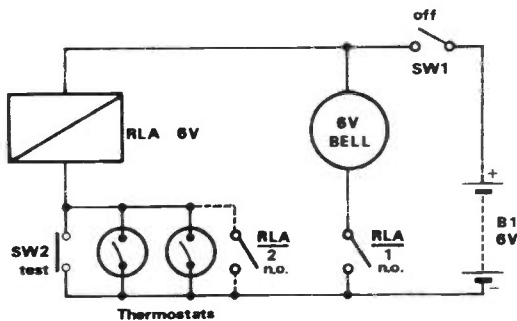


Fig 1 Simple relay-aided fire or over-temperature alarm using thermostat temperature sensors

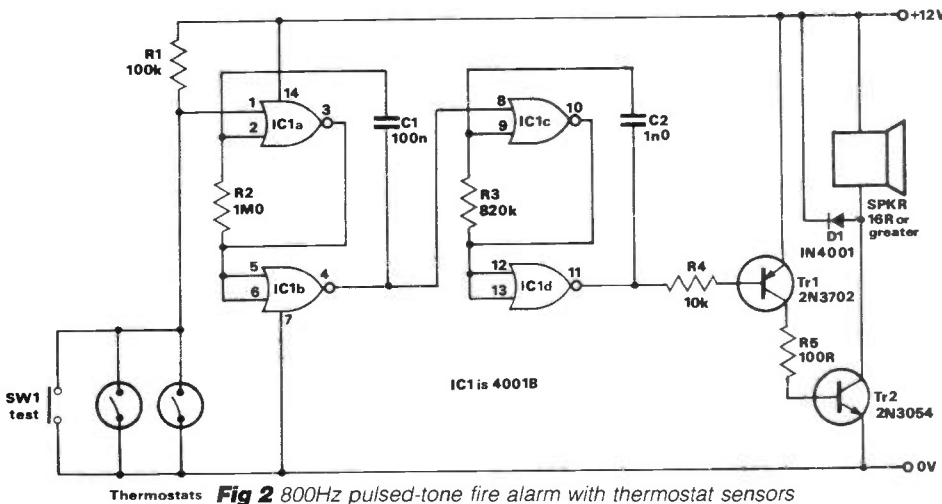


Fig 2 800Hz pulsed-tone fire alarm with thermostat sensors

In the last two editions of Data File we have looked at the basic operating theory and installation principles of modern home-security systems, and have shown a number of practical home-security alarm circuits that can be used to give a high degree of protection against fire, thuggery, burglary, and flooding, etc.

In the present edition of the file, we conclude our survey of electronic security systems by looking at temperature- and light-activated alarms for use in the home, and at a variety of 'security' circuits for use in the car.

## Temperature-activated alarms

Temperature-operated alarms can be designed to indicate an 'over-temperature' condition, an 'under-temperature' state, a 'temperature-deviation' state, or an excessive 'differential-temperature' state.

Obvious applications of over-temperature alarms are as fire or over-heating indicators for use in the home, greenhouse, or car. Under-temperature

alarms can be used to indicate the presence of frost or ice, or the failure of a heating system, etc.

Temperature-deviation alarms are specialised devices, and are used to sound an alarm when a monitored temperature goes above a pre-set upper value, or below a pre-set lower value. Useful domestic applications include the monitoring of tropical fish tanks or greenhouses.

Differential-temperature alarms are also specialised devices. They activate when two monitored temperatures differ by more than a pre-set amount, irrespective of the absolute values of the two temperatures. Practical examples of all four types of alarm circuit are shown in the next few pages.

Practical temperature-activated alarms may use either thermostats, thermistors, or silicon diodes (semiconductor junctions) as their temperature-sensing elements.

Figure 1 shows a practical example of a simple relay-aided fire or over-temperature alarm using electro-mechanical

thermostats as temperature sensors. These thermostats are normally-open (n-o) types, and close only when their temperature exceeds a pre-set value.

Thus, in Figure 1 the thermostats are normally open, so the relay and alarm bell are off and the circuit consumes zero current. When the temperature of either thermostat exceeds a pre-set value, however, the closed thermostat operates the relay, which then activates the alarm bell via contacts RLA/1.

Note that any number of thermostats can be connected in parallel, to monitor any number of points, and that the circuit can be given a functional check at any time by closing switch SW2. Also note that this circuit is normally non-latching, but can be made self-latching by connecting relay contacts RLA/2, as shown dotted in the diagram.

If the Figure 1 circuit is to be used as a fire alarm, with the thermostats located in normal living areas of the home, the thermostats should be set to close at a temperature of about 60°C (140°F); if they are located in unusually warm places, such as furnace rooms or attics, they should be set to close at about 90°C (194°F).

Figure 2 shows how a thermostat-type fire alarm can be made to generate a pulsed-tone alarm signal directly in a loudspeaker.

Here, IC1c and IC1d are wired as an 800Hz astable that can feed a tone signal into the speaker via Tr1 and Tr2 but is gated on and off by the output of IC1b, and IC1a-IC1b are wired as a 6Hz astable that can be gated on or off via the thermostats.

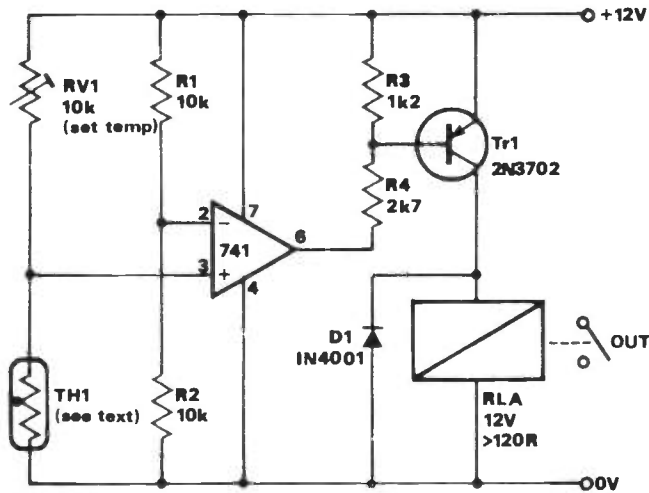
Normally the thermostats are open, and under this condition both astables are inoperative and the circuit consumes a quiescent current of only a microamp or so.

When either thermostat closes, however, the IC1a-IC1b astable is activated and so switches the IC1c-IC1d astable on and off at a 6Hz rate, thus generating an 800Hz pulsed-tone alarm signal in the speaker. The circuit gives a non-latching alarm operation, and the tone ceases as soon as the thermostats re-open.

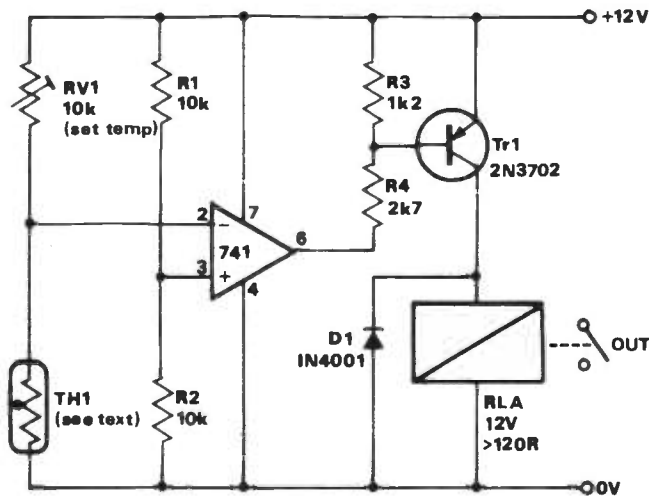
## Thermistor-activated alarms

Thermostats are electro-mechanical devices, and tend to be rather expensive and to offer relatively poor precision.

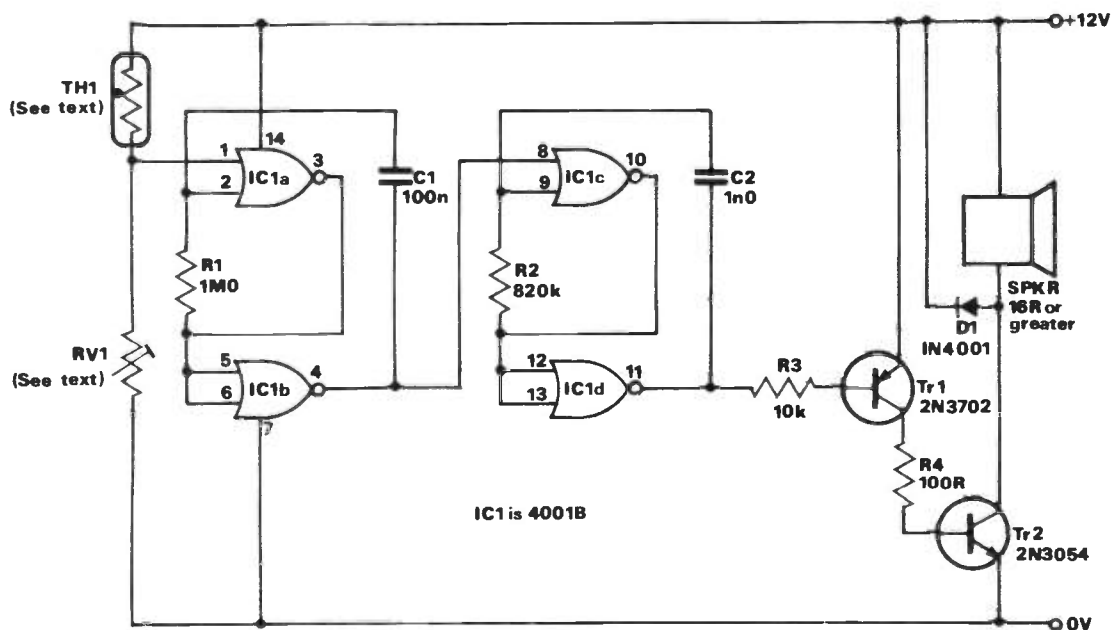
A useful and inexpensive alternative to this type of device is offered by the negative-temperature-coefficient (ntc) thermistor, which can be regarded as a temperature-sensitive resistor that pre-



**Fig 3** Precision over-temperature alarm with thermistor sensor



**Fig 4** Precision under-temperature alarm with thermistor sensor



**Fig 5** 800Hz pulsed-tone under-temperature alarm with thermistor sensor

sents a high resistance at low temperatures and a low resistance at high temperatures.

Figures 3 to 5 show some practical thermistor-activated alarm circuits. In each case, the thermistor (TH1) can be any ntc device that offers a resistance in the range 1K0 to 10K (5K0 nominal) at the desired operating temperature.

Figure 3 shows how ntc thermistor TH1 can be used in conjunction with a 741 op-amp and a transistor-driven relay to make a precision over-temperature alarm which activates an external alarm-call generator via contacts RLA/1.

Here, the op-amp is wired as a voltage comparator with a fixed half-supply reference voltage fed to its pin-2 inverting input via R1-R2, and with a temperature-dependent variable voltage fed to its pin-3 non-inverting input via potential divider RV1-TH1.

The action of the RV1-TH1 divider is such that the pin-3 voltage of the op-amp rises as the TH1 temperature falls, and vice versa, and almost equals the pin-2 voltage at the desired 'alarm' temperature.

Thus, when the TH1 temperature is below the required alarm value the pin-3 voltage of the op-amp is above that of pin-2, so the op-amp output (pin-6) is driven to positive saturation and zero base drive is applied to Tr1. Relay RLA is thus off under this condition. As the TH1 temperature rises, the pin-3 voltage falls, until eventually (at the desired alarm temperature value) the pin-3 voltage falls below that of pin-2 and the op-amp output swings into negative saturation, thereby applying base bias to Tr1 via R4.

Under this condition, RLA turns on and activates the external alarm-call generator via contacts RLA/1. Because of the

high voltage gain of the 741 op-amp, the relay can be turned on or off by TH1 temperature variations of a fraction of a degree around the required trip value, which can be pre-set via RV1.

Note that the action of the above circuit can be reversed, so that it acts as a precision under-temperature alarm, by simply transposing the pin-2 and pin-3 input connections of the op-amp as shown in *Figure 4*. Alternatively, the action of *Figure 3* circuit can be reversed by simply transposing TH1 and RV1.

*Figure 5* shows the circuit of an 800Hz pulsed-tone under-temperature alarm using a thermistor sensor.

This circuit is similar to that of *Figure 2*, in that IC1 is wired as a dual-astable pulsed-tone generator that can be gated on by pulling pin-1 towards the zero volts rail, or turned off by pulling pin-1 towards the positive supply rail. In *Figure 5* pin-1 is connected to the TH1-RV1 junction, which generates a low voltage at low TH1 temperatures and a high voltage at high temperatures.

Thus, the IC1 dual-astable activates when the TH1 temperature falls below a value pre-set via RV1, and thence generates a pulsed-tone signal in the speaker.

In practice, the precise 'gating' point of the IC1 CMOS chip is determined by a parameter known as the 'threshold voltage value' of the IC.

This threshold voltage is not a fixed value, but is equal to a fixed percentage of the IC's supply voltage, as in the case of a resistive potential divider. Consequently, the *Figure 5* circuit switches from the OFF to the ON state, or vice versa, when the TH1-RV1 ratios go above or below a precisely defined value.

This ratio is independent of the supply voltage, but does depend on the threshold value of the individual IC. The ratio has a nominal value of 50%, but may vary from 30% to 70% between individual ICs.

What the above means in practice is that the *Figure 5* circuit has excellent stability, and has a typical sensitivity of about 0.5°C. The under-temperature trip point can be pre-set via RV1. Note that this circuit can be converted to an over-temperature alarm by simply transposing TH1 and RV1.

### Diode-activated alarms

An ordinary silicon diode can easily be used as an accurate and very inexpensive temperature-sensing element in an alarm system.

Typically, a silicon diode generates a forward voltage drop of about 600mV at a current of 1mA. If this current is held constant, the voltage drop changes by about -2mV for each degree centigrade increase in diode temperature, thus exhibiting a temperature coefficient of about -2mV/°C.

All silicon diodes have similar thermal

characteristics. The small mass of a silicon signal diode such as the 1N4148 ensures that the device has a rapid thermal response time, and the device thus makes an excellent and accurate temperature sensor.

*Figure 6* shows how a 1N4148 can be used as a thermal sensing element in an op-amp over-temperature alarm circuit.

Here, Zener diode ZD1 generates a constant 5.6 volts across the two potential dividers formed by R1-RV1 and R2-D1. A constant reference voltage is thus developed between the ZD1-R3 junction and pin-2 of the op-amp, and a temperature-dependent voltage with a -2mV/°C thermal coefficient is developed between the ZD1-R3 junction and pin-3 of the op-amp. A differential voltage with a -2mV/°C temperature coefficient thus appears between pins 2 and 3 of the op-amp.

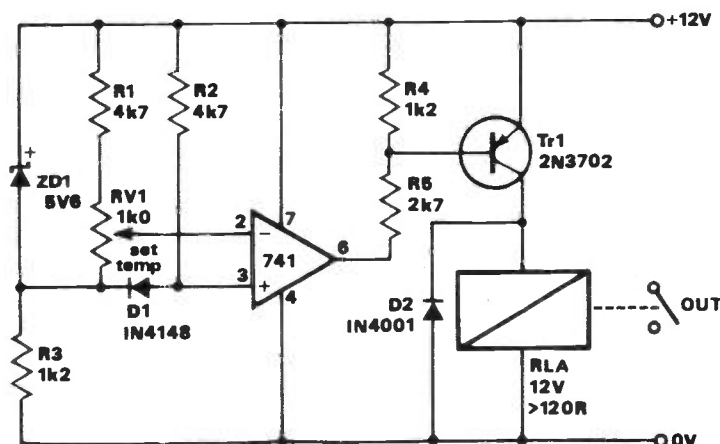
In practice, this circuit is set up by

simply raising the D1 temperature to the required trip level, and then slowly adjusting RV1 so that the relay just turns on. Under this condition a differential of about 1mV appears between pins 2 and 3 of the op-amp, and Tr1 and the relay are driven on.

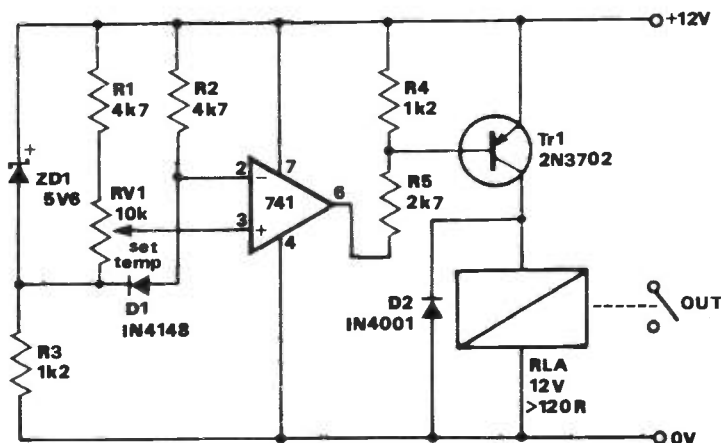
When the D1 temperature falls below the trip level, the pin-3 voltage rises above that of pin-2, driving the op-amp output to positive saturation and thus turning Tr1 and the relay off.

The circuit has a typical sensitivity of about 0.5°C, and can be used as an over-temperature alarm at temperatures ranging from sub-zero to above the boiling point of water.

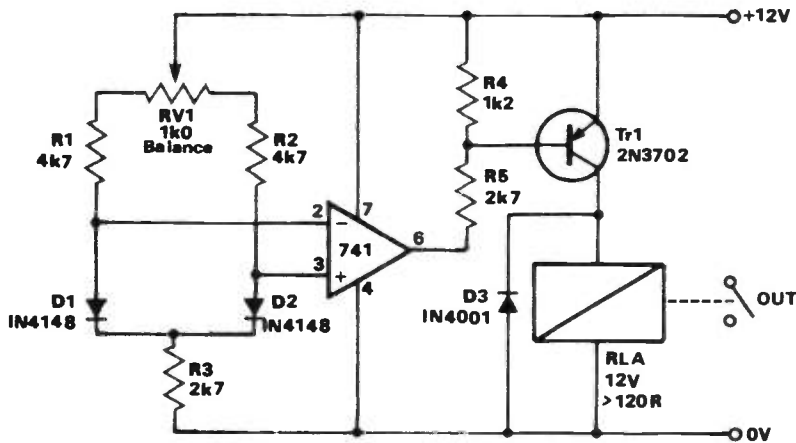
Note that the operation of the above circuit can be reversed, so that it acts as a wide-range under-temperature alarm, by simply transposing the pin-2 and pin-3 connections of the op-amp. *Figure 7* shows the connections.



**Fig 6** Over-temperature alarm with silicon diode temperature sensing element (D1)



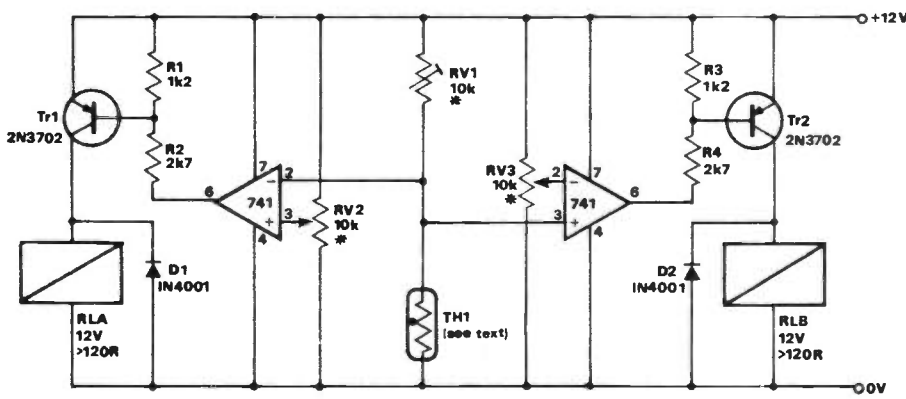
**Fig 7** Under-temperature alarm using silicon diode temperature sensing element



**Fig 8** Differential-temperature alarm using silicon diode sensors

Finally, *Figure 8* shows how a pair of 1N4148 diodes can be used as sensors in a differential-temperature alarm, which turns on only when the D1 temperature is more than a pre-set amount greater than that of D2, and is not influenced by the absolute temperatures of the two diodes.

Here, bias currents are fed to the two diodes via RV1, which enables a fixed 'offset balance' differential voltage to be set between pins 2 and 3 of the op-amp, thereby setting the differential trip temperature value of the circuit. Once set, this voltage is influenced only by the difference between the D1 and D2 temperatures. This circuit has a typical sensitivity of about 0.5°C, and can accommodate temperature differentials of up to 10°C.



- \* RV1: Set nominal half supply voltage
- \* RV2: Set under-temp trip value
- \* RV3: Set over-temp trip value

**Fig 9** Temperature-deviation alarm with independent over/under-temperature relay outputs

### Temperature-deviation alarms

Temperature-deviation alarms activate whenever a monitored temperature deviates from a pre-set value by more than a specific amount, ie when the temperature goes above a pre-set upper limit or below a pre-set lower limit. Such alarms are useful for monitoring tropical fish tanks or greenhouses, etc.

A temperature deviation alarm can be made by simply combining a standard over-temperature switch and an under-temperature switch in such a way that they share a common sensing device and drive a common alarm unit.

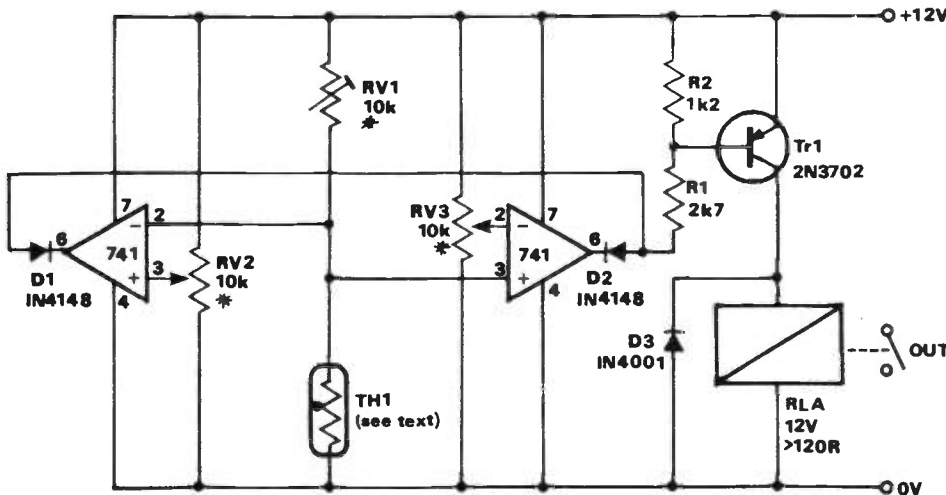
*Figures 9 and 10* show two practical examples of such a circuit. The *Figure 9* design provides independent relay outputs, with RLA providing under-temperature action and RLB providing over-temperature action. The *Figure 10* circuit uses a single relay to activate an external alarm-call generator if the TH1 temperature goes beyond pre-set limits.

In *Figure 9 and 10*, TH1 is an ntc thermistor with a resistance in the range 1K0 to 10K (5K0 nominal) at the middle trip-range temperature.

To set up each circuit, first adjust RV1 so that half-supply voltage appears on the RV1-TH1 junction when TH1 is at the nominal mid-range temperature value.

Next, set TH1 to the required lower-temperature trip value, and then adjust RV2 so that RLA just turns on.

Finally, raise the TH1 temperature to the desired upper trip value, and then adjust RV3 so that the appropriate relay (RLB in *Figure 9*, RLA in *Figure 10*) just turns on. All adjustments are then complete.



- \* RV1: Set nominal half supply voltage
- \* RV2: Set under-temp trip value
- \* RV3: Set over-temp trip value

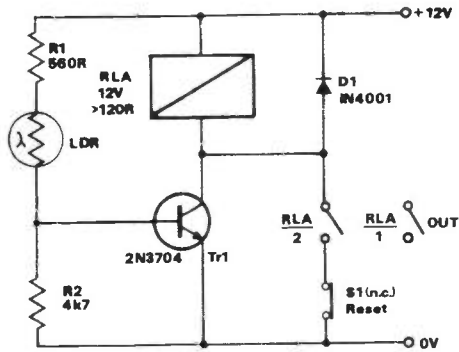
**Fig 10** Temperature-deviation alarm with single relay output

### Light-sensitive alarms

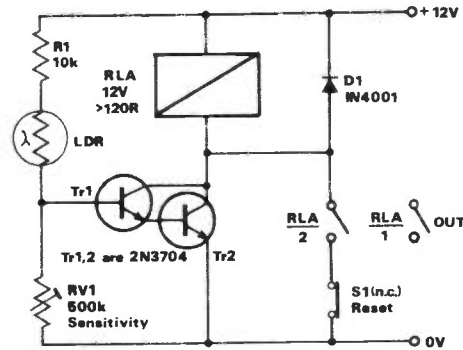
Light-sensitive alarms can easily be made to activate when light enters a normally-dark area such as the inside of a storeroom or wall safe, or when smoke interferes with the passage of a light source.

A number of useful domestic light-sensitive alarm circuits are shown in *Figures 11 - 15*. All of these circuits





**Fig 11** Simple self-latching light-activated alarm



**Fig 12** Improved light-activated alarm

use an LDR (light-dependent resistor) as a light-sensing element. The LDR is a cadmium-sulphide photocell, and acts as a variable resistor that presents a high resistance (hundreds of kilohms) under dark conditions, and a low resistance (hundreds of ohms) when brightly illuminated.

Each of the *Figure 11 to 15* circuits will work with almost any general-purpose LDR with a face diameter in the range 3mm to 12mm.

*Figure 11* shows a simple self-latching light-activated alarm, designed to activate when light enters a normally-dark area.

Here, LDR-R1 and R2 form a potential divider that determines the base-bias of Tr1. Under dark conditions the LDR has a very high impedance, so zero base-bias is applied to Tr1, and Tr1 and RLA are off. When a significant amount of light falls on the LDR face, the LDR resistance falls to a relatively low value and base-bias is applied to Tr1, which thus turns on and activates an external alarm-call generator via the RLA/1 relay contacts.

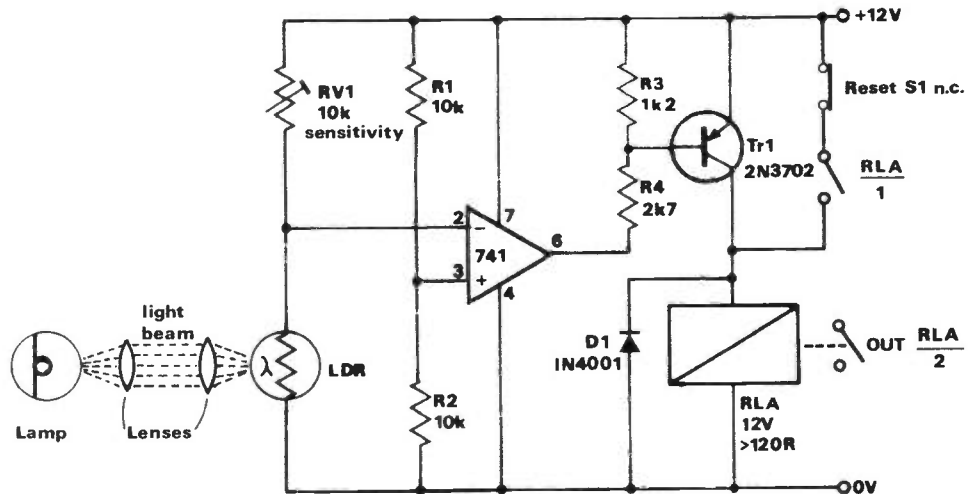
The simple *Figure 11* circuit has fairly low sensitivity, and has no facility for sensitivity adjustment. *Figure 12* shows how these defects can be overcome by using a Darlington-connected pair of transistors in place of Tr1, and by using sensitivity control RV1 in place of R2.

Note that the *Figures 11 and 12* circuits can be made to give a non-latching action by simply eliminating the RLA/2 set of relay contacts.

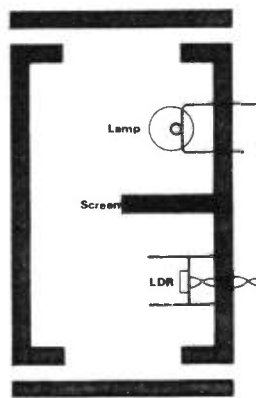
An LDR can be used to make a smoke alarm in either of two basic ways.

The most obvious way is to project a light beam on to the LDR face, and adjust the circuit sensitivity to such a level that the small decrease in light level (and increase in LDR resistance) caused by the intrusion of smoke in the beam is sufficient to cause the alarm to activate. *Figure 13* shows the practical version of such a circuit.

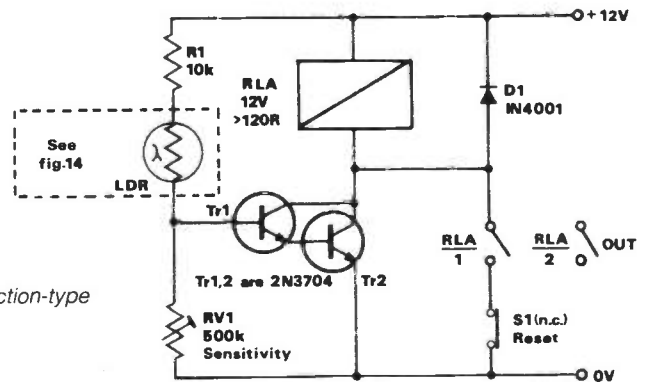
The alternative (and more satisfactory) way of making a smoke-activated alarm is to use the 'reflective' principle shown in *Figure 14*, which in the presence of smoke causes an increase in the light level in the LDR face.



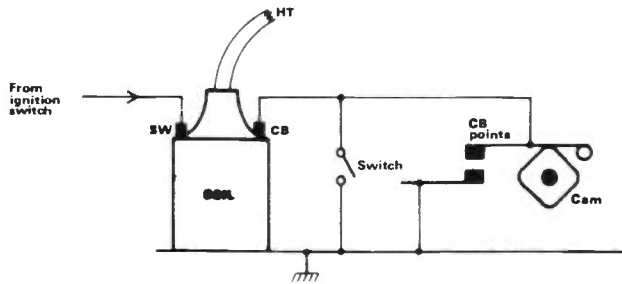
**Fig 13** Light-beam smoke alarm



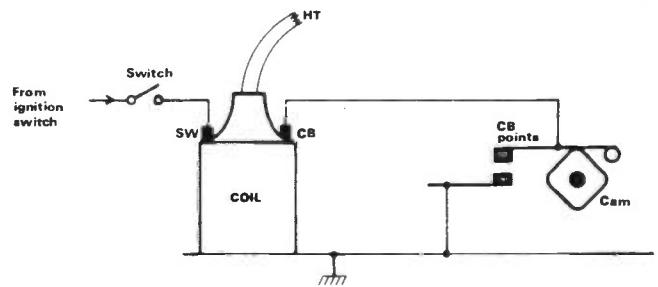
**Fig 14** Sectional view of reflection-type smoke detector



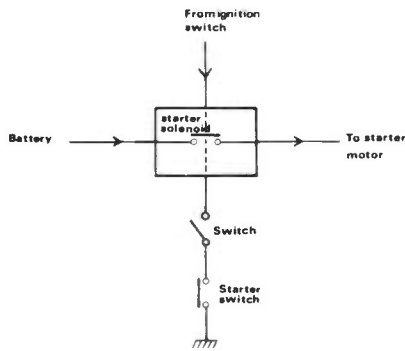
**Fig 15** Reflection-type smoke alarm



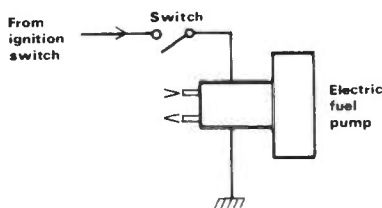
**Fig 16** Contact-breaker immobiliser



**Fig 17** Ignition immobiliser



**Fig 18** Starter-motor immobiliser



**Fig 19** Fuel-pump immobiliser

Here, the lamp and the LDR are mounted in an 'open ended' but light-excluding box, in which an internal screen prevents the lamplight from falling directly on the LDR face.

The lamp is a source of both light and heat, and the latter causes convection currents of air to be drawn in from the bottom of the box and to be expelled through the top. The inside of the box is painted matt black, and the construction lets air pass through the box but excludes external light.

Consequently, if the convected air currents are smoke free no light falls on the LDR face, and the LDR presents a very high resistance.

If the currents do contain smoke, however, the smoke causes the light of the lamp to reflect onto the LDR face and so causes a great decrease in the LDR resistance, which can easily be detected. *Figure 15* shows the practical circuit of a reflective type of smoke alarm.

### Car Immobiliser circuits

Vehicle anti-theft devices come in two basic types, one of these being the so-called 'immobiliser' and the other being the true 'burglar alarm'.

Immobiliser circuits are intended to simply reduce the thief's chances of starting or driving away a target vehicle; they give no protection against the burglar who merely wishes to steal objects that are left inside the vehicle. Immobilisers simply consist of a switch wired into some part of the electrical

section of the vehicle's power unit, thus allowing the engine to be easily disabled.

It should be noted that all non-diesel-powered cars are fitted with an immobiliser in the form of the ignition switch, which is wired between the battery and the ignition coil. To steal a car, thieves simply by-pass this switch, either by shorting it out directly, or by connecting a jumper lead between the battery and the coil.

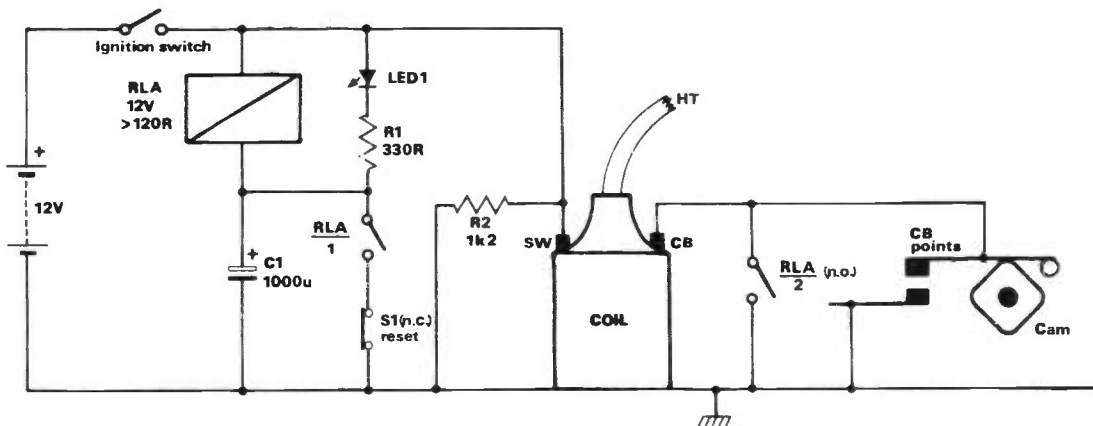
A thief's chances of stealing the vehicle can be greatly reduced by fitting an additional (concealed) immobiliser switch, and *Figures 16 to 19* show four alternative methods.

In *Figure 16*, the immobiliser switch is wired across the vehicle's contact breaker (C-B) points, and disables the vehicle when the switch is closed. This circuit gives excellent protection, particularly if the wiring is carefully concealed at the C-B end.

In *Figure 17*, the immobiliser switch is wired in series with the vehicle's ignition switch so that the engine operates only when the switch is closed.

The protection of this circuit is not as good as that of *Figure 16*, since a skilled thief can by-pass the immobiliser and ignition switches by hooking a jumper lead from the battery to the SW terminal of the coil.

*Figure 18* shows how the vehicle can be protected by fitting the immobiliser in series with the starter-motor solenoid, and *Figure 19* shows how it can be fitted



**Fig 20** Self-activating C-B immobiliser circuit

in series with the vehicle's electric fuel pump. In the latter case, the thief can start the engine but can drive only a short distance before the lack of fuel-pump operation immobilises the vehicle.

A weakness of the *Figure 16* and *19* circuits is that they must be turned on and off manually, and thus give protection only if the owner remembers to turn them on.

By contrast, *Figure 20* shows an immobiliser that turns on automatically when an attempt is made to start the engine via the ignition switch, but that can be turned off by briefly operating a hidden push-button switch (S1). A small reminder light (LED1) turns on when the engine is disabled by the immobiliser. This circuit is shown with *Figure 16*-type immobiliser protection provided via relay contacts RLA/2.

The circuit gives a very high degree of protection, since it does not depend on the memory of its owner.

**Car anti-theft alarms**

A car anti-theft alarm should sound an alarm (and perhaps also immobilise the vehicle's engine) if any unauthorised person tries to enter the vehicle.

The system must be provided with some means of turning the alarm on and off, and the on/off switch may be inside the vehicle, or can be fitted externally. If the switch is fitted internally, however, the system must inevitably incorporate some kind of time delay circuitry to enable the owner to enter and leave the vehicle without sounding the alarm. Typically, such a system may provide an exit delay of 30 seconds and an entry delay of 15 seconds.

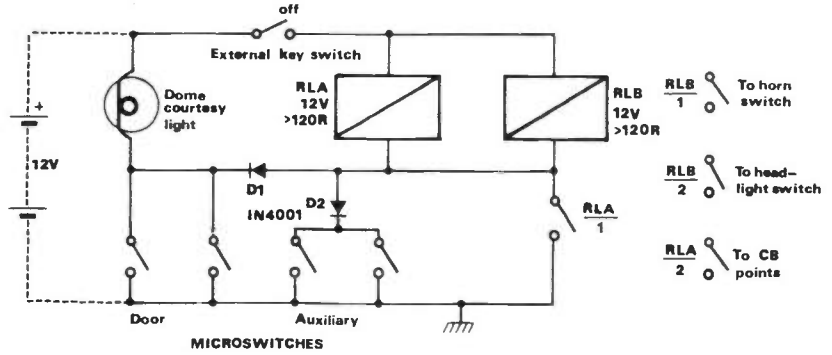
Consequently, alarm circuits that use internal on/off switches tend to be fairly complex and expensive, and thus have a fairly poor reliability rating. More importantly, they give poor anti-burglar protection, since thieves are given a full 15 seconds of entry time in which to steal any worthwhile goodies before the alarm goes off.

By contrast, externally-switched alarm systems can be very simple, reliable and inexpensive, and, since they can be made to sound off the instant a car door starts to open, can give excellent anti-burglar protection. *Figures 21* to *23* show some useful alarm circuits of the latter type.

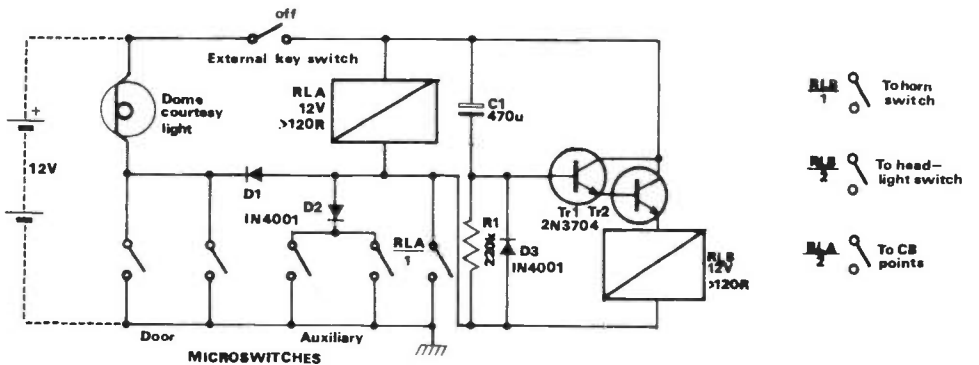
The *Figure 21* design is a purely electro-mechanical circuit. If either door-mounted microswitch (accessible via the vehicle's 'dome' or 'courtesy' light) closes, relays RLA and RLB are driven on via D1.

Similarly, if either of the 'auxiliary' microswitches (fitted to the vehicle's hood and trunk) close, RLA and RLB are turned on via D2.

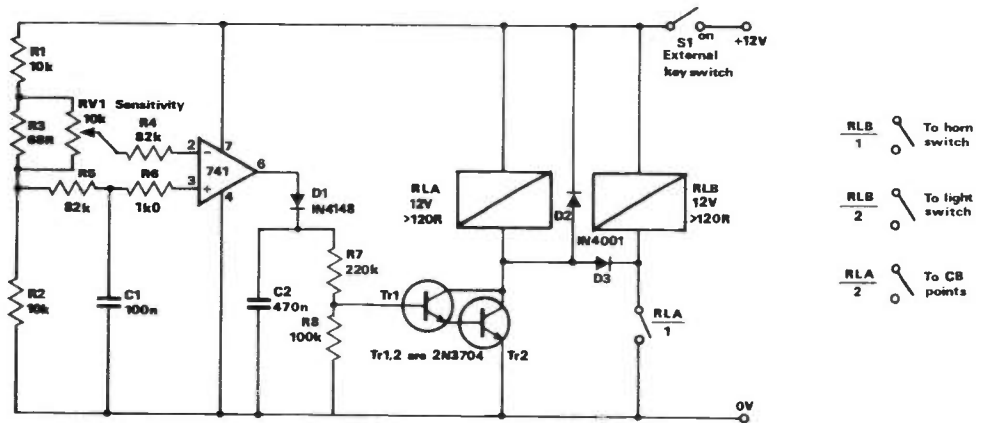
In either case, the relays are self-latched via contacts RLA/1 and the vehicle is disabled via RLA/2, and-



**Fig 21** Simple microswitch-activated anti-theft alarm/immobiliser



**Fig 22** Improved microswitch-activated anti-theft alarm/immobiliser turns horn and lights off automatically after four minutes



**Fig 23** Voltage-sensing anti-theft alarm/immobiliser

simultaneously the horn and headlights are activated via contacts RLB/1 and RLB/2 respectively.

A minor disadvantage of the *Figure 21* circuit is that, if the unit is activated, the horn and lights operate until the system is either turned off by the owner or until the vehicle's battery goes flat.

This defect can be overcome by modifying the circuit as shown in *Figure 22*, so that RLB turns off automatically after approximately four minutes (determined by R1 and C1).

Finally, to complete this survey of security-alarm systems, *Figure 23* shows the circuit of a 'voltage sensing' car alarm, which detects the small but

sudden drop that occurs in battery voltage when a courtesy light or ignition switch, etc. is turned on, thereby enabling the alarm to be activated by the vehicle's battery rather than by a number of microswitches.

In *Figure 23*, C1 effectively 'remembers' the mean value of the battery voltage and applies this value to pin-3 of the op-amp, while the instantaneous battery value is fed to pin-2. If the instantaneous value falls significantly below the mean value, the op-amp output switches high, driving RLA on via Tr1-Tr2 and thereby disabling the ignition system via RLA/2, and activating the horn and headlights via RLB.

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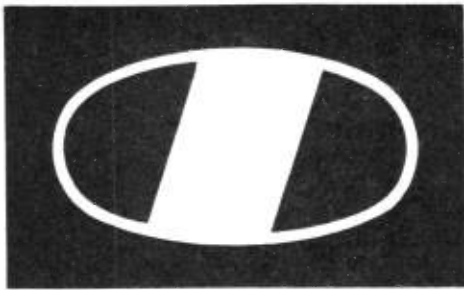


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IR 106a..... <b>20p</b> IR 3051..... <b>10p</b>	TIP 29..... <b>30p</b> TIP 30..... <b>35p</b> TIP 30A..... <b>35p</b> TIP 30B..... <b>40p</b> TIP 30C..... <b>45p</b> TIP 31..... <b>30p</b> TIP 32..... <b>25p</b> TIP 33B..... <b>50p</b> TIP 33C..... <b>70p</b> TIP 34A..... <b>50p</b> TIP 34B..... <b>80p</b> TIP 34C..... <b>70p</b> TIP 35B..... <b>50p</b> TIP 35C..... <b>70p</b> TIP 35D..... <b>80p</b> TIP 36..... <b>50p</b> TIP 36C..... <b>70p</b> TIP 41B..... <b>40p</b> TIP 41D..... <b>70p</b> TIP 42/BRC 6109..... <b>30p</b> TIP 48..... <b>40p</b> TIP 49..... <b>30p</b> TIP 57..... <b>30p</b> TIP 100..... <b>30p</b> TIP 102..... <b>30p</b> TIP 112..... <b>30p</b> TIP 115..... <b>30p</b> TIP 117..... <b>50p</b> TIP 120..... <b>35p</b> TIP 125..... <b>35p</b> TIP 130..... <b>30p</b> TIP 131..... <b>25p</b> TIP 136..... <b>30p</b> TIP 140..... <b>50p</b> TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
IS 164..... <b>10p</b> IS 521..... <b>10p</b> IS 3011a..... <b>10p</b> IS 3072a..... <b>10p</b> IS 5024a..... <b>50p</b> IS 5030..... <b>50p</b>	BU 508A..... <b>£1.20</b> BU 526..... <b>75p</b> BU 807..... <b>£1</b> BUX 84..... <b>60p</b> BUW 84..... <b>30p</b> BUY 71..... <b>£1</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
IT 921..... <b>10p</b> IT 923..... <b>10p</b> IT 1075..... <b>10p</b> IT 2001..... <b>10p</b> IT 2002..... <b>10p</b> IT 4150..... <b>10p</b>	TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
ZE 1.5..... <b>10p</b>	TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
ZF 3, 3.3, 4.3, 10, 11, 12, 15, 33, 43, 47, 82..... <b>10p</b>	TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
ZPD 3.9, 4.7, 5.6, 10, 47..... <b>10p</b>	TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
ZPY 8v2, 12, 16, 24, 43, 47, 56..... <b>10p</b>	TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
ZTK 22..... <b>10p</b> ZTK 33..... <b>10p</b> ZTK 33a..... <b>10p</b>	TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
ZW 13..... <b>12p</b> ZW 27..... <b>10p</b> ZW 4-3..... <b>10p</b> ZW 310..... <b>10p</b>	TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
ZX 68..... <b>30p</b>	TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20p</b> Thorn panel 6x100 pot + changeover switch (Irish)..... <b>50p</b> Battery converter TA 75 for colour TV. 12/24v Thorn 3787..... <b>£8</b> Thorn 3500 2A cut out..... <b>75p</b> Stereo GEC amp 20 watt + pre-amp with 4 pots + mains power unit with circuit..... <b>£8</b>
ZY 47..... <b>10p</b> ZY 72..... <b>10p</b>	TIP 147..... <b>50p</b> TIP 640..... <b>80p</b> TIP 2955..... <b>35p</b> T 8032..... <b>30p</b> T 8040..... <b>40p</b> T 8046..... <b>40p</b> T 6047..... <b>40p</b> T 6049..... <b>40p</b> T 6051..... <b>40p</b> T 6052..... <b>40p</b> T 9004..... <b>40p</b> T 9005..... <b>40p</b>	G820 turn 100K pot..... <b>35p</b> Transformer 240v/20v..... <b>75p</b> 500mA..... <b>75p</b> Viewdata torroids..... <b>£8</b> CVC 20 tube base..... <b>£2</b> Tube Base Rank & G11..... <b>£1.20</b> Sankyo tape motor..... <b>75p</b> Swiss made 250rpm/240V motor very small..... <b>75p</b> Mono scan coil 110" small neck..... <b>£1.50</b> Infra red led..... <b>15p</b> LD57CA..... <b>£3</b> Mono scan coil..... <b>£3</b> G 8 transductor..... <b>£1</b> AT 4041/41 transductor..... <b>£1</b> 2K5 Lin pot with 40mm spindle..... <b>20p</b> 1982 Hitachi Ae isolator..... <b>50p</b> Mullard FM decoder 1401..... <b>£1</b> Philips service pack, flat films, 57 condensers 56nF-2.2uF..... <b>£2</b> VHF 3 Transistor rotary tuner DX-TV..... <b>£1</b> 15K-20 turn pots..... <b>20</b>



## A beginner's guide to the Field Effect Transistor, by James Dick

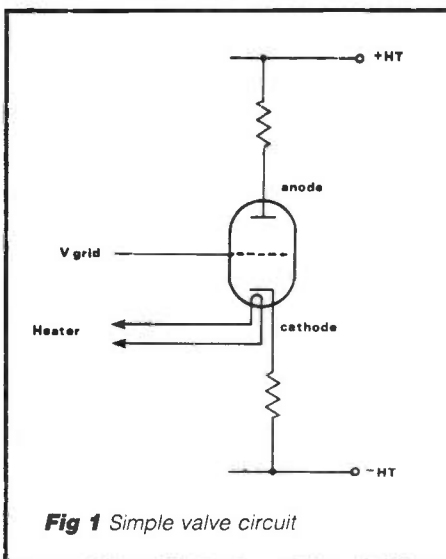


Fig 1 Simple valve circuit

The Field Effect Transistor (FET) has had a bad press over the last few years. Its characteristics are distinctly valve-like, and perhaps this association with a departing technology is responsible for the FET's archaic image.

Reality, however, is rather different. The FET is making a comeback in nearly all areas of electronics: it is increasingly used in op-amps, as a discrete device in power audio and radio-frequency output stages, and, particularly, in digital circuitry. Perhaps we need to re-discover the FET. Its wide range of uses (from

amplifiers to 32-bit microprocessors) certainly invites our curiosity.

### In the beginning

Before we look at how the FET can be used, we need to understand how it works.

Figure 1 shows a simple valve with anode, cathode and grid. Electrons, boiled off the cathode by the heater, are attracted to the positive anode. Hence, they stream across the valve and are responsible for the current 'flowing' in the valve.

If a negative potential is applied to the grid, the electron flow is partly reduced because some of the (negative) electrons are repelled by the like-sign charge on the grid.

If the grid is made increasingly negative, a point is reached when the cathode-anode current is almost zero. This simple valve model can be applied to the FET because the action is very similar.

Figure 2 represents the physical construction of an N-channel FET: a bar of N-type semiconductor (with its ends called DRAIN and SOURCE) surrounded by P-type semiconductor (with a connection called GATE).

The circuit in Figure 3a shows a FET connected up and Figure 3b represents what is happening, electrically, inside. With the drain positive, a current flows from the drain to the source - perhaps it is less confusing to say that electrons enter at the source, flow along the semiconductor channel and exit at the drain.

If the gate is made negative relative to the source, virtually no current will flow in the gate because it behaves like a reverse-biased diode.

However, the potential on the gate sets up an electric field in the channel. Just as in the valve, this field controls the magnitude of the current flowing in the channel - to the point that if it is sufficiently strong, the channel current will cease flowing. Hence the name 'Field Effect Transistor'.

### 'N'-channel

Figure 3 shows an 'N-channel' FET: the semiconducting channel is of N-type material. A 'P-channel' type is also available - circuit polarities are reversed.

Both the N- and P- type FETs described are junction devices. The gate electrically joins the channel and, if forward-biased, would conduct current. Since JFETs are used because the gate

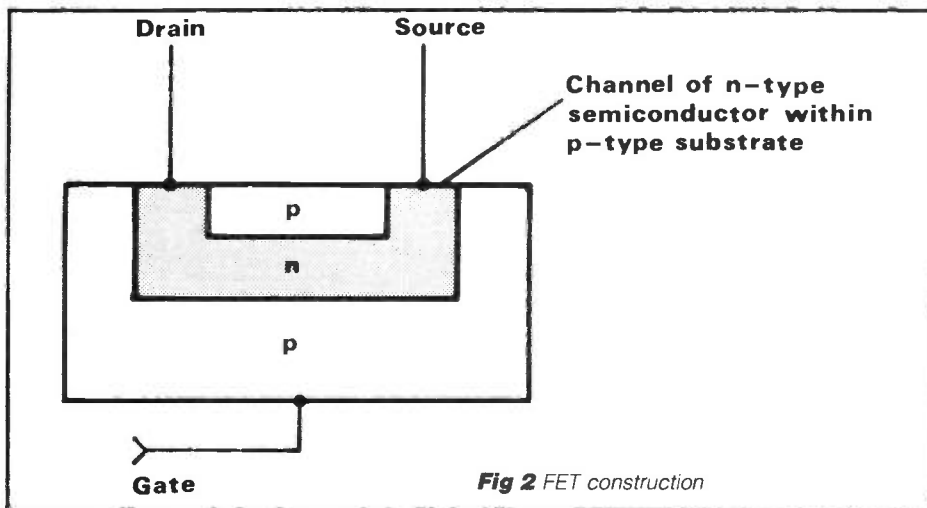


Fig 2 FET construction

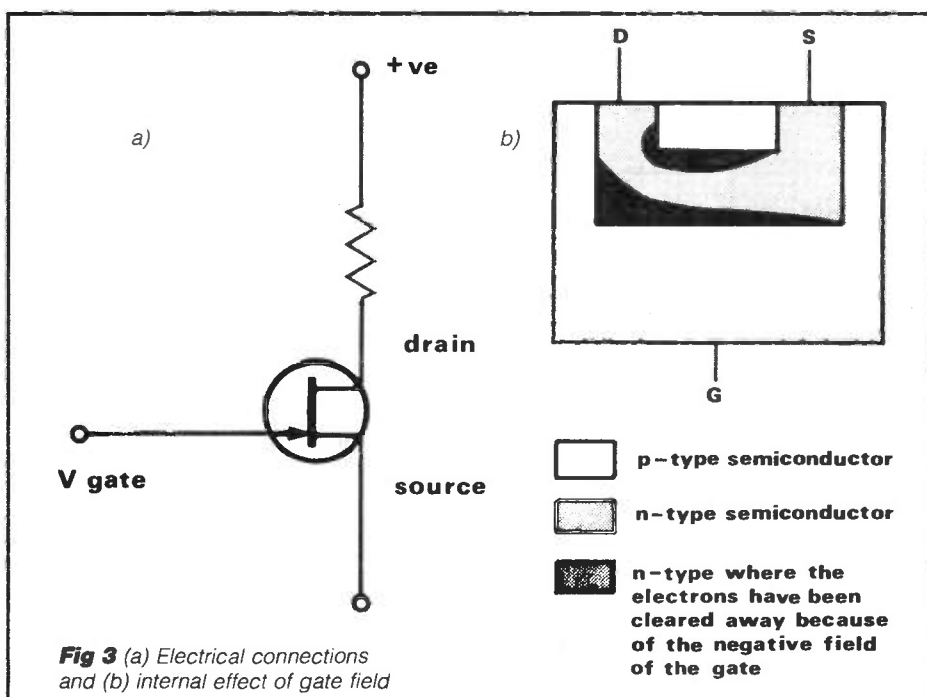


Fig 3 (a) Electrical connections and (b) internal effect of gate field

# HART

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After a little interesting manipulation, this reduces to:

$$C_N = 16\epsilon_{22} \hat{k}_{26}^2 \sin^2 \bar{S}_{NY} \ell \sin^2 \bar{y}_{NE} b / N^2 \gamma^2 \bar{S}_{NE}^2 \bar{y}_{NE}^2 L_{NTE} h$$

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# FETs

potential, which controls the channel current, requires only a few nano-amperes to maintain it, the forward-biased gate will cause circuit failure.

Another type of FET is the Insulated Gate FET (IGFET, for short). Here, a thin layer of silicon dioxide (glass) is grown between the FET channel and the gate, hence their alternative name – Metal Oxide Semiconductor FET (MOSFET). MOSFETs are available in two types: depletion- and enhancement-mode.

Depletion MOSFETs behave rather like JFETs. As the gate voltage becomes increasingly reverse-biased, the channel current decreases and eventually ceases.

Enhancement devices are nearly the opposite in character: with gate and source at equal potentials, no current passes in the channel – only when the gate becomes forward biased does current flow in the channel.

Remember that no gate current will flow in a MOSFET (even when it is forward biased) because of the insulating layer between the gate and the channel. *Figure 4* shows the symbols used for JFETs and MOSFETs.

## FET characteristics

Since all FET types have a certain commonality in electrical behaviour, it is possible to look at one type – an N-channel JFET – to gain an insight into FET characteristics. *Figure 5* shows the circuit that was used and the results discussed are in *Figure 6*.

*Figure 6* has the voltage between drain and source plotted on the x-axis, and the current passed through the channel on the y-axis. The curves plotted on the graph show the relationship between the current through, and the voltage across the device for different voltages applied between the gate and the source.

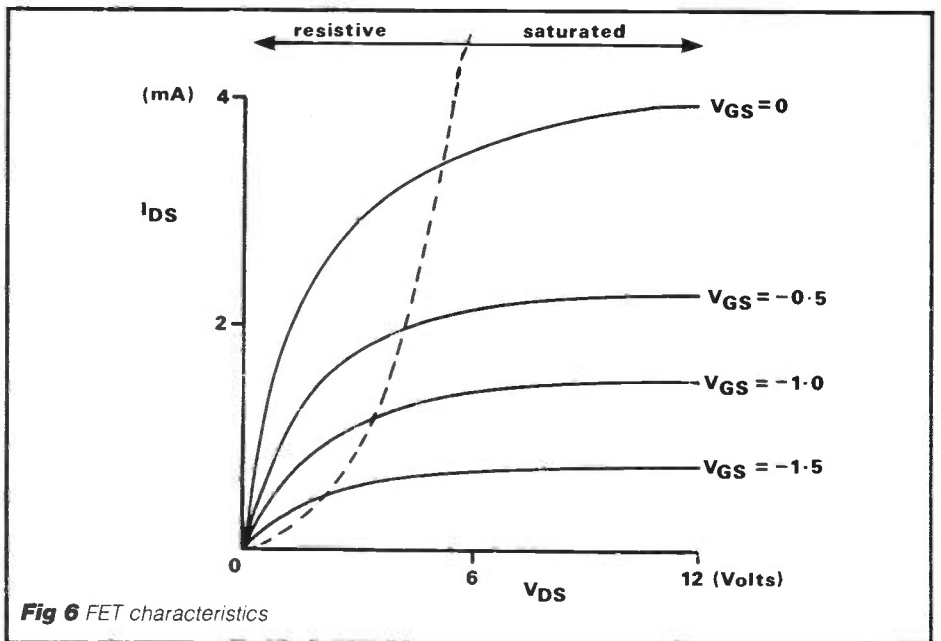
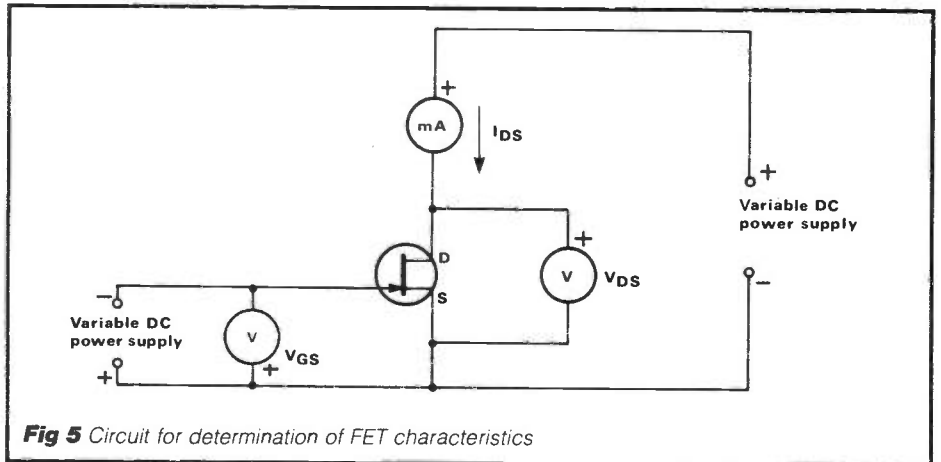
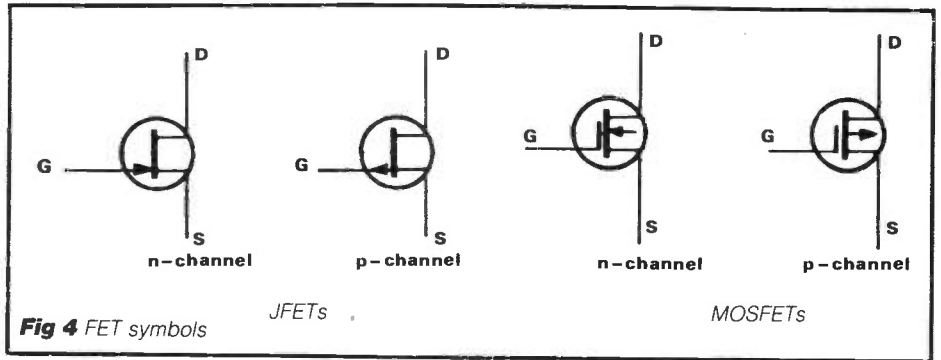
The voltage control of channel current can be clearly seen – as the gate/source voltage becomes more negative, the current (regardless of drain source voltage) decreases.

Indeed, at voltages around -2.5V, the current has been effectively stopped. This voltage is known as the 'pinch-off' voltage,  $V_p$ , and it is an important parameter in the FET's characteristics.

The dotted line in *Figure 6* splits the FET characteristic curve into two: the saturated and resistive regions.

The saturated region is where the FET has its channel current determined only by the gate/source voltage – ie the current is independent of the drain/source voltage (within operational limits). Note that this is particularly true as the gate/source voltage approaches the pinch-off limit.

When the gate is tied directly to the source (the gate/source voltage then being zero), the current passed through the channel is referenced as  $I_{DSS}$ , which is normally obtained for a known drain/



source voltage, allowing the channel current at a given gate/source voltage to be calculated from

$$I_{DS} = I_{DSS} \left[ 1 - \frac{V_{GS}}{V_P} \right]^2$$

when the FET is operated within the saturation region.

We shall return to this region when the

FET is considered as an amplifier.

The other region of the FET's characteristic plot, the resistive region, is also shown in *Figure 6*. Again, of course, the drain/source voltage and channel current are shown for various gate/source voltages.

However, unlike the behaviour in the saturation region, the current in the channel is now dependent on the drain/source voltage – indeed, the lines



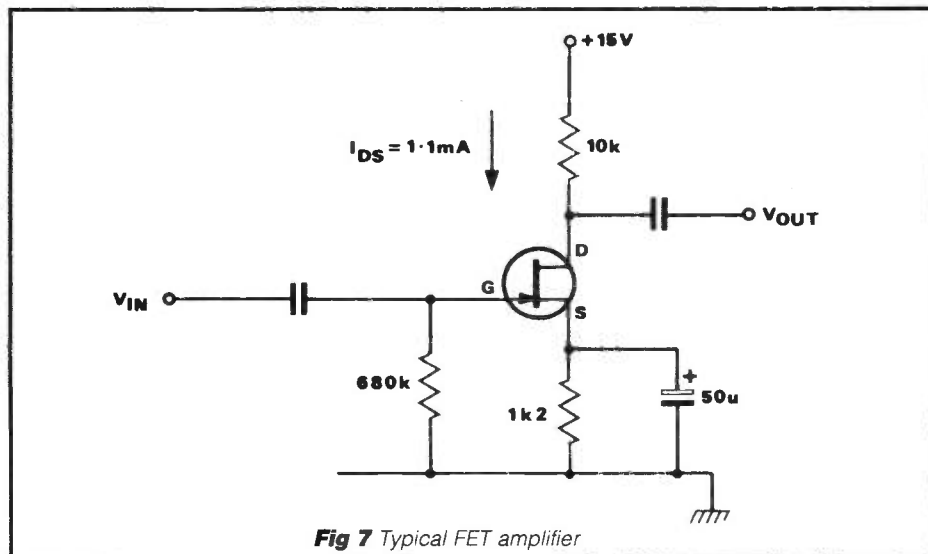


Fig 7 Typical FET amplifier

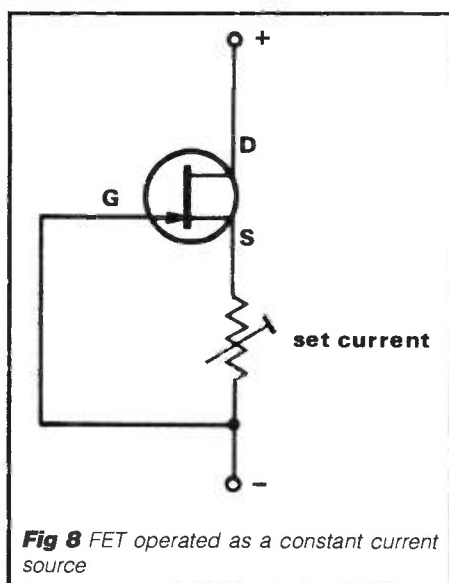


Fig 8 FET operated as a constant current source

Figure 7 shows a typical circuit of a simple FET amplifier – note that apart from a different bias arrangement, the basic layout is similar to that of a bipolar (NPN) transistor amplifier.

In its amplifier mode, the FET is operated in the saturation region and so acts as a voltage-controlled current source.

If the current from drain to source is plotted as a function of gate-source voltage, the results are:

$V_{GS}$	$I_D / \text{mA}$
-1.1	1.44
-1.3	1.16
-1.5	0.9
-2.0	0.4

The voltage across the drain resistor is governed by the channel current – so the gate-source voltage essentially controls the potential at the drain.

The ability to change a voltage (at the gate) into a current (in the channel) is called transconductance, and quantitatively identified by the symbol  $g_m$  where

$$g_m = g_{m0} \left( \frac{I_{DS}}{I_{DSS}} \right)^{1/2}$$

and  $g_{m0}$  is a constant which depends on the FET's manufactured qualities. It is always quoted by the manufacturers and suppliers on their data sheets, and is called the common-source transconductance.

The gain of the amplifier is given by

$$\text{Gain} = -g_m R_d$$

where  $R_d$  is the drain resistance.

This equation is relatively straightforward to understand. The value of  $g_m$  tells us how good the FET is at changing a variable voltage at the gate into a variable current, and the voltage across the drain resistor is found from multi-

plying its resistance by the current through it (Ohm's Law).

From the table we see that a change of 0.01 volts (at  $I_{DS} \approx 1\text{mA}$ ) will result in a 10 microamp change in channel current. For a 10 kilohm drain resistor, this will mean a fluctuation of 0.1 volts: hence, a voltage gain.

The value of gain obtained with FET amplifiers is generally less – perhaps by a factor of 50 – than a similar bipolar transistor circuit. Hence, FETs are seldom used for general purpose amplifiers.

Their main advantage is a very high input impedance –  $10^{14}$  ohms is possible. In common amplifier circuits, the input impedance is limited by the bias resistors but, since they have virtually no current passing through them, these may have a high value – typically, a few megohms.

The high input impedance is well suited to capacitor microphones, buffer circuits in instruments, and any other application where a signal must be loaded as lightly as possible.

## Design

The basic steps to design a simple FET amplifier are:

- 1) Choose the required channel current (a few mA, say).
- 2) Calculate the gate/source voltage which is needed to set the channel current (from the first equation).
- 3) Calculate  $g_m$  at the chosen current.
- 4) Find  $R_d$  for the required gain.
- 5) Find  $R_s$  from Ohm's Law ( $R_s$  passes the channel current and must have the gate/source voltage across it).
- 6) Check that the FET is in the saturation region (suitable  $V_{DS}$ ) and that the supply voltage is suitable (it must equal  $I_{DS} R_s + V_{DS} + I_{DS} R_d$ ).

Designing a FET circuit tends to give the impression that it is less simple than a bipolar circuit. To a certain extent this is true – but then the design of a high-impedance bipolar amplifier would not be easy. In general, fairly modest gains and relatively high supply voltages have to be used.

FETs can also be used as current sources. Note that, in Figure 5, the channel current ( $I_{DS}$ ) is independent of the drain/source voltage when the device is operated in the saturation region, and has its value set by the voltage between the gate and source.

Figure 8 shows a FET current source. The variable resistor allows the current to be set, and also allows compensation for the wide range in FET parameters that is encountered.

Because of this range – which can make FET amplifier biasing non-trivial – it is normally better to use a constant-current diode (a FET in disguise) which has been designed for invariance to load and temperature: they are available for currents in the milliampere range.

# FETs

Figure 6 showed how the FET behaves like a voltage-controlled resistor when the drain/source voltage is small. The most common application of this characteristic is in automatic gain control.

An example of such a circuit is in Figure 9. The op-amp is configured as a non-inverting amplifier with the N-channel FET acting as one of the resistors in the feedback network. As the gate voltage becomes more negative, the channel resistance rises and the gain decreases.

Figure 10 shows a potential divider circuit which operates in a similar manner. The type of FET chosen will be dependent on the polarity of the signal to be attenuated and that used to control the FET as well as the FET's characteristics (as in Figure 5).

## Analogue switches

This application is a hybrid between the voltage-controlled resistor and digital techniques. MOSFETs are the most commonly used species as they offer low ON resistance, high OFF resistance, and, with correct biasing, will switch signals with both positive and negative polarities present.

Figure 11 illustrates a simple FET on-off switch. In this instance, the signal must remain positive. By analogy with the voltage-controlled resistor, when the gate of the FET (insulated) is grounded, the drain-source resistance is very high—perhaps a few gigohms—and so the output is severely attenuated by the presence of the fixed resistor.

However, when the gate voltage is raised to around 20 volts (dependent on FET type) the channel resistance drops to a few tens of ohms and the signal passes straight through.

The gate voltage has to remain a few volts higher than the most positive signal peak; if negative signals are present, the FET will switch on because the gate will then be more positive than the signal.

However, voltages which go positive and negative can be switched if the bias is set so that the signals all appear positive to the FET. Such signals may have the bias removed simply by using a capacitor to perform ac coupling. This bias arrangement may not always be convenient—if a limited supply voltage is available, for instance.

Here, two MOSFETs (one N- and one P- channel) are connected in parallel with their gates driven from complementary levels. Such a configuration is used in the CMOS analogue switch packages like the 4066 and the signal multiplexers—4051, for example.

One switch from the 4066 is illustrated in Figure 12. These ICs allow analogue signals to be switched or routed under the control of digital signals and are therefore an important part of any computer system which interfaces with the 'real-world'.

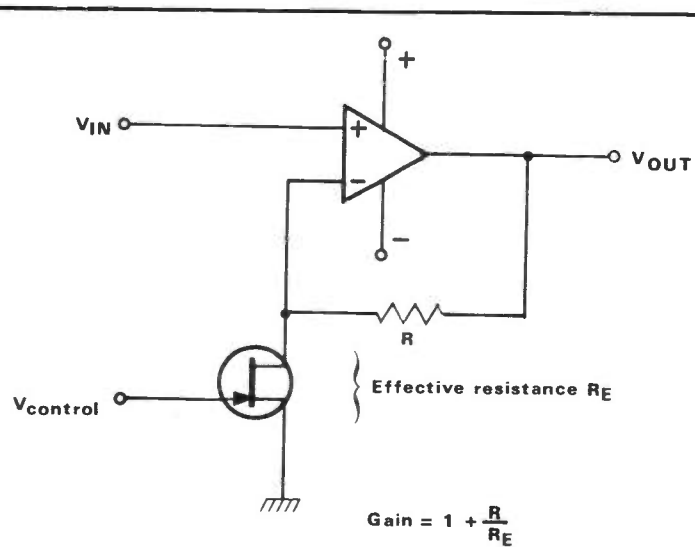


Fig 9 Automatic gain control – the FET as a variable resistor

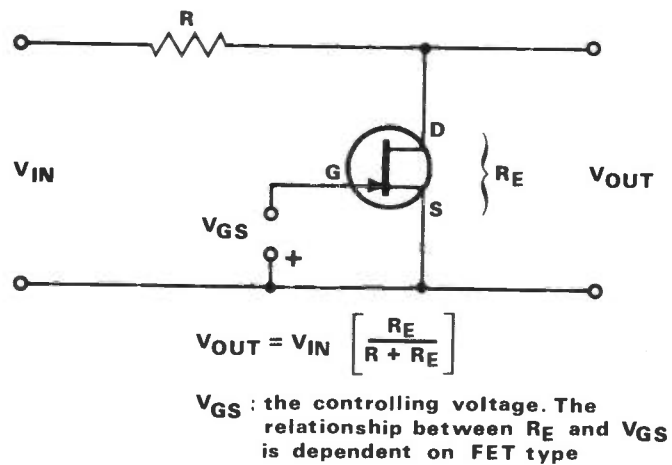


Fig 10 Voltage controlled potential divider

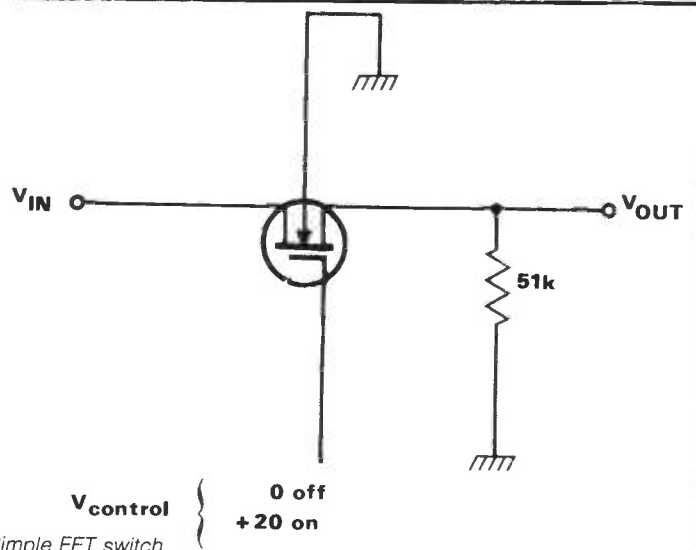


Fig 11 Simple FET switch

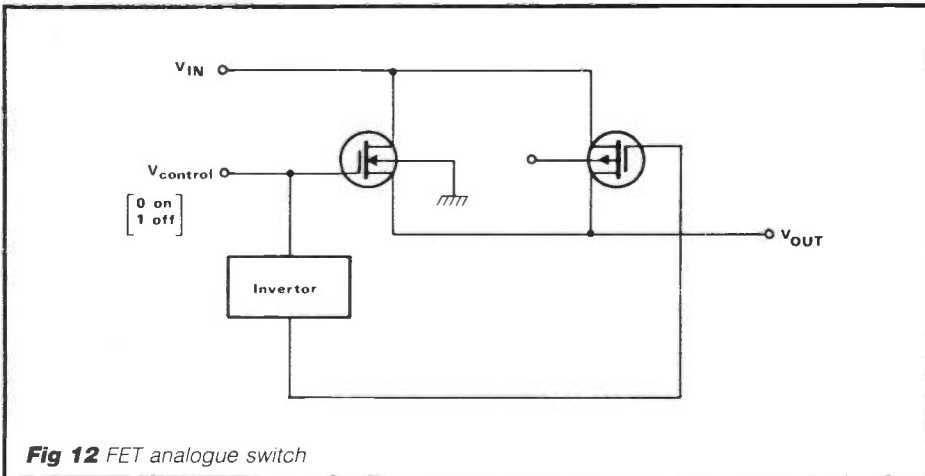
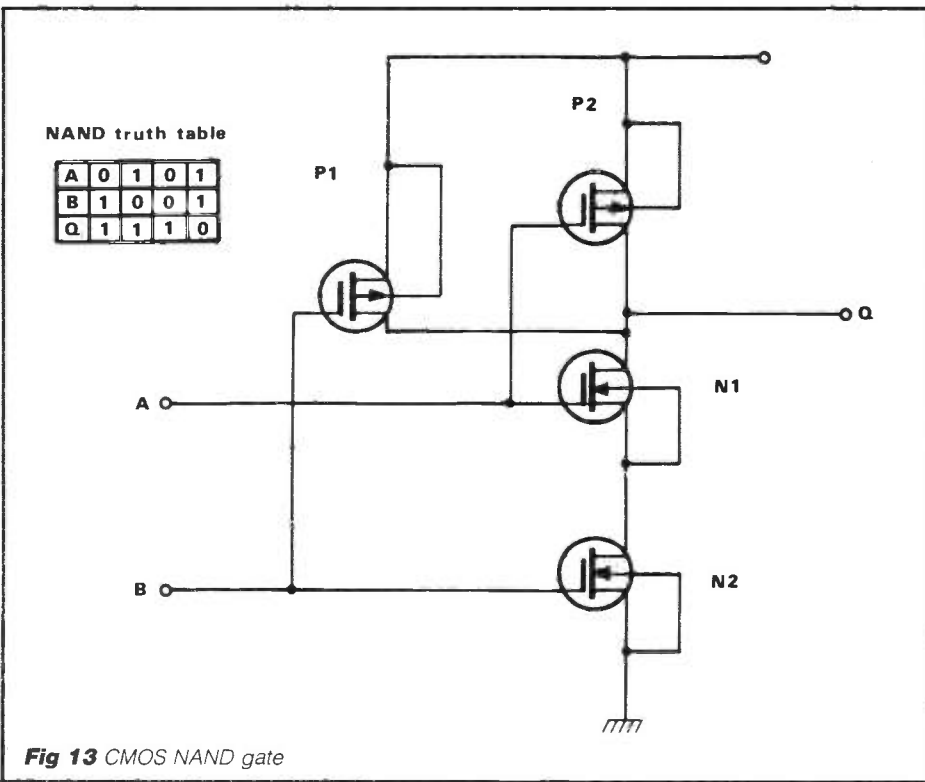


Fig 12 FET analogue switch



NAND truth table

A	0	1	0	1
B	1	0	0	1
Q	1	1	1	0

Fig 13 CMOS NAND gate

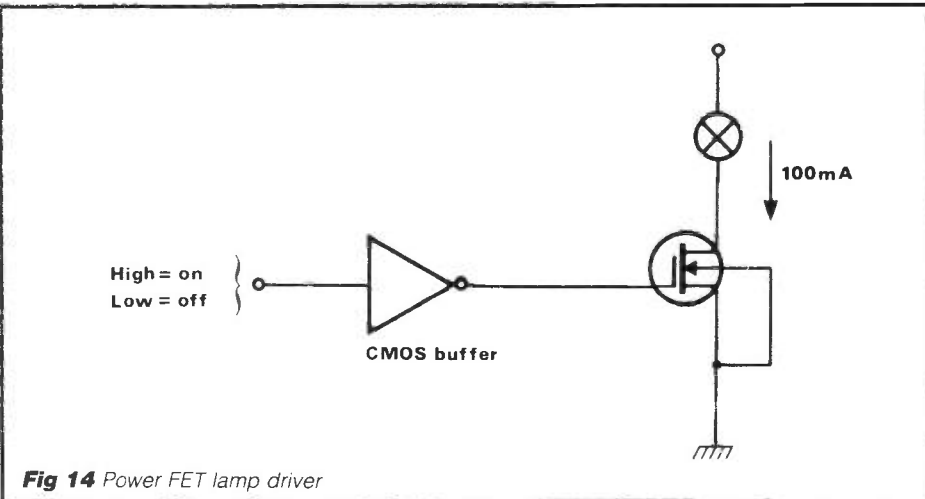


Fig 14 Power FET lamp driver

FETs in digital circuitry

Following on from the discussion of FETs as analogue switches, it seems rather obvious that they can be used to switch at logic levels. After all, logic levels are only analogue signals constrained to two discrete values.

The MOS logic family has steadily grown in size, and now includes simple logic gates, medium-scale integration (like the 4017 decade counter and complete clock systems), and 16-bit microprocessors. Most common devices available to the home constructor are CMOS: Complementary MOS-FET, so-called because the circuit is fabricated from N and P type MOSFETs.

To explain how a circuit functions, let us look at a simple NAND gate, as illustrated in Figure 13. The NAND gate has two inputs (A,B), one output (Q), and utilises four MOSFETs (P1,P2) and (N1,N2). The two P-channel FETs are connected in parallel so that they are only both off (high resistance) when A and B are both at logic 1.

Resistance path

Hence Q, the output, has a low resistance path to ground only when A and B are at logic 1; otherwise it is connected to the positive supply (logic 1).

Note that there are no states of A and B that permit a low resistance path between the supply and ground. Hence, in a quiescent state, only the very high impedance of at least one MOSFET is across the supply – so CMOS consumes virtually no power.

The power consumption rises linearly with frequency because the charge stored in the capacitance of the FETs has to be dissipated on every switching operation.

Once we have built a simple NAND gate, it can be shown that any other logic element can be synthesised from such gates – so the simple circuit described above could be combined with others to produce flip-flops, counters, and even microprocessors.

One of the most interesting developments involving FETs has been the introduction of power-handling devices. Currently available devices can handle up to a few tens of amperes and have breakdown voltage up to several hundred volts.

These devices are MOSFETs with special geometries (the name 'VMOS' is derived from 'vertical-groove MOSFET') to handle the large channel current.

Because these devices still have the high gate impedance associated with MOSFETs, the channel current is controlled by the gate voltage, unlike bipolar devices where the base current is the controller. Hence, logic outputs (from CMOS in particular) may be interfaced to heavy current devices – such as relays – simply by using a power MOSFET as shown in Figure 14.

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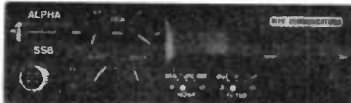
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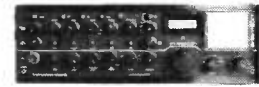
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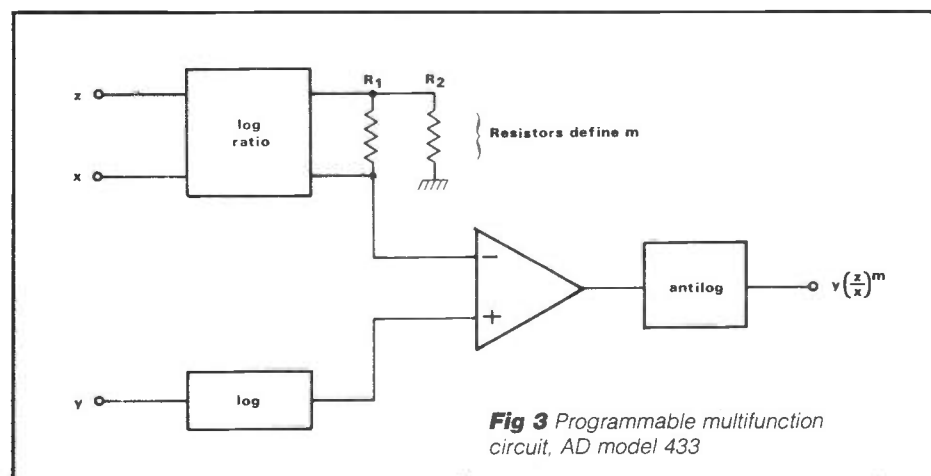
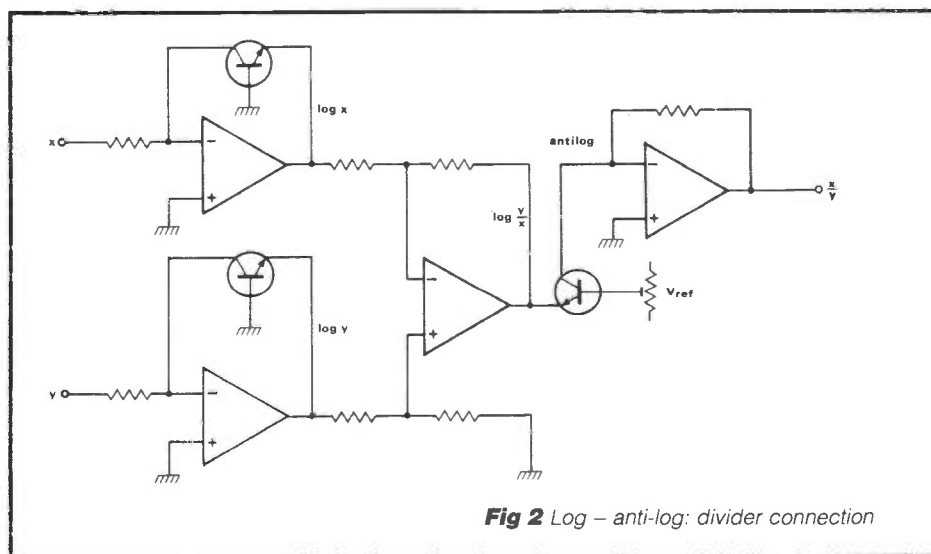
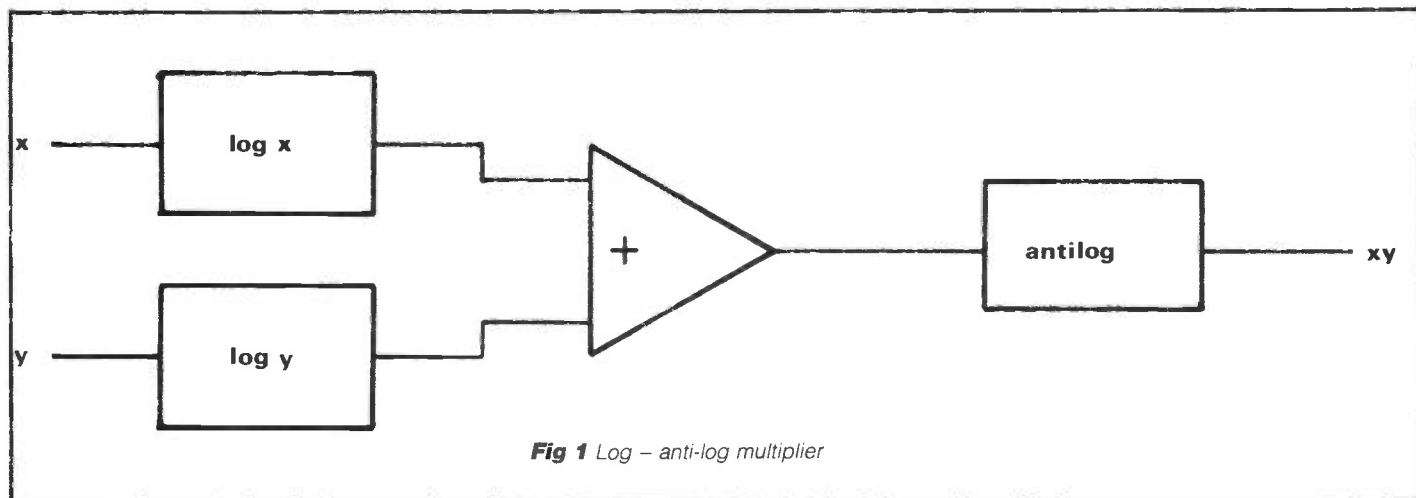
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# Non-linear elements: Log and anti-log

by Dr. CJD Catto



The exponential relationship between current and voltage for a diode or transistor is well known, and this law can be exploited in log and anti-log circuits. As well as for signal compression and expansion, the 'log method' allows accurate multipliers or dividers to be constructed.

In fact, log conformance, as it is called, can apply over as many as six decades (ie 120dB) of signal level, and so is a much better way of using diodes than the old square-law technique mentioned in an earlier article<sup>1</sup>.

### Functions

Moreover, one is not restricted to simple products and squares.

Using the arrangement shown in *Figure 1*, the product  $xy$  is obtained by adding the logs of  $x$  and  $y$ . In *Figure 2*, the quotient  $x/y$  is produced by subtraction. Further, in *Figure 3*, the inputs  $z$  and  $x$  are raised to an arbitrary power  $m$ , which does not even have to be an integer.

Of course, for reasons of dc drift and circuit stability, there is a limit to the usable values for  $m$ , these being typically between  $1/5$  and  $5$ .

With regard to drift, a temperature-dependent term enters the equations, and this must be counteracted by thermal control of the circuit or the inclusion of a resistor of the appropriate temperature coefficient, as shown in *Figure 4*.

It is for this reason that it is generally better to use a packaged log module, such as AD751 P or N, where the compensation is built in<sup>2</sup>. The N or P suffix indicates the polarity of the devices inside: clearly, a diode or

# LOG AND ANTI-LOG

transistor will not work in this mode if fed a signal of the wrong polarity.

## Alternatives

Although log modules, like analogue multipliers, are somewhat costly for the home constructor, some useful circuits can often be built with discrete diodes or transistors, albeit with some sacrifice in dc stability.

A simple example is illustrated in Figure 5, where an op-amp and diode provide a log response for a signal level meter; the second diode allows the circuit to be used for ac. The other op-amp is connected as a precision rectifier, using the diode bridge around the meter.

Note that op-amp bias currents and diode resistance set a limit to the dynamic range obtainable with this kind of log circuit.

## Applications

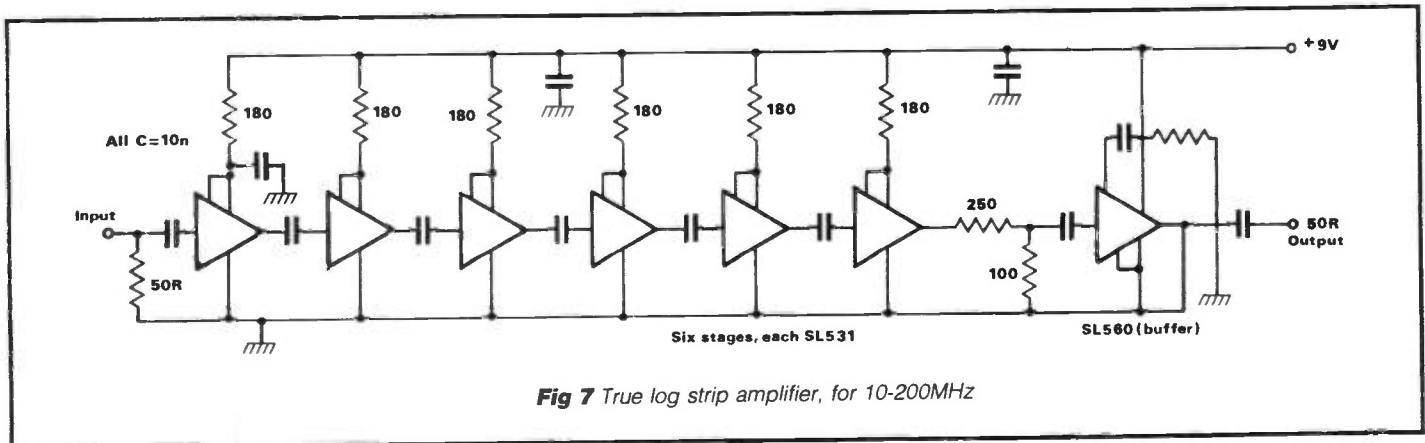
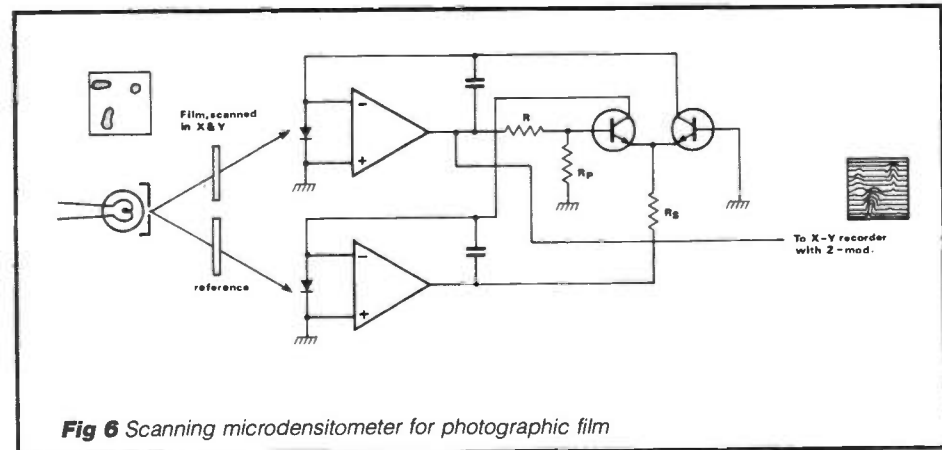
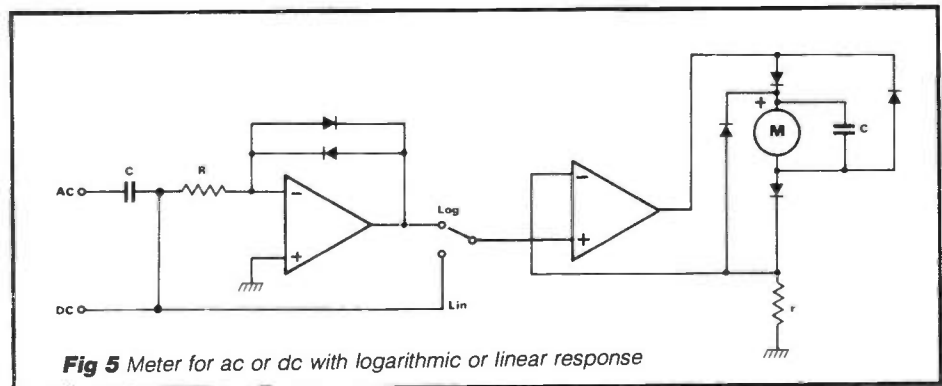
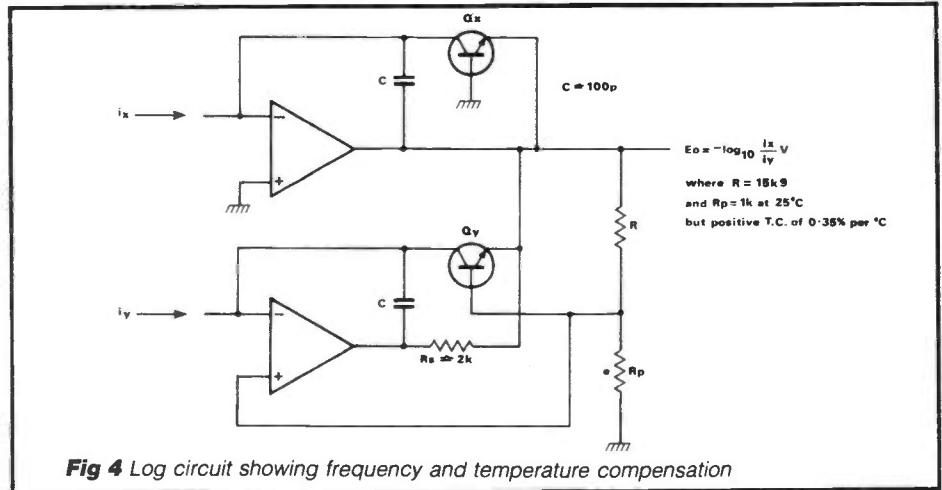
A type of circuit involving the log law occurs in photographic or X-ray microdensitometry, where one wishes to accommodate the characteristics of photographic film.

Referring to Figure 6, the light passing through the film being scanned is compared with a reference beam through a neutral-density filter, and their log ratio is derived. An advantage of the circuit is that it compensates for ageing of the bulb.

In signal processing, the log method allows one to compress, expand and adjust gain (within the bounds set by usable signal-to-noise ratio), and an application of some bearing to the field of radio frequency engineering is the log IF strip.

An example of this has been described by Ryan<sup>3</sup>, and is illustrated in Figure 7. Each of the six amplifiers in the cascade has a gain of 10dB up to a prescribed signal level; thereafter, the gain is 0dB.

Thus, as the input signal is increased, the sixth amplifier 'limits', then the fifth, then the fourth, and so on, till eventually they are all working at unity gain; ie the gain of the cascade has come down gradually from its maximum of 60dB. This represents a 'log'.



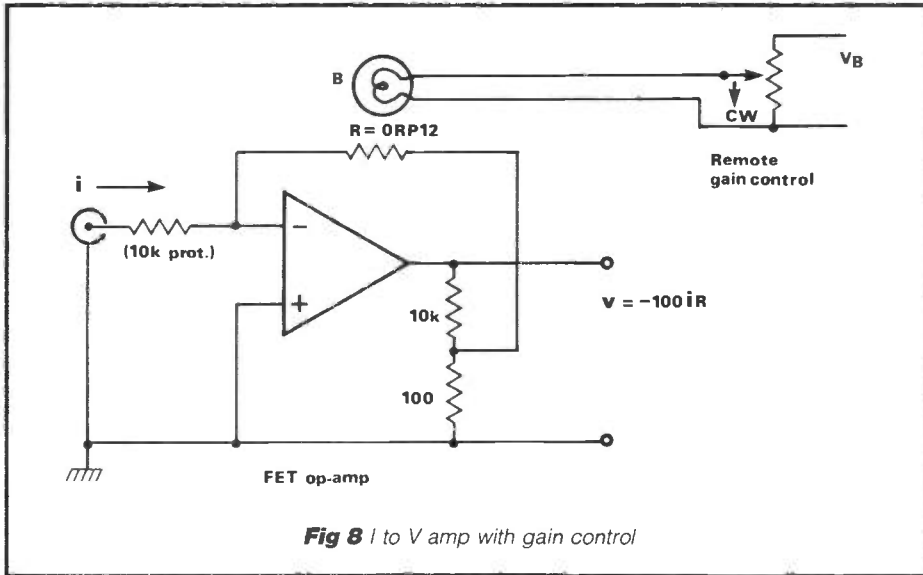


Fig 8 I to V amp with gain control

Finally, and this may seem a retrograde step having discussed log circuits using silicon technology, it is quite feasible to obtain a sort of log law in a wide-range gain control employing a CdS photoresistor illuminated by a tungsten-filament bulb, as outlined in Figure 8.

With a little thought, log effects can also be obtained digitally. One way is to pick out the leading 1 from a binary number.

For example, if a signal of unknown frequency F is fed to a cascade of divide-by-two counters, each with an output

latch, then a linear array of LEDs driven by them will give a bar-type display proportional to log F.

The updating time needs to be much shorter than the display period, or else the higher order LEDs will appear much dimmer than the lower order ones.

### Conclusion

There are still many areas where judicious use of log and anti-log elements can provide a straightforward solution to signal processing and measurement problems.

The exponential law  $I = I_0(e^{qV/kT} - 1)$  holds true over many decades, even for relatively cheap diodes and transistors. With Bi-FET op-amps, the error introduced by bias currents can be minimal.

### References

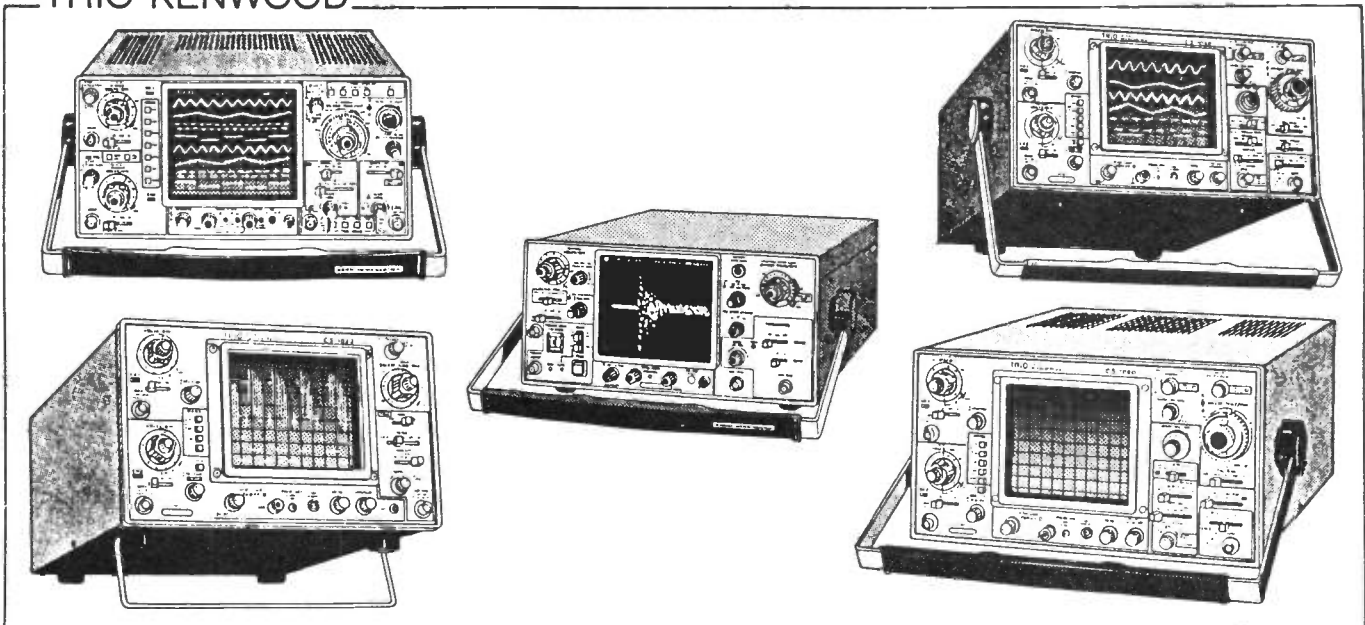
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- 2 Sheingold, DH : *Non-linear Circuits Handbook, published by Analog Devices, Norwood, Massachusetts 02062, USA, 1974.*
- 3 Ryan, C : *Log amps for compression, New Electronics, March 24 1981, 36-40.*

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AA119	9p	BC357	6p	BFX87	15p	TIP115	45p	2N3819	100p	BYX70/800	36p	ECC82	40p	4043	57p	7485	25p	74LS399	35p	LA-1365	170p	TC420	40p
AA123	9p	BCY32	150p	BFY50	14p	TIP117	56p	2N3866	65p	BYX71/600	80p	ECC83	40p	4044	56p	7486	100p	74LS670	130p	LA-1367	170p	TC490	80p
AC107	25p	BCY34	150p	BFY51	14p	TIP121	48p	2N4031	25p	OA90	4p	ECC84	40p	4047	56p	7489	35p			LA-3301	180p	TC490	85p
AC126	17p	BCY34	150p	BFY51	14p	TIP121	48p	2N4031	25p	OA90	4p	ECC85	40p	4048	56p	7492	35p			LA-3350	150p	TD41170	90p
AC127	15p	BCY42	20p	BFY52	14p	TIP122	47p	2N4037	25p	OA91	4p	ECH81	40p	4049	56p	7493	35p			LA-4032	190p	TD42002	80p
AC128	20p	BCY42	20p	BFY52	14p	TIP125	47p	2N4443	25p	OA200	7p	ECH84	40p	4050	56p	7495	35p			LA-4051	250p	TD42020	150p
AC128K	23p	BCY70	15p	BFY57	25p	TIP126	56p	2N4444	25p	OA202	7p	ECL80	57p	4051	62p	7495	35p			LA-4101	140p	TD42020	140p
AC141K	23p	BCY71	16p	BFY64	25p	TIP127	56p	2N5061	20p	IN814	2p	ECL81	57p	4052	61p	74107	30p			LA-4102SK	140p	TD42030	140p
AC142K	22p	BCY72	16p	BFY90	60p	TIP147	100p	2N5294	30p	IN4001	4p	ECL82	57p	4053	62p	74111	55p			LA-4240	150p	TD42522	90p
AC153K	23p	BD115	20p	BR100	14p	TIP2955	34p	2N5296	30p	IN4002	4p	ECL85	57p	4054	62p	74115	55p			LA-4430	150p	TD42530	90p
AC176	18p	BD124P	110p	BT106	90p	TIP3055	34p	2N5454	21p	IN4003	4p	ECL86	57p	4055	62p	74119	55p			LA-4431	150p	TD42540	90p
AC176K	20p	BD124	110p	BT106	90p	TIP3055	34p	2N5454	21p	IN4003	4p	ECL86	57p	4055	62p	74119	55p			LA-4432	150p	TD42540	90p
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AC187K	20p	BD131	35p	BT116	90p	TIS44	45p	3N128	55p	IN4006	4p	EF85	34p	4066	72p	74123	40p			LA-4434	150p	TD42540	90p
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		BC149	9p			2N2484	20p			IN4049	11p	PC97	100p	4075	72p	74131	40p			LA-4477	150p	TD42540	90p
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		BC158	9p	R2010B	80p					IN4051	11p	PC97	100p	4075	72p	74131	40p			LA-4479	150p	TD42540	90p
		BC182	9p			2N2904	20p			IN4052	11p	PC											



# THE NUMBER ONE SYSTEMS NETWORK ANALYSIS PROGRAM

reviewed by Simon Karas

This program performs a linear voltage gain, input impedance or output impedance analysis of an electronic circuit, listing the frequency response; it does this by a small signal analysis, hence it assumes all components are correctly dc biased and operating linearly.

Clearly, then, it is aimed at those who know what they are doing.

The program is useful and for the most part a success, in that it produces a very good simulation of a circuit. The circuit description is nodal (a component is defined by the nodes to which it is connected), and the program can analyse circuits containing up to 16 nodes and 60 components (resistors, capacitors, inductors, field effect transistors of dc model, bipolar transistors – NPN or PNP – and operational amplifiers).

There are also several features of practical interest; capacitors and inductors are considered perfect com-

ponents and entered exactly and all resistors have 0.2pF of capacitance added across them. In addition, the amplifier has constant 90° phase shift and has a gain bandwidth product of 3MHz, simulating the performance of an LF351 or TL081 type amplifier.

It is possible to change this to a 741 type by changing the program – how to do this is explained in the very complete instructions. This can be a time consuming process due to the program's deficiencies, which I will come to later.

One deficiency worth mentioning here is that a series based resistance is not included in the bipolar transistor. This has already been noted by Number One Systems, and the instructions advise the user to add an external component at high frequencies. Presumably this minor inconvenience will be dealt with in any revision of the program.

To analyse a circuit the program prompts for a number of steps (less than 51). If a positive number is entered it will

analyse in linear frequency steps; if negative, it will analyse in logarithmic steps.

Steps can also be read from a DATA statement (at line 2410). A start and end frequency must then be entered.

As well as working out the voltage gain, by changing the analysis parameters the program will calculate input impedance and output impedance.

Several voltage gains can be chosen:

1. Gain (dB absolute);
2. Gain (dB relative);
3. Gain (linear absolute);
4. Gain (linear relative).

The results are then shown in tabular form and can be printed at the touch of a button. After entering a circuit it is also possible to modify or save it on tape or microdrive.

## User-friendly

This program is very 'user-friendly' in that the program prompts every input. To save time before inputting a value the program prints the last values used; therefore, if that value is required, only 'enter' need be pressed to re-enter it.

The major draw-back of this program, and one that may infuriate all but the most precise and careful of users, is that it may crash through accidental entry and must be restarted by re-running it in its entirety.

If this has to be done all the data will be lost and must be inputted again. The larger the circuit being analysed the more irritating this is.

A lesser but more persistent irritation is the length of time taken to calculate results; the analysis of the test circuit, after the data was entered, took 3 minutes 30 seconds for 10 frequencies.

This might be considerably improved by using a machine-code routine – it seems inexplicable to me why the programmer did not do this instead of sticking to Basic.

By doing this he would have saved memory which would, perhaps, have allowed him to incorporate some simple graphics to illustrate the circuit (as it is, the user must work from a circuit designed fully on paper beforehand).

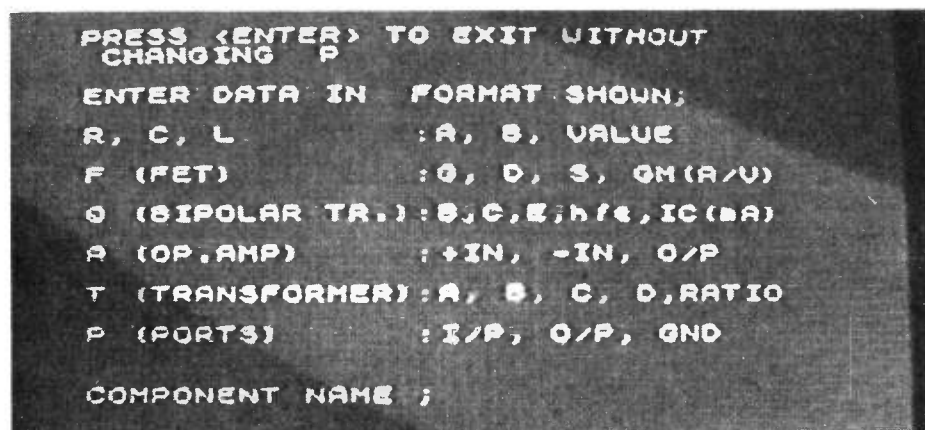
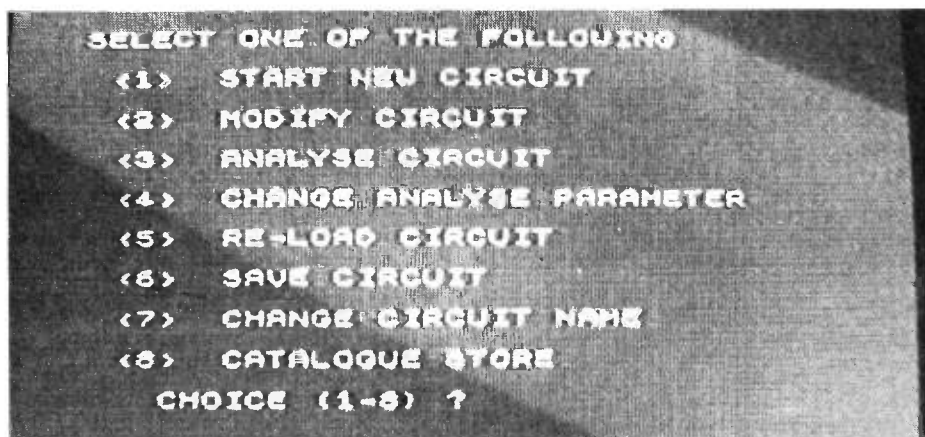
Even if this is impractical, a graph of results might be handy for the user.

A more basic improvement would be the provision of a key that will always (even in the middle of calculations) return the main menu screen.

The instructions, which are on the whole very clear, indicate that one can change the program, but the only way that I found of listing the program was to input impossible data and, when the program crashed, list it.

On the whole the program does its job solidly and will prove useful to electronics buffs in possession of the Spectrum 48K.

It shows signs, however, of being the product of an electronics man who has taken up computing, rather than of an experienced programmer who has looked for the neatest ways of tackling his task with the user always in mind.





# LATEST LITERATURE

Clubs, manufacturers, publishers and agents are invited to send details of new books, catalogues, data sheets, etc for inclusion on this page

## THE RADIO AMATEURS' Q&A REFERENCE MANUAL

By R E G Petri, G8CCJ.

This book is not intended as a source of information – its purpose is to stimulate the student towards further research and reading.

This is a very good way to learn, and is vastly preferable to merely reading through yet another book of theory – however good these books are, they do not stimulate as much mental activity on the part of the reader as a book of this nature.

This said, however, there must be a tendency for some to flick to the end of a chapter for the answer, so of course we are back to the main part of doing well in a course of study – self discipline.

The author teaches the RAE course, and has arranged his book in the order in which he lectures on the subject.

It is divided into twenty sections covering different topics, each ending with the answers to the questions, with an additional section containing some useful computer programs.

In each section there is a series of multiple-choice questions, with the answers at the end of the chapter.

The questions are well arranged, and although at times the grammar leaves a little to be desired the meaning is always clear enough (but not always the answers!).

There are, of course, many diagrams (circuits, waveforms, etc) and one irritating aspect of some of the questions following these diagrams is that they are frequently over a page; I dislike having to flick a page between a question and the diagram to which it refers.

In addition, the diagrams tend to be unappealing visually (although not lacking in clarity), as does the typeface, which is reminiscent of an old typewriter.

Also, the list of recom-

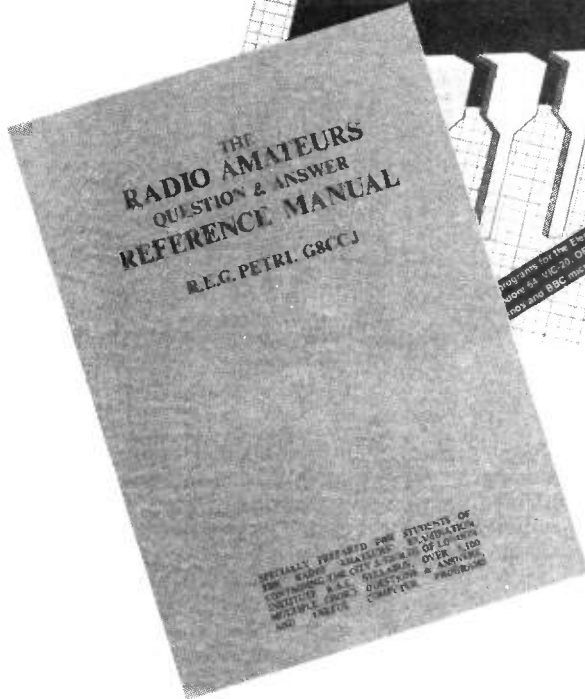
mended books at the end of the preface is not as long as I would have wished; since different people have different preferences when it comes to the approach of an author to his subject, I would have preferred a larger choice here.

However, there is no doubt that this is a very useful study aid indeed, and I would definitely recommend it to anyone studying the RAE course.

R E G Petri, G8CCJ, 11 Wayville Road, Dartford, Kent DA1 1RL.

## An Introduction to 6502 Machine Code

R. A. & J. W. PENFOLD



## AN INTRODUCTION TO 6502 MACHINE CODE

By R A & J W Penfold.

Many readers will be aware that the advantage of using machine code, rather than a high level language (such as BASIC), is its greater speed of operation.

In this book, the authors set out to give a general outline of how to use the machine code of the 6502 microprocessor. This chip is used in many popular home computers, including the BBC models A and B, Electron, Vic-20, Oric 1/Atmos and Atari (the Commodore 64 uses the 6510,

which is a slightly modified, but software compatible version of the 6502).

Preceding the details of the 6502 machine code is a general introduction to microprocessors, assembly languages and the various binary systems used.

This introduction is written with impressive clarity, and forms a good guide to the basics of microprocessors.

This clarity is continued in the subsequent details of the actual machine code, and so the book provides an excellent introduction to machine code programs for anyone with a good grounding in the high level languages.

Bernard Babani (publishing) Ltd, £1.95

Also available from Babani is a computer books catalogue containing details of their range concerning the various aspects of micro computers. Anyone sending their name and address to the publishers will receive a copy of this leaflet free of charge.

## VHF/UHF NEWSLETTER

For a few months now the RSGB have been publishing a newsletter with the aim of assembling both theoretical and practical material for the VHF/UHF enthusiast.

The newsletter, edited by David Butler, G4ASR, appears monthly and is mailed direct to subscribers. It should prove a useful source of information for the increasing number of amateurs using the VHF/UHF bands, and despite the fact that it shows signs of being a very youthful publication, it would seem well worth subscribing to at a cost of only £4.20 per annum (payable to the Radio Society of Great Britain).

RSGB, Secretary – VHF/UHF Newsletter, Alma House, Cranborne Road, Potters Bar, Herts EN6 3JW.

# LATEST LITERATURE

## THE LID OFF LASER 558

By Paul Alexander Rusling.  
OK, who doesn't know what Laser 558 is? For the few readers who may still be unaware, this is the latest off-shore pirate radio station.

Many amateurs might think this book would contain little of interest, but the author is a licensed amateur, G4LBC, who was closely involved in the setting up of this venture.

The technical details included make fascinating reading, and I'm sure many people will be surprised to find just how large the European involvement was, considering some of the rumours circulating about the station regarding mystery Americans.

The book is produced by Pirate Publications, and certain aspects of its production seem to justify this name.

The cover of this paperback, for example, looks as if it will part company with the rest of the book sooner rather than later (otherwise, however, it is well enough bound - pages will not fall out, etc).

In addition, the pages are not numbered. There is a contents page listing the chapter headings, but these are listed by chapter number rather than page number.

The book could be better written, but is certainly not unreadable. Indeed it is a damn good yarn, and the quality is not as bad as some of the above comments might lead one to expect.

Available from Pirate Publications, PO Box 19, Herne Bay, Kent.

## THE PRACTICAL GUIDE FOR PEOPLE WITH A NEW IDEA

By Laurence Shaw.

So who's fancied themselves as an inventor!

The author of this book is a patent agent, trademark agent and European Patent Attorney.

It is not intended as a guide to taking out your own patents, which is a complicated business best left to the experts (such as the author!).

Rather, it is intended to indicate the advantages of patent protection, and to explain briefly all aspects of

the different legal systems, patents, trademarks and copyright requirements, how to get them, what they will cost and what good they will do.

Many people assume that a patent will only be granted for a novel idea, but fail to realise that a novel idea can mean an inspired modification or improvement to an existing device or idea.

This is certainly a well written book. The author, as well as knowing his subject (as he ought to, of course, it being his job) also knows how to present it well. There are plenty of tables and some examples of some very interesting patent specifications (chemical, mechanical and electrical).

In addition, the contents list has a summary after each chapter heading of what the chapter covers - something too rarely seen in books these days.

The Practical Guide for people with a new idea.



This book is invaluable for people running small businesses, and very interesting for those who just love tinkering in their shack with new ideas.

The only criticism I have is a minor one. The text is not arranged ideally, some of the paragraphs being rather too long and the layout being uncomfortable on the eye. This, perhaps, is merely down to my own taste, and anyway is a minor point in view of the book's quality.

Laurence Shaw, George House, George Road, Birmingham B15 1PG.

## 25 SIMPLE TROPICAL AND MW BAND AERIALS

By E M Noll.

This book describes how to build 25 simple aerials for operation on the 550-1600KHz band and on the 60, 75, 90 and 120 metre bands.

An appreciable amount of the material in this book also appears in *25 Simple Short-wave Broadcast Band Aerials*, by the same author and also published by Babani. This leads me to wonder whether the price of £1.75 is really justified for such a small book, of 54 pages, even if it is 20 pence cheaper than its shortwave companion.

One or two of the diagrams are not particularly clear, but on the whole they are simple and easily understood.

References in the text to the diagrams are sometimes incorrect, and although it is obvious which diagram the author is referring to, it is a little irritating nonetheless. More often than not a page must be turned between the figure reference in the text and the diagram.

It is useful having a collection of aerials described in one volume, and the aerials themselves are perfectly adequate (the author being well-experienced in the radio field).

However, some of the practical hints, this being essentially a practical book, do not seem as robust as they ought to be.

For all the above, this is an interesting and fairly useful book. It is probably worth buying if your money is burning a hole in your pocket.

Bernard Babani (publishing) Ltd, £1.75

## B & R COMPONENTS CATALOGUE

The second edition of the phone/mail order catalogue published by B & R Electrical Products Ltd is now available. It is some 20% bigger than the first edition, with new items in most of the sections.

According to B & R, close attention has been paid to clarity of format. This is certainly the case, particularly as regards the photographs, which are of above average quality for such a catalogue.

Readers who require a free copy of the catalogue should contact the company.

B & R Electrical Products Ltd, Temple Fields, Harlow, Essex CM20 2YD.



## ATTENUATOR NETWORK DESIGN PROGRAM

1. UNBALANCED-T NETWORK
2. UNBALANCED-PI NETWORK
3. BALANCED-T NETWORK
4. BALANCED-PI NETWORK

SELECT NETWORK 1-4  
2

ENTER INPUT AND OUTPUT IMPEDANCES- OHMS  
300 75

ENTER DB RANGE LOW,STEP AND HIGH  
5 5 40

2. UNBALANCED-PI NETWORK

ZIN= 300 OHMS ZOUT= 75 OHMS

ATTN DB	INPUT OHMS	R OHMS	OUTPUT OHMS	R OHMS	CENTRE R OHMS
5	CONFIGURATION NOT POSSIBLE				
10	CONFIGURATION NOT POSSIBLE				
15	907	85.1	408.4		
20	486.9	81.6	742.5		
25	384.3	79	1329.5		
30	342.7	77.3	2369.3		
35	322.8	76.3	4216.2		
40	312.4	75.7	7499.3		

RUN AGAIN? (Y/N)

## Computing attenuators

On the left is a test calculation for the computer program detailed in Computing Attenuators, which appears on page 19 of this issue.

## Low Power Transmitter

The author of this article from the September issue, D G K Guy G3IBH, has pointed out an error in one of the formulae. Step 7 of the calculations should read:

$$X_{C1} = \frac{R_D}{Q} \left( \frac{1}{1 - \frac{X_{C2}}{QR_L}} \right)$$

## Radio Frequency Bridge

This project, featured in June, prompted an interesting letter from C J Raspin, G4 KUE (complete with comprehensive calculations):

'The article appeared to me to be so simple that it was too good to be true. Further investigation reveals that this is indeed the case. Before too many people take critical readings with this instrument, may I make some remarks that I feel are of importance.

'Once the bridge has been calibrated using known resistors, it gives a method of determining any arbitrary value of pure resistance.

**Whilst every effort is made to ensure that there are no mistakes with our diagrams, the occasional error does occur. We appreciate our readers' co-operation in notifying them to us.**

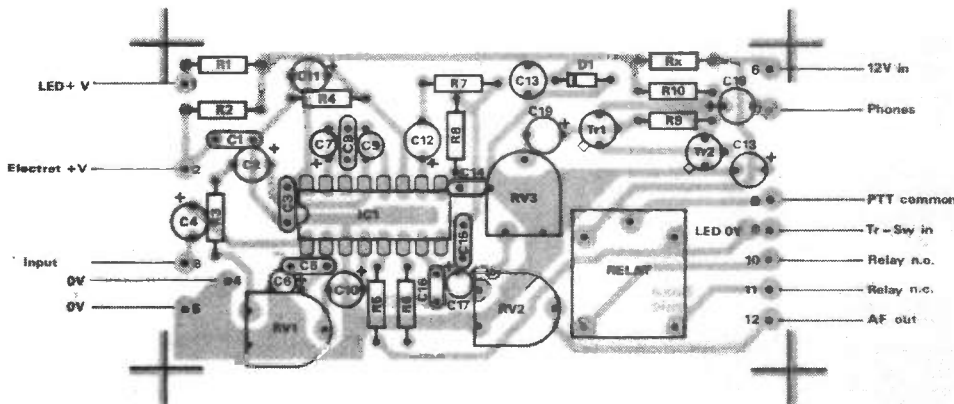
'However, when it comes to anything other than a pure resistance (as is the case more often than not) the same mathematical relationship does not hold. According to the article, a pure inductance can be measured using the same scale as that calibrated using a pure resistance of known value. This is far from the truth. At the minimum value of voltage reaching the receiver we find that for a resistive impedance.

$$R = \frac{R_1 R_3}{R_2}$$

but for a purely reactive impedance this becomes

$$|Z| = R_3 \sqrt{\frac{R_1}{R_2}}$$

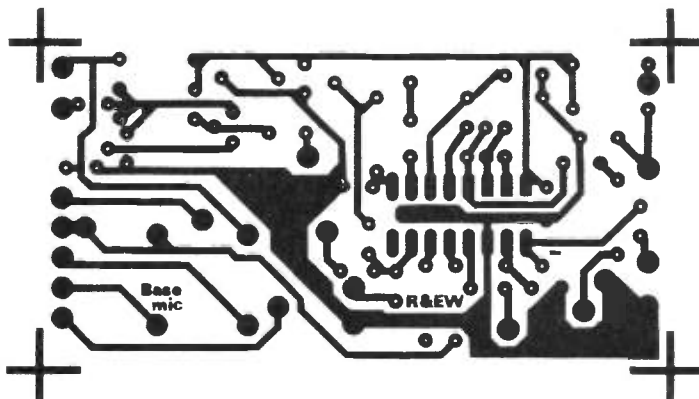
The relationship as stated in the article only holds when  $R_1 = R_2$  ie at the potentiometer midpoint only. We therefore cannot assume the resistance calibrated scale holds for anything other than resistance.'



## Base Mic PCB

The artwork has now been completed for Peter Rouse's project, featured last month in R&EW, and the foil pattern and component overlay are shown on the left.

PCBs are available from *Edwardschild Ltd*, (see their advertisement in this issue).



## PARALLEL RESISTANCES

### A M Tucker presents a helpful program written for the Sinclair Spectrum home computer

This is a short program which should be useful to the electronics enthusiast. Enter the required resistance value (setting the value between 10 and 100), and the required tolerance; the program will then print out all the combinations (within practical limits) of two resistances in parallel to give values within the specified tolerance.

The values are chosen from a table of standard values, which are considered as having a tolerance twice as good as that required, eg 1% for an answer within 2%. The table can be changed for another range if preferred.

In order to keep the calculation time to a minimum, program lines are included which exclude values which cannot produce the required sum whatever the value of the second resistance. **REW**

```

20 GO SUB 200
30 CLS : LET y=0: LET z=0
40 PRINT " RESISTANCES IN PA
RALLEL""(Approx. values using
resistors of tolerance half stat
ed figure)"
50 INPUT "Enter value required
""(10 to 100):- ";x,"Tolerance
(% ) ? - ";t;"%"
60 PRINT AT 2,0;" Value: ";x,"
Tolerance: ";t;"%"
70 LET t1=1-t/200: LET th=1+t/
200: LET x1=x*t1: LET xh=x*th
80 FOR n=2 TO 25: IF x>=a(n-1)
AND x<=a(n) THEN LET y=n
90 LET m=n+24*(x>50): IF x>2*a
(m-1) AND x<2*a(m) THEN LET z=m
100 GO TO 110+10*(y=n AND z=m)
110 NEXT n
120 PRINT " R(1) R(2) (min)
Sum (max)""
130 FOR m=y TO z: FOR n=2 TO 49
: LET xn=a(n)*a(m)/(a(n)+a(m))
<1e3):a(m);
140 IF xn>xh OR xn<x1 THEN GO T
O 170
150 PRINT TAB (a(n)<100)+(a(n)<
1e3);a(n);TAB 5+(a(m)<100)+(a(m)
<1e3);a(m);
160 PRINT TAB 14;INT (xn*t1*100
+.5)/100;TAB 20;INT (xn*t100+.5)/
100;TAB 26;INT (xn*th*100+.5)/10
0
170 NEXT n: NEXT m
180 PRINT #0;AT 0,0;"Required l
imits: ";INT (x*(100-t)+.5)/100;

```

```

" - ";INT (x*(100+t))/100'"For a
nother value press any key "
190 PAUSE 0: GO TO 30
200 DIM a(49): FOR n=1 TO 25: R
EAD a(n): LET a(n+24)=a(n)*10: N
EXT n: RETURN
210 DATA 10,11,12,13,15,16,18,2
0,22,24,27,30,33,36,39,43,47,51,
56,62,68,75,82,91,100

```

#### SAMPLE SCREEN DISPLAY

#### RESISTANCES IN PARALLEL

```

Value: 55.77 Tolerance: 4%
R(1) R(2) (min) Sum (max)
470 62 53.68 54.77 55.87
510 62 54.17 55.28 56.39
560 62 54.7 55.82 56.94
620 62 55.24 56.36 57.49
680 62 55.68 56.82 57.96
300 68 54.33 55.43 56.54
330 68 55.25 56.38 57.51
220 75 54.81 55.93 57.05
180 82 55.21 56.34 57.46
150 91 55.51 56.64 57.77
130 100 55.39 56.52 57.65

```

Required limits: 53.54 - 58  
For another value press any key

# What the competition hasn't been waiting for.

Latest version of Forth for the BBC  
(Is not rehashed Forth 79 Code)

Unique Stack Display Utility



16k Eprom type 27128

Multi-tasking operating system  
for Real-Time use.

Here's the Forth Eprom for the BBC Micro that makes all others out of date.

It's Multi-Forth 83 from David Husband who has built his reputation for Quality Forth products with his ZX81-Forth ROM, Spectrum Forth-I/O Cartridge and now New Multi-Forth 83 for the BBC Micro. This is not rehashed Forth 79 Code, but a completely new version of the Forth 83 Standard. It's unique in that it Multi-tasks, and therefore the user can have a number of Forth programs executing simultaneously and transparently of each other.

Multi-Forth 83 sits in the sideways ROM area of the BBC along with any other ROMs in use. It is compatible with the MOS, and specially vectored to enable a system to be reconfigured. It contains a Standard 6502 Assembler, a Standard Screen Editor, and a Unique Stack Display Utility.

With this Forth, David Husband has provided the BBC Micro with capabilities never before realised. And being 16K rather than 8K is twice the size of other versions. Multi-Forth 83 is supplied with an

extensive Manual (170 pages plus) and at £45+VAT it is superb value.

Order it using the coupon adding £2.30 p&p (£5 for Europe, £10 outside) or if you want more information, tick that box instead. Either way, it will put you one step ahead of the competition.

Please send me Multi-Forth 83 for BBC Micro. £45+VAT De-luxe System inc. Disc £80+VAT  
Cheques to Skywave Software Readers' A/C (or enter Visa No.)

**REW**

Name \_\_\_\_\_  
Address \_\_\_\_\_  
Post code \_\_\_\_\_

Subject to availability. FOR 1.005 ONWARDS  
Send to Skywave Software, 73 Curzon Road, Bournemouth,  
BH1 4PW, Dorset, England. Tel: (0202) 302385

Please send me more information  
 Multi-Forth 83  
 ZX81-Forth ROM  
 Spectrum Forth-I/O Cartridge

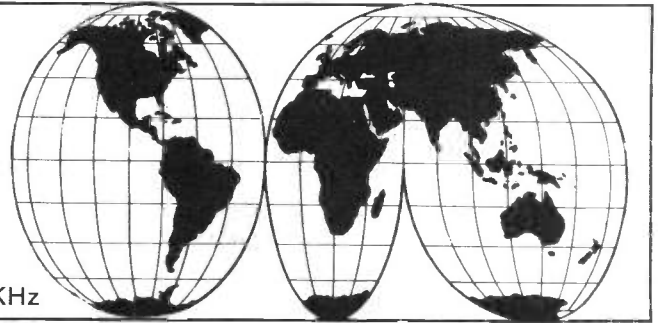
**Skywave SOFTWARE**

## MULTI-FORTH 83 FOR THE BBC MICRO

# SHORT WAVE NEWS FOR DX LISTENERS

By Frank A Baldwin

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



**C**ontinuing with the review of the clandestine stations currently operating on the short wave bands, the first to be listed this month is another Middle Eastern transmitter.

## Voice of the Mojahedin-Khalq

This originally operated over the range **7500** to **7750** in order to avoid the constantly chasing jammer. According to my latest information, however, this one now operates on, or around, **4190** and **6600** from 1600 to 1900 in Persian. The policy is one of opposition to Khomeyni and the present government of Iran.

## Voice of the Broad Masses of Eritrea

This is hostile to the government of Ethiopia and in favour of the Popular Front for the Liberation of Eritrea. It broadcasts in Arabic and other local languages on five shortwave channels, but I have only heard them on the **14328** outlet. Listen for the Arabic language transmissions on or near this channel—it varies a few kilohertz—from 1430 to 1500 or from 1930 to 2000.

## Radio Iran

This may be heard on **11640**, at which point I logged it at 1902 a couple of weeks ago. The language used is, of course, Persian and the evening schedule is from 1830 to 1925. It supports a former Persian Prime Minister and is therefore anti-Khomeyni.

## Voice of the Sudanese Popular Revolution

This is a clandestine that has been mentioned several times in these columns. It operates on **17940** and can be heard from around 1430 until about 1715, the language used being Arabic. The policy is anti-Sudanese government and the transmitter is based within the borders of Libya.

## Voice of Lebanon

This is on **6550** from 0415 through to 2125, but the best chance of identification is to listen for the newscast in English radiated from 1815 to 1825 when it identifies as 'This is the Voice of Lebanon, the voice of freedom and dignity'. The programmes are pro-Falangist in content, mainly in Arabic but with English and French newscasts twice per day. This is an easy clandestine for beginners to log.

## Radio Venceremos

This backs the Farabundo National Liberation Front which is against the government of El Salvador, or was when I logged it way back last year on **6855**, just audible amid the surrounding QRM at 0010. It has since been reported on **6588** and **7025**, but according to the latest reports is said to be operating on **6750** variable and somewhere between **3500** and **4000**, the **3670** channel being that last mentioned in the SWL press.

## Radio Ignacio Agramonte

This has been heard on several occasions, usually when searching for some of those rather elusive Peruvian stations operating within the confines **5100** to **5800**—without success I might add! R Ignacio Agramonte transmits the La Voz del CID (Cuba Independiente Democrática) programme and was originally identified simply as LV CID. Tune to **5106** at 0150, at which time it was last entered into my logbook. The language is, of course, Spanish and this part of the schedule is from 0030 to 0330 (not on Monday).

## Voice of the PLA

The station of the People's Liberation Army has been logged once only, and that was way back in February this year at 1115 on a measured **9267.6**. At that precise time it opened with the 'Internationale', then

OM with the station identification in Chinese, following with a talk in the same language.

The programme content is said to be—I don't speak Chinese—anti-Chinese government, the station operating irregularly. I have listened several times since that logging but have failed to repeat that success.

## Bizim Radyo

'Our Radio' is anti-Turkish government and supports the Communist Party of Turkey. The transmitter is thought to be sited in Romania and it

operates several times per day. One such session may be heard from 2000 to 2030 on **5915**, this being logged several times of late.

## Voice of the Communist Party of Turkey

This is also anti-Turkish government and supportive of the Turkish Communist Party. It identifies as 'Turkiye Komunist Partisinin Sesi' so listen for this at the commencement of the transmission shown here, although there are several such broadcasts each day. Listen then on **6200** at 1900.

## AROUND THE DIAL

This is the section in which information is provided on the channels to tune, the time to select and the country to log. Under each area the countries are listed in alphabetical order and their stations according to frequency.

## AFRICA

### Benin

Cotonou on **4870** at 0405, OM with songs in vernacular together with the fast rhythmic music of the locality. Late risers need not worry about the time listed here: Cotonou is on the air daily until 2300 as follows—**0400** (Saturday from 0545, Sunday from 0600) to **0800** (Saturday until 1100, Sunday until 2300), from **1300** to **2300**. This is the Home Service in French and vernaculars but there is a newscast in English from 2000 to 2015. The power is 30KW.

### Cameroon

Radio Bertoua on **4750** at 2207, OM with announcements in French then suddenly off without the National Anthem at 2209. R Bertoua is on the air from 0430 to 0800 and from 1600 to 2200, programmes being in French, English and vernaculars. English is used weekdays from 1800 to 1840 and on Sunday from 0615 to 0645. The

power is 20KW.

Radio Yaounde on **4850** at 2010, OM and YL with a talk in French. This is the National Service which is in English and French.

The schedule is from 0400 to 0700 and from 1630 to 2400. The English newscasts are timed at 0530, 0600 (Sunday only), 1830 and 2100. The power is 100KW. Yaounde is the capital of the Cameroon Republic.

### Kenya

Voice of Kenya, Nairobi on **4885** at 1833, OM with a talk in vernacular in the North Eastern and Coastal Service which is on this frequency from 0250 to 0630, 1330 to 2020 with a power of 5KW. There is a Swahili newscast on each hour and the programmes are in Somali and vernaculars. This channel replaces **4934** which presumably was causing interference with the Educational Service on **4932**, which emanates of course from Lagos in Nigeria.

### Lesotho

Maseru on **4800** at 1850, OM with a talk in Sesotho. Although mainly using Sesotho, there are newscasts in English at 0500, 0530 (not Sunday), 1130 and at 1600. The schedule is from 0300 to 2200 and the power is 100KW.

# SHORT WAVE NEWS

## AMERICAS

### Brazil

Radio Nacional, Cruzeiro do Sul on **4765** at 0048, OM with sports commentary in Portuguese and station identification at 0100, the signal riding over that of the Moscow relay at Havana.

R Nacional is on the air from 0900 to 0400 with a power of 10KW.

Radio Nacional da Amazonia, Manaus on **4845** at 0026, OM with a pop song, OM with announcements in Portuguese. An easy one for beginners, it has a power of 250KW and, like the above station, is part of the Radiobras network.

The schedule is from 0900 to 0200, after which time you may be able to log the co-channel R Bucaramanga in Colombia or even R Fides located in La Paz, Bolivia. The latter closes at 0300 whilst the Colombian works around the clock.

On the higher frequencies Brasilia may be heard with signals from Radio Nacional do Brasil on **15270**, at which point on the dial we logged it at 1858 just prior to the station identification in Portuguese at 1900, then into the German programme for Europe, timed from 1900 to 2000.

### Canada

Montreal on **15190** at 0110, OM with a newscast during a Spanish transmission for South America timed from 0100 to 0130 on Sunday and Monday only.

Montreal on **15325** at 1922, OM and YL with a talk about the early colonists in Canada in an English presentation for Europe, scheduled from 1900 to 1930 weekdays only.

### Colombia

Radio Bucaramanga on **4845** at 0350, OM with a local folk song in Spanish, OM with announcements and promos. R Bucaramanga works around the clock and has a power of 10KW.

### Costa Rica

Radio Columbia, San Jose on **4825** at 0513, YL with a pop song in Spanish, OM with the station identification at 0315. R Columbia is listed as being on a 24-hour schedule but has been reported as operating

from 1030 to 0500/0600. The power is 10KW.

Faro del Caribe (Lighthouse of the Caribbean), San Jose on **5055** at 0230, OM with station identification and some news items of local interest. This one is scheduled from 0955 to 1500 and from 2200 to 0430 but has been reported closing as late as 0740 on occasions. An English programme is radiated daily from 0300 to 0400 and the power is 5KW.

### Cuba

Havana on **15250** at 0105, OM with a talk in Spanish during a programme in that language directed to the Americas and timed from 0000 through to 1645.

### Dominican Republic

Radio Clarin, Santo Domingo on **11700** at 0120, OM with a political talk (CID programme) in Spanish, jammed of course. HIUA R Clarin has a power of 50KW and is on the air from 1100 to 0500. Santo Domingo, a seaport on the south coast, is the capital of the Republic.

### Ecuador

CRE Guayaquil on **4656** at 0155, OM with a talk in Spanish about commerce in Ecuador. This one identifies as 'Radio Tropicana' and is scheduled from 0900 to 0430 (Sunday until 0300) and the power is 10KW.

Radio Nacional Progreso, Loja on a measured **5061** at 0237, OM with a ballad in Spanish followed by OM with announcements. RN Progreso can be a little tricky for beginner listeners in that the frequency can vary from **5061** to **5066** although it is listed on **5060**. It is scheduled from 1000 to 0430 (Monday to 0200), but has been noted closing at 0500 and at 0700 on occasions.

HCJB ('Herald Christ Jesus Blessing') Quito on **15155** at 0034, OM with station identification and a newscast in English during a programme in that language beamed to the Americas from 0030 to 0130.

### Guatemala

Radio Tezulutlan, Coban on **4835** at 0216, OM with announcements in Spanish - Coban being mentioned sev-

eral times and then some local music in typical style. R Tezulutlan is on the air from 1100 to 1600 and from 2100 to 0230 with a power of 3KW.

### Netherlands Antilles

Radio Netherlands Relay, Bonaire on **15315** at 0029, interval signal, OM with station identification followed by a Dutch programme intended for eastern North America, western South America and the Caribbean, scheduled from 0030 to 0125.

### Peru

Radio Amazonas, Iquitos on **5060** at 0158, OM with a folk song then OM with the station identification, announcements and promos at 0200. R Amazonas is scheduled from 0930 to 0500 (Sunday until 0230) and the power is 5KW.

### USA

WINB Red Lion on **15145** at 0038, OMs with hymns, OM with a religious talk in the Spanish programme for the Americas timed from 0030 to 0045 (not Saturday or Sunday). OM with station identification in English at 0045.

## ASIA

### China

Radio Peking on **11375** at 1423, OM with a talk during the Kazakh programme in the Domestic Minorities Service. The Kazakh programme is scheduled from 1400 to 1455.

Radio Peking on **11575** at 1421, Chinese music during the Tamil programme for South Asia, scheduled from 1400 to 1430.

### Iraq

Baghdad on **21585** at 1920, OM with a newscast in the Arabic programmed 'Voice of the Masses' transmission, timed on this channel from 0000 to 2305.

### Pakistan

Karachi on **11673** at 1450, YL with local-style songs and music in the Urdu presentation to the Middle East and the Persian Gulf area, timed daily from 1330 to 1600.

### Syria

Damascus on **12085** at 1914, OM with songs complete with music in a relay of the Arabic Domestic Service, scheduled

on this frequency from 0900 to 2200. Ah, Damascus! Well, I never set my eyes on a houri nor a magic carpet but I did see a street magician causing various items to apparently vanish - including my small contribution to his art!

Damascus, or Esh-Sham in Arabic, is the capital city of the Syrian Republic and claims to be the oldest continuously inhabited city in the world.

## EUROPE

### Austria

Vienna on **12015** at 1508, YL with a most interesting talk about religious buildings in Austria and this during an English programme for Europe, North Africa and South East Asia being timed daily from 1500 to 1530.

### Czechoslovakia

Prague on **15240** at 1458, OM and YL with announcements and station identification at the end of the English transmission to Africa, the Far East, the Pacific and South Asia, scheduled daily from 1430 to 1500.


## CLANDESTINE

A Voz de Verdade ('The Voice of Truth') or A Voz de Resistencia do Galo Negro ('Voice of the Resistance of the Black Cockerel'), the black cockerel being the symbol of UNITA, which is hostile to the Angolan government: logged on **4950** at 1847, OM with exhortations in a vernacular. The evening schedule is from 1730 to 1930 on Tuesday, Thursday and Sunday in Portuguese and local vernaculars.

## NOW LOG THIS

Radio Inca, Lima, Peru on a measured **4762.5** at 0333, YL with a pop song, OM with announcements in Spanish. R Inca is scheduled around the clock, but sometimes works from 0900 to 0500. The power is 1KW.

## NOW HEAR THIS

Radio Abaroa, Riberalta, Bolivia on a measured **4718.5** at 0357, YL with a song in Spanish complete with local-style music. Scheduled 1000 to 0400 but varies to 0500 and the QRG can vary from 4715 to 4720: power is 0.5KW. 



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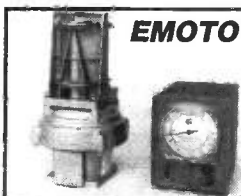
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1352	YK-88SN	1.8kHz SSB filter	33.00	1342	VB-2530	2SW Amplifier	75.00	1303	RA-1	Antenna	8.00
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1327	SP-230	External Speaker	45.00	1311	PB-25	Nicad Battery	26.00				

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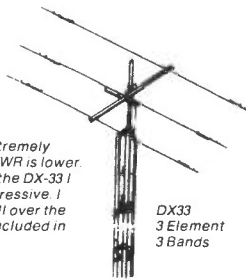
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2. G3AAE This letter is to tell you how pleased I am with the DX-33 antenna. On unpacking the DX-33 I was immediately impressed with the quality of the hardware, and in operation it is just as impressive. I have used it on all three bands and have been obtaining excellent reports from DX stations all over the world. I have conducted tests with other stations and these show that the electrical figures included in the DX-33 specification are fully met in practice. Congratulations on a very fine product!



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

## **Forthcoming DXpedition**

A major DXpedition is currently being planned by members of the West Kent Amateur Radio Society (G3WKS), who are located in Tunbridge Wells.

The objective of the expedition is to establish a station at an identified, if somewhat inaccessible location in Eire, to attempt a *direct* contact between Europe and North America on the two metre band – 144MHz.

Such a contact would be a considerable accomplishment on the band and the group believe that with the right preparation and effort, this world-first contact can be achieved.

The group is currently looking for sponsorship in the form of both radio and other equipment to help achieve the goal. It is intended to make a video presentation of the preparations and the expedition, which will be made available to clubs who are interested.

Activity is also anticipated on other bands; more details will be available as plans progress.

## **The Racal User Group**

Peter Barker, G8BBZ, has written with a view to increasing awareness of The Racal User Group, of which he is organiser.

The group is a non-profit organisation, the aim of which is to enhance the interest and enjoyment of amateur radio enthusiasts who own or use communications equipment manufactured by Racal and now available on the surplus market.

So far Peter has had quite a few enquiries, all of which have received in reply a copy of the Racal User Group newsletter.

Considering the number of RA17/117 receivers that have passed into amateur hands over the last few years, there

should be many amateurs who could benefit from a group like this.

Peter Barker, G8BBZ, can be contacted at *8A Alwyne Place, London N1 2NL*.

## **SSTV activity**

One of the great stalwarts of SSTV, Richard Thurlow G3WW, has written to us with some news of activity (and some inactivity!) in that mode:

'G1AMR Maurice Webb from Prescot in Merseyside writes to me that he and G6YBC were accused of causing QRM on the SSTV calling frequency (144.500MHz) when transmitting SSTV, and told that such actions meant that the Band Plan was not worth the paper it was written on!

'Similar trouble has been found on the HF calling frequency of 14230KHz, although on most occasions here a QSY request, *along with an explanation of that request*, is met with an apology and a quick QSY.

'I had a visit recently from G3UEU John Holmes, an 'old-time' SSTVer who wanted an update on some modern techniques including the new Robot 12 second single frame colour; also, don't be surprised to see GM4WIL back in the SSTV 'fold' shortly with colour.

'What has happened to the 80m Sunday morning SSTV net? Nothing has been noted of it here for months and months. Where is everybody: all listening on 14230?

'Several first time 2xSSTV QSOs in early August, including DL1MY (who says there is a daily EU SSTV net on 7040KHz at 0730GMT), CT1BK, HA3MQ and 4X6LM, have brought my all-time total up to 2031. 73 de G3WW'.

## **23cm TV repeater**

A number of people have expressed interest in a 23cm TV repeater for the Southampton/Bournemouth area.

Several possible locations are being discussed. Suggestions have been made that it may be better to have two repeaters – one for the Poole/Bournemouth area, and one for the Southampton area. This would permit better coverage of the low lying areas in the central parts of Southampton, Bournemouth and Poole.

In order that any proposals can take into account all interested amateurs in the areas concerned, it would be most helpful if those genuinely interested in 23cm TV operation in the areas in question could contact Nick Foot, G4WHO, 47 Mallard Road, Colehill, Wimborne, and let him know of their interest.

## **Amateurs beware!**

Brian Barwick, G1ESG, has written with an instructive tale of an indignant neighbour and a visit from the DTI. All innocent amateurs who would learn the ways of the world, read on...

It all began about three months ago when a young man in a bedsit on the floor below me complained that he was hearing my voice on his AM portable radio when I used my FT290R on 2.5W output.

I visited his room with my rig and, sure enough, when I put the rig on SSB and gave a quick whistle, it came over on his radio.

I explained that this sometimes happened because the front end of many radio receivers was very broad, with poor rejection, and would therefore pick up any moderately strong signal.

No way would our friend have this; he was certain I was doing it on purpose to annoy him. After this I suggested he fill in the proper form from British Telecom and let them sort it out.

He also said that when he listened to his radio in the evening, he could hear 'noises'.

Since I did not transmit at this time I put this down to hetrodyne from other broadcast stations – a frequent occurrence on our overcrowded medium wavebands in the evening.

One afternoon I received a

visit from two men from the Department of Trade and Industry, each with a lot of paperwork under his arm, and each equipped with a hand-held rig.

They asked me many questions about amateur radio, most of which were above the level of the RAE, and I assume I gave reasonable replies as I received nods of approval after each answer.

My licence was examined and, after a brief discussion, one of the men left the room and asked via their radio link for me to give short test transmissions. When he returned ten minutes later, he told me my rig was 'clean'.

Next in line was my log book, which is the standard spiral bound RSGB type. After spending some time looking at my entries, they told me that I should number each page, as this 'official' RSGB log book was 'loose leaf', (a letter I wrote later to the RSGB, however, brought the reply that the RSGB logbook had the full approval of the DTI).

I was also told that I should enter the exact frequency I transmit on, and not the band as I had been taught in RAE classes at college, and as seen in various examples of log book entries in RAE manuals.

Before leaving they recorded their visit in my log book, and added in writing their instructions about numbering each page and entering the frequency used.

After they left I felt that I had been doing everything wrong but, according to all other sources, I had been acting within the terms of my licence. Needless to say, I have now numbered the pages and always record the exact frequency used.

Oh yes, the young man downstairs with his AM radio still wasn't satisfied! I won't repeat what I said! In the end it turned out that his radio was picking up the time-base from a TV next door, which was against the wall and only 9in from his radio!

Everything is peaceful again now. Our furious friend and his radio moved out, still certain that I had somehow arranged all this to annoy him! It is also rather peaceful due

the fact that I left my rig on the bus one day! I was so interested in the very pretty female sitting opposite me that I nearly missed my stop, and had to jump up quickly before the bus pulled away – which it then did, complete with my two metre rig and a very pretty lady!

## Yet another society?

The founding of the *Hilderstone Radio Society*, Thanet, Kent, took place in Nottingham Castle, Westwood during July this year.

The group has evolved from a very successful RAE course run in the local Adult Education Centre last session. The activities envisaged include the usual talks, demonstrations, visits and things like junk sales.

The constitution will make a special point about beginners and listeners, as well as those who are especially keen on constructional work in radio/electronics.

In other words, there will be no prejudice or status differences between those with different interests, ie call signs will not confer status and so on.

All persons interested in the society's venture, irrespective of age, race, sex etc, are very welcome to contact Ken Smith, G3JIX, regarding meetings, visiting and joining. An sae would be appreciated.

## RAIBC

I am sure there must be many readers who are unaware of the activities of the Radio Amateur Invalid and Blind Club, and many who, although they have come across it, have not given it a great deal of thought.

I am equally sure that a great many enthusiasts reading this, sympathetic as they are to the invalid and blind, would want to lend a helping hand to those they see as less fortunate than themselves and who share a common interest in the fascinating field of amateur radio.

If you would like to help, as of course you would, send an sae to *The Honorary Secretary Mrs Frances Woolley, G3LWY, 9 Rannock Court, Adelaide Road, Surbiton, Surrey KT6 4TE.*



*Dr Tim Cole and Dr Roger Whitehead at the Dunn*

## AMTOR at the Dunn

The Medical Research Council's Dunn Nutrition Unit in Cambridge has been a licensed amateur radio club station, G4DUN, since 1976. Part of their work involves research into malnutrition, and they have a research station in Keneba, an isolated village in The Gambia, West Africa.

The radio link is invaluable for keeping in touch with colleagues in Keneba, both for maintaining morale in difficult circumstances and for helping out in the occasional crises that blow up there.

Last year, for example, an epidemic of the potentially deadly disease meningococcal meningitis was averted by the unit being able to obtain the necessary drugs from France and send them to The Gambia, on the same day as the disease was diagnosed in the village.

The club station is run by the Unit's director, Dr. Roger Whitehead (G3ZUK) and Dr. Tim Cole (G4RQH); also newly licensed in Cambridge is Dr. Chris Bates (G1DAR). Roger also has a Gambian licence (C53U) and has previously been an amateur in Uganda (5X5NA).

Six other members of staff have had Gambian call signs

at different times, the current holders being Dr. Bill Lamb (C53EE) and Dr. Mark Lawrence (C53EW).

Until last year they had daily voice skeds between the Dunn and Keneba using a Yaesu FT101ZD transceiver at each end, but with the drop in sunspot activity the skeds became more and more difficult.

The purchase of two ICS AMT-1 AMTOR units in May last year (one for each end) transformed the radio contacts. Previously, anything factual had to be repeated several times, whereas with the AMTOR unit information typed in at one end only appears on the sender's screen when it has been received at the other end.

All the uncertainty about whether or not the message was copied correctly vanishes.

The two AMTOR units, connected to BBC Model B micro computers, are left on standby during the day so that either end can call up the other whenever necessary.

The Dunn uses selcal GDUN, while Keneba is selcal CCEE or (when Bill is on leave) CCEW. They are usually on 21100KHz, so give them a call.

## GBOLMS 17-18 November

To commemorate the birth of Leslie McMichael, 100 years ago, this station will be operated by members of the McMichael ARS from their club in Stoke Poges, Bucks.

Leslie McMichael, who held the callsign MXA from 1913 until the first world war, was one of the founders of the London Wireless Club (later to become the RSGB) in July 1913. He became the first Vice-Chairman in 1914 and then Secretary in 1919.

The following year he was licensed as 2FG, and allowed to use up to 10 watts on 180 metres. The licence allowed him to contact only three named stations!

In 1921, on behalf of the Wireless Society of London, he successfully petitioned the Postmaster General to allow the broadcasting of speech. This led to the establishment of the Marconi station 2MT, which broadcast speech and music for nearly a year, and soon after to the formation of the BBC.

Leslie McMichael was one of the few Honorary Members of the RSGB, and died on his birthday in 1951.

Details of the station from RF Muggleton, G6AMN, 23 Randolph Road, Langley, Berkshire SL3 7QF. REW

# DX-TV

## RECEPTION REPORTS

Compiled by Keith Hamer and Garry Smith

**D**ismal was the best way to describe Sporadic-E activity during the first half of July. This view was shared by many enthusiasts, and as one reader has commented 'as for July, it's the worst ever'.

However, all bad things eventually come to an end and the exotics rolled in towards the end of the month. The 26th was most memorable with the Canary Islands in Leeds, Morocco in Wigan and Greece in Derby. Fortunately, all were showing a test card providing positive proof of origin.

Tropospheric reception in Band III and at UHF was disappointing, with only a few stations centred around Luxembourg received in the north of England on the 5th and 6th.

### DX conditions

July 19th provided an interesting opening from the south-east during the late afternoon with Italian TV signals on channel IA and a strange sounding, but tuneful, signal at 48MHz. This was thought to have been some form of digital transmission. Band I was simply jammed with low-power transmissions such as Italian cordless telephones at 46MHz and 49MHz and various private FM radio links operating between 50 and 60MHz. At least one was heard in stereo.

Early morning DX has been around this year, just in case anyone was wondering! On the 23rd at 0428 BST the Russian electronic colour test card was seen on channel R1, this being replaced by a monochrome pattern, usually termed the 'letterbox' test pattern.

The old monoscopic test card known as the '0249' was seen as a floater just

before reception faded completely at 0450.

The low-power Greek transmitter on E3 has made several appearances this season on both the test card and programmes. It was noted on the PM5534 in Derby on the 26th at 0815, during an opening to Italy and the south-east.

Kevin Jackson in Leeds saw TVE on E3 on a regional bar test pattern, not from the mainland but from the Canary Islands. The pattern carried the transmitter location and channel, ie 'IZANA 3'. It was received shortly after mid-day.

Another exotic from the south occurred during the evening when Arthur Milliken, Andrew Webster and Tony Cater (all of Wigan) were startled by the appearance of the Moroccan PM5544 on channel E4 at 1855. The test card carried the identification 'RTM' with an inscription in Arabic at the top. This was followed by the station opening caption and the Koran at 1900 then programmes and cartoons.

Arthur telephoned to advise that Morocco was present at 1925, but only a very weak signal (a cartoon) could be resolved here in Derby. The E4 sound channel was monitored and during a programme French dialogue was heard.

Strong signals in Spanish were present on E3 during this reception, and the picture quality was very similar to DX via the F2 layer with smeary multiple images, although the signal was stable. Considering the close proximity of the Moroccan transmitter at Laayounne (in the south of the country) to the Canary Islands, it is felt that the Spanish transmission originated from the outlet at Izana.

### DX log for July

This month's log shows the reception conditions noted here in Derby during the month. All times are BST and reception was via Sporadic-E propagation unless stated otherwise.

**2/7/84:** DDR:F1 (East Germany) E4 on colour electronic test pattern from the Cottbus transmitter; ORF (Austria) E2a with the Telefunken monochrome test card.

**4/7/84:** RAI (Italy) IA on programmes during the late afternoon. Many Italian FM private radio links operating throughout Band I were also noted. The OIRT FM band was also very active.

**5/7/84:** TVE (Spain) E3 on the GTE test card during the morning; RAI IA on programmes during the afternoon; JRT (Yugoslavia) E3 seen on 'JRT TV BGRD' PM5544.

**6/7/84:** TVP (Poland) R1 noted on dark background PM5544.

**8/7/84:** TVE E4 motor racing – good colour at 1630.

**9/7/84:** RAI IA on 'RAI 1' PM5544 at 0830; DR (Denmark) E3 with 'DR DANMARK' PM5544; CST (Czechoslovakia) R1 and 2 showing the 'RS-KH' EZO test pattern; TVP R1 on PM5544.

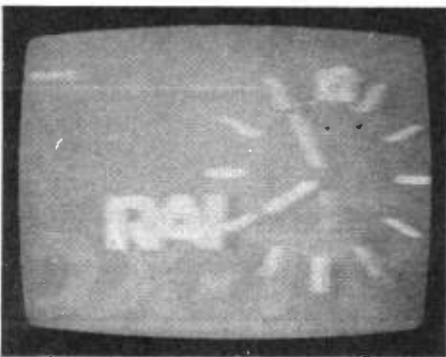
**13/7/84:** MTV (Hungary) R1 on multiburst test pattern at 0843; TVP R1 on PM5544.

**14/7/84:** TSS (Russia) R1 and 2 with programmes – SpE opening in progress at switch on at 0900; RAI IA on PM5544 test pattern; SR1 (Sweden) E2 with 'TV1 SVERIGE' PM5534 at 1235.

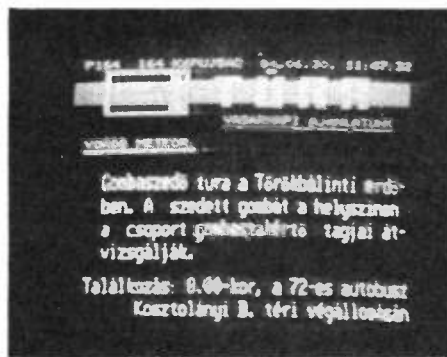
**15/7/84:** TVE E2 and 3 with cartoons, medical programme, M\*A\*S\*H and a David Bellamy nature programme – all good quality, slow fading and in good colour during the afternoon; unidentified meteor shower signal E5; TSS R1 and 2 at 1759 with YL announcer followed by clock caption and BPEМЯ.

**16/7/84:** BR1 (West Germany-Bayerischer Rundfunk) E3 on FuBK test pattern; meteor Shower 'ping' on E5 during the reception of E3 consisting of FuBK test pattern, thought to be of West German origin.

**19/7/84:** TDF (France) Ch5 showing PM5544 test pattern at 0830; CST R1 on 'RS-KH' EZO test pattern; TVE E3 with 'AITANA 3' 'bar' test pattern; DDR: F1 E4



Clock caption radiated by Radiotelevisione Italiana (RAI) in Italy



The Hungarian teletext service 'Képujság'. Photo courtesy of Chris Howles



Programme schedule from NRK in Norway received via Sporadic-E

on colour test pattern; SR1 E2 showing the PM5534; late afternoon opening with RAI IA and many Italian private radio links.

**20/7/84:** TVE E3 and 4 on GTE test card.  
**21/7/84:** CST R1 and 2 on EZO test pattern at 1300; ORF E2a radiating the Telefunken card but switching to the PM5544 at 1315.

**22/7/84:** TVE2 E2 on cartoons followed by 'tve2' caption at 1757. Unidentified golf programme on E3 at 1815.

**23/7/84:** TSS R1 on 'UT 0167' test pattern at 0428 switching to the 'letterbox' type at 0430 – another R1 station showing the monochrome 0249 test card was noted as a floater; YLE (Finland) E3 seen at 0810 showing the FuBK test pattern; SR1 E2 on PM5534 seen during the early afternoon; RAI IA programmes noted late afternoon and early evening; ORF E2a on programmes and previews; JRT E4 with clock and DNEVNIK news at 1830.

**24/7/84:** TSS R1 and 2 with programmes at 0755; West Germany (Bayerischer Rundfunk) noted on E4 with FuBK displaying 'OCHSENKOPF' transmitter identification; BR1 E3 with FuBK test pattern displaying 'KREUZBURG' transmitter identification; CST R1 on EZO test pattern; CST R2 on PM5544 with 'SR1 TV BRATISLAVA' identification; TVP R1 on PM5544; SR1 E2 and 4 showing 'TV1 SVERIGE' PM5534 at 1820; TSS R1 and 2 on BPEMЯ news; unidentified programme on R3 possibly TVP.

**25/7/84:** TDF Ch5 on EBU bar test pattern without identification; TVP R1 on PM5544; YLE E3 on FuBK pattern with 'YLE TV1' inscription.

**26/7/84:** RAI IA with PM5544 at 0800; EPT (Greece) E3 at 0815 on PM5534 pattern; RTM (Morocco) E4 showing cartoons at 1930; also seen was TVE E3 and 4 with film clips.

**29/7/84:** RAI IA on test pattern during the morning; TVE E4 with programmes noted at switch on at 2015.

**30/7/84:** TVE2 E2 with standard colour bars; TVE1 E3 and 4 with Olympics; RAI IA showing Olympics.

**31/7/84:** RAI IA from 0755 showing bland raster and PM5544 until 0830; unidentified test pattern consisting of colour bars with the lower 2/3 blank.

## Reception Reports

Iain Menzies of Aberdeen found July 26th an interesting day with two mystery signals from 1840 onwards. The first consisted of colour bars but with the lower half reversed. Iain hasn't supplied channel details but the mode of propagation was meteor shower.

The Spanish 2nd network was seen later on E2 but incredibly there were two stations floating. As far as we know there is only one TVE-2 outlet and that is situated at Santiago on the northwest coast.

One theory for the two TVE-2 signals is that during the multiple-hop Sporadic-E reception from Morocco and the Canary Islands, the TVE-2 signal also travelled south and was reflected back towards the UK, thus producing a standard SpE signal together with a multiple-skip signal. Reception lasted for approximately 30 minutes.

Iain has been evaluating the Sinclair multi-standard flat-screen mini-TV while on holiday in Italy. The profusion of private TV stations on every UHF channel resulted in a good test for the Sinclair in terms of selectivity. Unfortunately the limitations were noticeable at times, especially under strong signal conditions on adjacent channels.

Andrew Webster (Billinge, Wigan) heard Arabic wailing and music on the E2 sound channel (53.75 MHz) on July 30th shortly after 1300 BST. Although Andy's E2 vision channel is partially obliterated by the BBC-1 Holme Moss sound channel, there were signs of a PM5544 test card breaking through. Could this have been another exotic from the Middle East?

The relatively late time for the test transmission tends to rule out countries such as Dubai which is occasionally received in the UK via Sporadic-E. One likely possibility is that the signal emanated from the new Egyptian 2nd network transmitter at Dumyat. This has an ERP of 900 watts.

Kevin Jackson (Leeds) reports snow-free pictures from Luxembourg on channels E7 and E27 on the 6th. West German DX came from Grosser Feldberg with Hessischer Rundfunk (HR-1) trans-

missions on E8, ZDF on E34 and the HR-3 service on E54.

An excellent Sporadic-E opening occurred on the 24th with reception from many countries. The Rumanian FuBK test card was logged on R2 at 1245 with the identification 'TVR BUCURESTI'. A little later two Bayerischer Rundfunk (West Germany) stations were noted radiating the FuBK pattern with transmitter identifications 'KREUZBURG' and 'OCHSENKOPF' on channel E3 and E4 respectively.

Clive Athowe (Blofield, Norwich) has sent us a log for DX-TV reception noted during June. His log didn't quite make it in time for the last column. Of importance was the reception of Italian Band III signals on channel D (E5, 175.25MHz) between 1015 and 1030 on Sunday June 17th. So keep a watch on Band III!

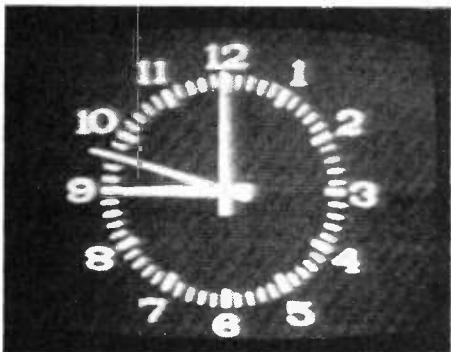
Bob Brooks witnessed a sustained Sporadic-E opening from the south during the afternoon of the 15th. At his home in South Wirral he saw Spain in colour on E3, with cartoons and an episode of a Thames TV nature series featuring David Bellamy dubbed in Spanish.

Bob has sent a photograph of a caption featuring the letters 'EPP' and wonders where it originated from. It is in fact the logo shown between commercials on Yugoslavian TV, sometimes received on channels E3 and E4.

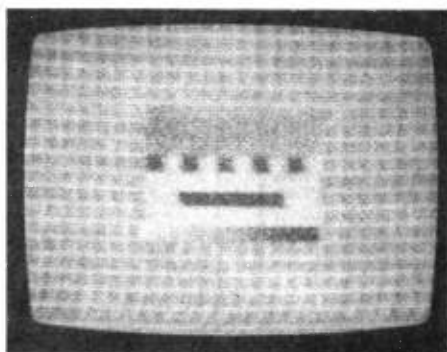
Chris Howles of Lichfield has noted several European countries this season. He too has noticed the general lack of activity during the first two weeks of July. His DX equipment consists of a multi-band Plustron TVR 5D portable with 5.5MHz and 6.0MHz sound, a VHF to UHF converter feeding a video recorder, and more recently, a D-100 DX converter feeding a standard UHF receiver.

His Band I array is mounted in the loft and is, unfortunately, not rotatable. Recently Chris was able to record a sample of teletext pages radiated by Magyar Televizio (MTV, Hungary) prior to programmes. The results are shown in one of this month's photographs.

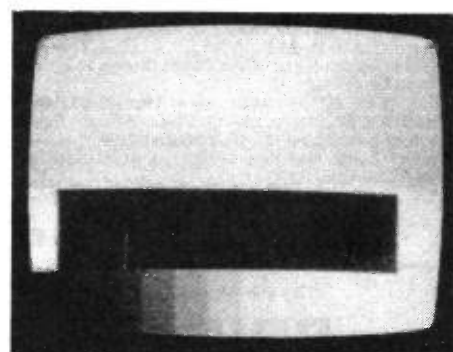
He has also seen a PM5544 test card on channel E8 in Band III from time to time, just above noise level. This is almost



Russian clock caption shown prior to the main TSS news programme.



Electronic test card received from Russia (the 'letterbox' pattern).



EBU bar pattern transmitted by the fourth network in France, 'Canal Plus'.



certainly the Belgian French-language service from the Wavre outlet.

Simon Hamer of Powys has sent in a full log for July with reception in Band I from 14 countries. Towards the end of the month he noted the Swiss FuBK test card on channel E2 with the identification '+PTT SRG 1'. On the 21st Simon received the 'ORF FS 1' Telefunken test card on E2a from Austria, the MTV-1 'BUDAPEST' PM5544 from Hungary on R1 and a grid pattern on channel E2 from TVE in Spain.

He also saw Denmark on E3 and E4 with the news programme called 'TV Avisen', programmes from TVP in Poland on R1 and a programme with subtitles at 1855 on E2 and E3 from Sveriges Radio in Sweden.

On the 23rd, Rumania was noted on R2 with the news programme from TVR called 'Telejurnal'. It featured an item about the miners' dispute in the UK.

### Mancunian pirates?

Several enthusiasts in the north-west of England have been mystified by the presence of a strong 625-line transmission towards the upper end of Band III. Transmissions normally commence during the late evening and a chequerboard pattern is often displayed.

The station's output occasionally takes the form of typical 'amateur shack' activities. The signal is not usually present on the ATV band and it appears to come from the Manchester area with reception reaching as far as South Wirral.

Can anyone supply further information on this subject?

### DX equipment and aeriels

Tony Harris (Fareham, Hampshire) has sent details of the Luxor SX9 colour TV receiver which he is using. Tony's version will receive PAL systems B,G and I, SECAM B and G, SECAM L (French) and NTSC.

The latter is for VCR/satellite use only. The receiver has 100-channel capability covering all bands and channels from E2 upwards.

Different TV standards can be memorised on particular selector buttons. The receivers are available, to order, with 5.5MHz and 6.0MHz or 5.5MHz and 6.5MHz sound options.

An excellent brochure is available from the *Technical Services Manager, Luxor (UK) Ltd, 87-89 Farnham Road, Slough, Berkshire SL1 4UL*. An accessory/option leaflet is also available.

*Protel Aerials and Communications of 295 Ballards Lane, London N12* have sent

their latest aerial and accessory catalogue. Of interest to DX-TV enthusiasts is the wide range of grouped and wideband UHF systems available, such as the Triax BB Grid and the Antiference XG21. A Band I/III diplexed dipole assembly is available for DX VHF reception, although it is best suited for strong signals only. Specialist aeriels are available to order.

### DX-TV converter

Following many enquiries about the DX-TV converter featured in the August 1983 issue of R&EW, a ready-built updated version is now available to order. Known as the D-100, it is distributed by *HS Publications, 17 Collingham Gardens, Derby DE3 4FS*.

We have just one item of Service Information this month.

The new independent TV service operating in the black township of Bophutswana (BOP-TV) is currently being jammed by the main state-owned network of the South African Broadcasting Corporation (SABC/SAUK). Apparently BOP-TV are transmitting programmes which are politically embarrassing to the government of South Africa.

The identification caption used by BOP-TV was featured in the April 1984 edition of R&EW. REW

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## NEXT ISSUE

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Nigel Cawthorne G3TXF describes the operation of one of the newly franchised cable companies

### **COMPUTING — MAIDENHEAD**

Brian Kendal G3GDU & Jeff Howell G4BXZ present 3 short programs dealing with the various aspects of the Maidenhead Locator system

### **UoSAT 2 TELEMETRY ON THE BBC COMPUTER**

Terry Weatherley G3WDI on decoding the tones from the UoSAT 2 satellite using the BBC micro computer

### **DATA FILE**

Ray Marston takes a look at opto-electronics

### **SPEECH PROCESSOR**

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# ATV ON THE AIR

Presented by  
**Andy Emmerson G8PTH**

**W**hether you would believe it or not, I have a job each month deciding what to put in this column. Not because of shortage of material: I'd have a job to run out of things to say about ATV. But I try to set down what I think would be useful to ATVers and the only way I can do this is from feedback.

With a national magazine this is not easy, and there is a danger of assuming that your own local 'crowd' is the centre of the universe and what they are up to is what everyone else is doing. This is obviously not the case, and I have promised to print no more G4MDU/G6LTZ pictures (my local emporium has stopped stocking this magazine as these pictures upset their customers – who wants to offend their local shop even if these people are ATV megastars?).

Sorry about that, especially if it doesn't make sense, but it is the silly season...

Feedback: well, there doesn't seem to be much through the magazine (perhaps *R & EW* readers cannot find the time to write), but I do hear comments at rallies (and in the local emporium). Two comments I heard recently led me to sort out the material for this article.

## Too much 24cm?

Complaint number one was that there was too much emphasis on 24cm. Everyone knew that it was only for local contacts, and even if it wasn't, it was too expensive. Apart from the cost of the rigs you had to spend a fortune on feeder and antennae.

Point number two (this wasn't a complaint, fortunately) was that horn antennae looked 'fun things' and they would be nice to try on 70cm or 24cm because the gain ought to be phenomenal.

OK, let's deal with both these points, because other people may be thinking along the same lines. Is there really too much emphasis on 24cm in the magazines?

I don't really think so: the point is that it is an area for experimentation which is genuinely fascinating to a number of people. FM is different and many folk like playing with new circuits. It makes a change from erecting Slim Jims in the loft, too. With careful engineering a 24cm system gives results very comparable to 70cm, so forget all that 'local QSOs only' nonsense.

Yes, feeder is expensive. Or is it? What will it cost you?

Most people will get away with 10

metres (from an upstairs room to the roof), and using H100 co-ax at 85p a metre this will cost you just £8.50. Less than you spend on this magazine in a year, and it will last you many years.

## Aerials

Ah, but the aerials for 23 and 24cm are dear ... Yes, if you buy something like a commercial corner reflector, but you are not obliged to buy other people's products. A couple of months back I published in our sister magazine *'Amateur Radio'* a simple and easily reproducible design for a 10dB gain horizontal stack array. The details also appeared in *'CQ-TV'*.

If this design did not appeal to you read on. One of the fun things about amateur radio (and we *are* allowed to enjoy the hobby!) is experimenting with aerials. So many people think only in terms of commercial offerings and stock up whatever the local dealer stocks. Once it's up it stays there until it falls to pieces or the masthead changeover relay fails (or whatever).

In truth, a lot can be learned by trying out alternative designs, and if you are prepared to make them yourself this need not be an expensive exercise. Materials are straightforward and can be found with just a little shopping around (if you are not sure where to buy, ask on the air or at your local radio club). The most that you will need to buy are things like thin brass tubing (from hobby or model shops), welding rod, thin wire and aluminium tubing.

So, let's build some really exotic aerials and have them guessing at the

local club when you say you are using a Skeleton Horn or a Sterba Curtain.

You may not achieve the greatest gain for the size of antenna, nor the world's best engineered aerial. On the other hand you won't have spent a fortune either and you will have a working antenna.

A bonus is that the designs described here are not over-fussy on dimensional accuracy, unlike long yagis, so if your workshop facilities are the kitchen table don't worry!

The 'Worthing' type of horizontal colinear aerial is just one example of a class of antennae known as phased arrays. When you arrange a number of dipoles (full or half wave) and feed them in phase you get a phased array. By putting reflectors behind the array you ensure that all the energy is beamed in one direction.

## Sterba curtain

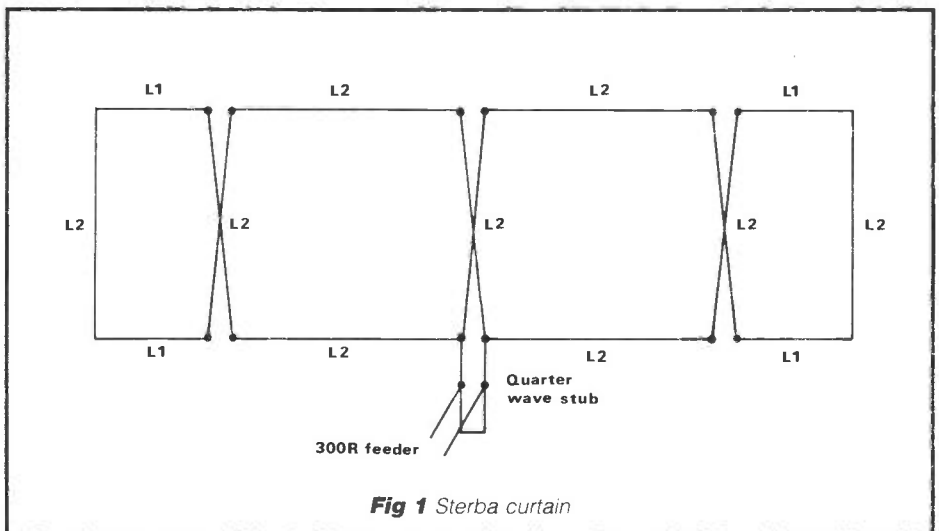
There are many designs of phased array, and one allegedly popular on the HF bands (how would I know?) is the Sterba Curtain. It works at UHF as well, of course, and has the advantage of being much smaller at 'our' frequencies.

The design comprises arrays of half-wave elements stacked vertically, the ends being terminated in quarter wave sections. Vertical spacing is half a wavelength.

Figure 1 shows the basic arrangement, and here are the dimensions for the elements:

Freq	L2 (half wave)/ins	L1 (quarter wave)/ins
432	13½	6¾
1215	4⅞	2⅞
1296	4½	2¼

The gain of the six element aerial shown is about 8dB; this can be increased to about 11dB by arranging another curtain a half wavelength behind, fed out of phase. This means with



parallel feeders, not crossed over as on the 'Worthing' array. The extra half wavelength the signal travels to reach the rear curtain reverses its phase relative to the front curtain.

Gain can be increased further by adding extra pairs of elements in the horizontal legs (see *Figure 2*).

The type of wire used to make this aerial is not really critical, and I would suggest you try 12 or 14 SWG enamel wire or normal insulated hookup wire. The feed impedance of these antennae is 300 ohms, and you can use good quality ribbon feeder from the feedpoint to wherever you transform to 50 ohms coaxial feeder. The spacing of the wires at the feedpoint should match that of the ribbon feeder (1/2 inch).

Note the quarter wave stub: use crocodile clips on the feeder and an SWR meter, then slide the feeder up and down to find the best spot. Make a permanent joint afterwards.

You will find more on the theory of matching stubs in the RSGB VHF-UHF Manual.

The length of 300 ohm feeder should be short, and then, if you are wondering how to transform the 300 ohms balanced down to 50 ohms unbalanced, take a look at the 'Worthing' antenna in July's 'Amateur Radio' (page 69).

This shows a printed circuit balun, and while I have details of other patterns using semi-rigid coax or pieces of brass tubing they are neither so compact nor as easy to weatherproof.

The only other thing I should mention about Sterba Curtains is their radiation pattern, which is narrow horizontally and fairly broad vertically. If you put in more horizontal elements, as in *Figure 2*, it should even things up. It would be fine for meteor scatter, though not so good as a search aerial.

### The horn aerial

But now for something completely different; the horn aerial. Unlike most other aeriels it is non-resonant (not cut to a particular frequency), so it will work on several bands, the gain increasing with frequency. And whereas most antennae are derived from transmission line principles, this one comes from waveguide theory.

The principle of a horn is a gentle change in the spacing of a transmission line inducing the radio wave fields to spread over a sufficiently large area so as to rush off into space (or something like this). By making the transition from small area to large very gently you avoid any disturbances.

To achieve this fascinating effect you need large surface areas, because below a certain size the antenna acts merely as a highpass filter with sharp cutoff, ie open circuit.

Horn antennae are normally made of solid material which would make a pretty unwieldy structure, but we can 'cheat' by making a skeleton affair, leaving off two sides. The other two sides are made of wire, with wire mesh covering. The holes in the mesh should not exceed 0.01 of the highest wavelength to be used. You retain the vertical sides and leave off top and bottom to get horizontal propagation (the reverse for vertical).

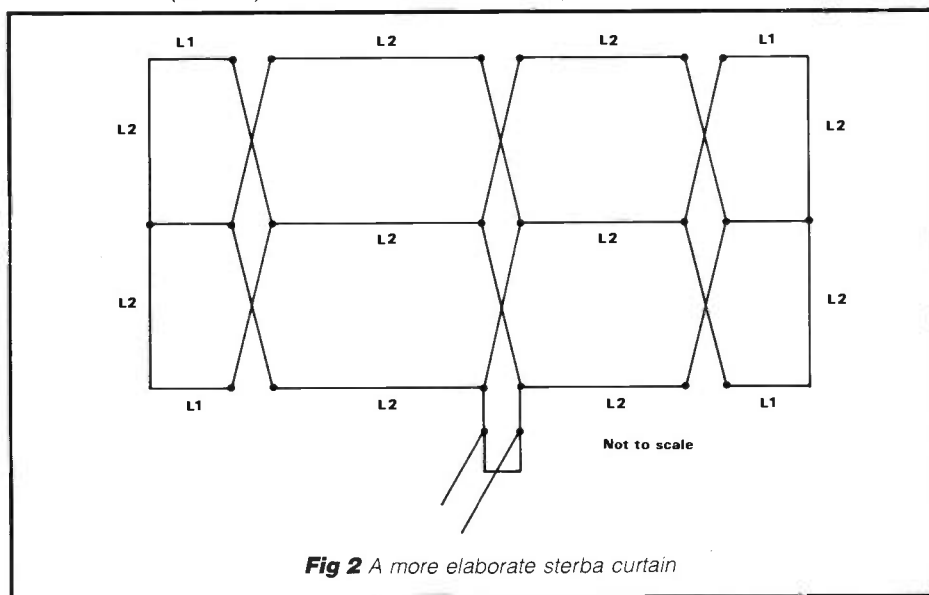
It is difficult to draw a three-dimensional affair in perspective but *Figure 3* should give the general idea. Imagine a horn with a square aperture and sides the same length (L) as the square sides of the aperture. As it is a wire antenna you will need a balun to get the impedance down to 50 ohms.

The table gives the theoretical gain achieved for various lengths of L. It looks very tempting ...

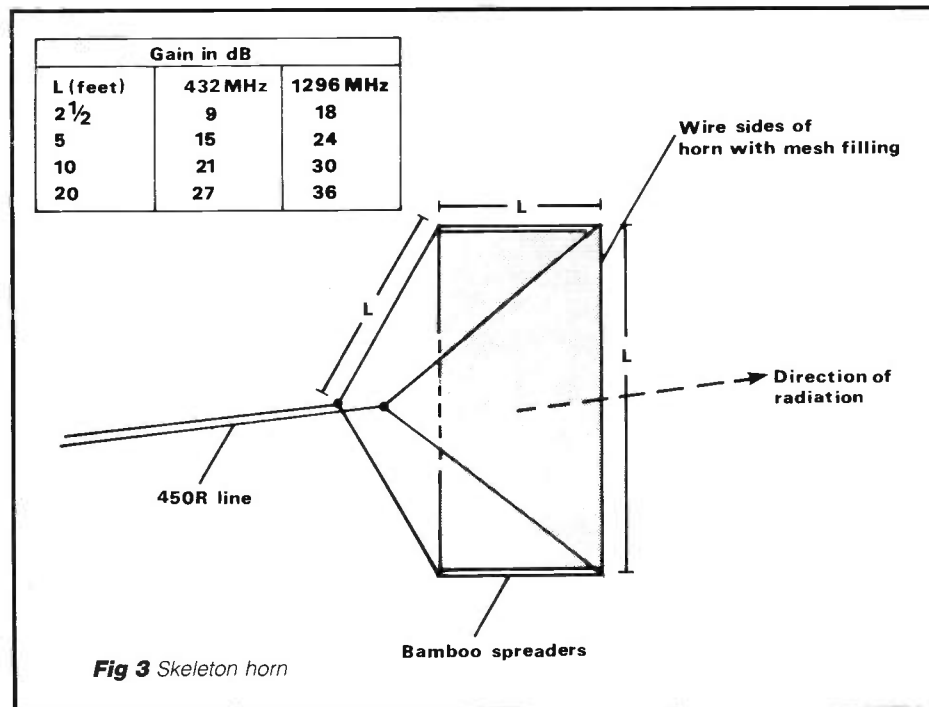
### Do something different...

I hope this has stimulated your interest in doing something different with aeriels (I won't tell you where to put them!). Do write in and tell us your results if you make them up!

If you wish to experiment further I suggest you take a look at the RSGB and ARRL VHF manuals. The best antenna manual I have found is the 'VHF Antenna Manual' by Alex Barvicks, WB4RVH. In 93 pages it combines theory and practical designs, with the emphasis on a large number of the latter. The publisher is 73 magazine in the USA and price here is £4.95. I got my copy from Dillon's University Bookshop in London. **REW**



**Fig 2** A more elaborate sterba curtain



**Fig 3** Skeleton horn

# Amateur RADIO

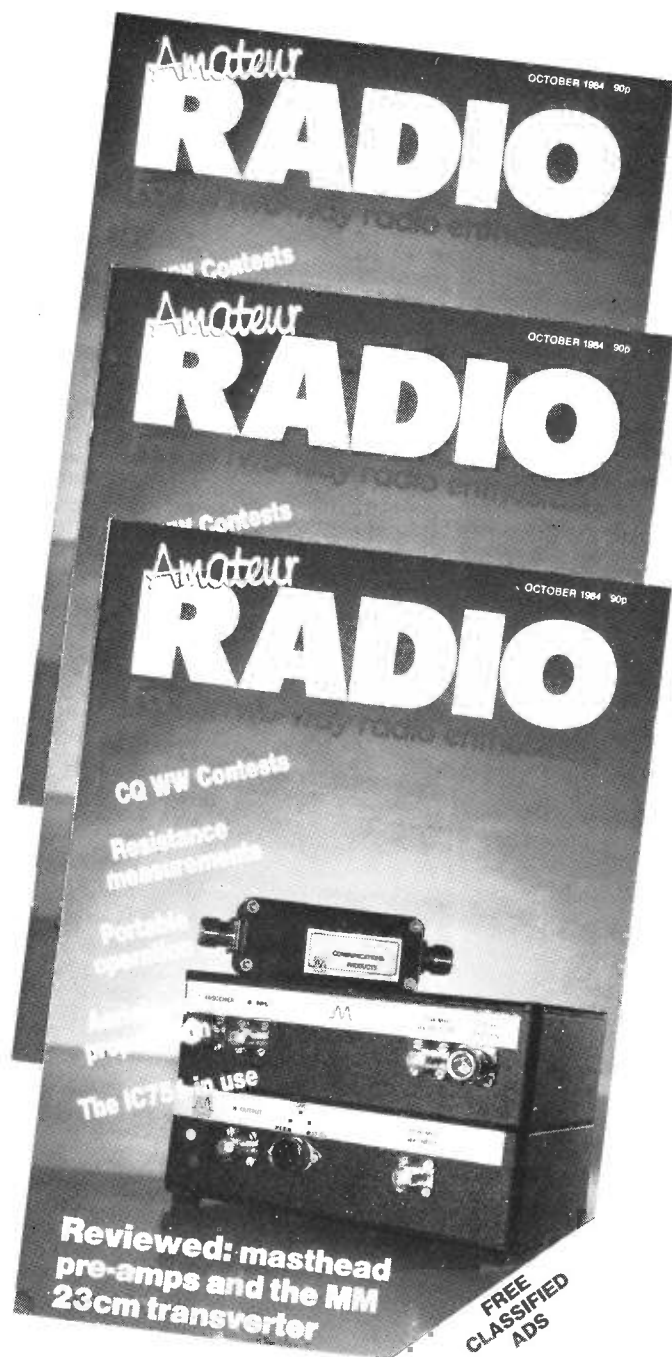
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# TIPS FOR CONSTRUCTORS

## PAUL WESLEY WARREN

It sometimes seems that there are not many of us left in the electronics home construction hobby. I feel, however, that with the soaring prices of imported commercial gear and overpriced 'kits' we will see a vast return to home construction.

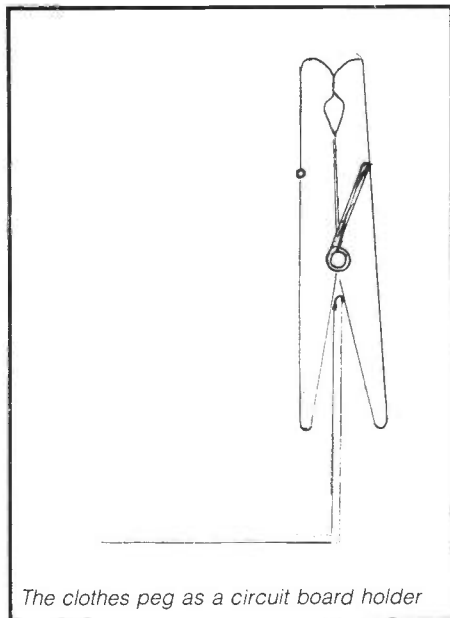
Through necessity home constructors are, in my opinion, a collection of scroungers, as we have to be prepared to pick up what we can in the way of surplus gear and modify it to our particular needs in order to keep costs within reasonable limits.

Sadly, however, the surplus markets are now drying up, and what is left is over-priced obsolete junk of the valve era; so we find we have to look to other areas.

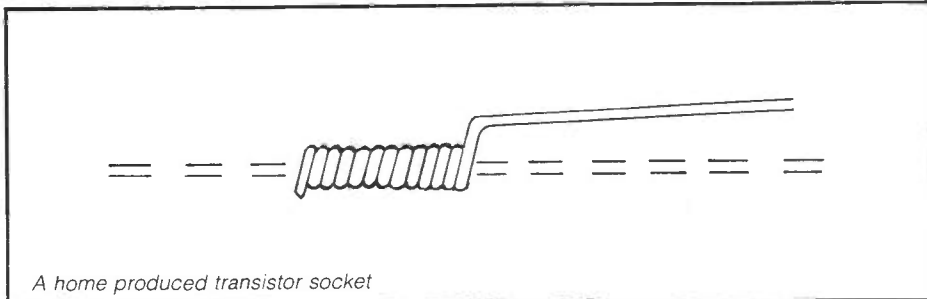
If you have dealt with commercial circuit boards you will have noticed how flimsy the foil is; you only have to leave the soldering iron on just a fraction too long and the foil starts to peel off. It is always a good idea to have a good circuit diagram to hand before you start, with all the colour codes, so that you can relocate those fine little wires as soon as they come adrift, as they surely will.

### Transistor testing

If you wish to determine whether a transistor will work in any particular application I have always felt that the best method is to try it in the actual circuit. I have an old CB handheld rig and a VHF pocket tranny for just this purpose, but soldering and unsoldering transis-



*The clothes peg as a circuit board holder*



*A home produced transistor socket*

tors in a circuit causes problems, as mentioned above.

### Sockets

If you have an endless budget, you can of course purchase transistor sockets, but really this money would be better spent on something else, and the delivery period involved will only strain your patience.

You can make your own sockets for transistors and ICs using silver coated telephone wire, if you can get hold of it, or similar 26swg wire. Cut the wire to lengths of about 6-8 inches for as many sockets as you require, and strip off the plastic coating. For standard transistors you will require three or four pieces for each, but more for certain types of IC.

The socket is made by wrapping the length of wire about a dozen times around a former, leaving a 1½-2 inch lead.

For ICs, with pins close together, this former should be another piece of the same wire. For transistors, insertion can be made easier by using 18swg wire.

The same technique can, at a pinch, be used for jack sockets. 18 or 16swg wire, wrapped in the same manner around a suitable former, then fastened to copper tracked veroboard, will make a temporary, if not exactly attractive, socket.

### A third hand

Another old gem that can be used as a reasonable substitute for the 'helping hands' type of accessory is the old spring loaded clothes peg. We all seem to need three hands on occasions, especially while working on PCBs, and in this situation a couple of these pegs are a rather cheaper alternative.

Simply clip the pegs to the circuit board and place them upside down on the edge of a biscuit tin. This gives the added benefit of being able to keep components required in the tin, so that they don't wander off.

A more permanent version of this can

be made by screwing the pegs to a secure base, such as a 2 x 4 inch block of wood, or to the workbench itself.

There are many household items that can be used in hobby electronics projects, a few of which are detailed below. Don't be afraid to let your imagination run loose, or let conventional ideas stand in your way.

### Bic

The sawn-off 'Bic' pen shell is familiar to most in the role of anything from coil formers to circuit board mounting spacers.

The front of your latest project can be protected using clear self-adhesive book covering – this will stop Letraset labelling from rubbing off, as well as protecting paintwork.

Clear plastic cassette cases, carefully trimmed, make good dial covers, or dial pointers when cut into narrow strips. Plastic protractors are also excellent as analogue tuning scales.

Old six volt lantern battery cases, tops temporarily removed along with the four battery cartridges and any thin plastic partitions inside, make ideal cases for small dc voltage supplies, to operate radios and tape recorders etc.

Plastic spice cans (for black pepper etc) can be used as coil formers for ATUs; lined with contact adhesive and foil they also make good coil or small project screening cans for VHF RF amplifiers.

### Lights

6 and 12 volt Christmas tree lights are a cheaper source of panel and dial lights, especially if you can get them at a discount after Christmas. They are also a convenient way of providing fused voltage dividers if, say, you have a 6 volt radio you want to power from a 12 volt car battery; simply insert a 6 volt bulb of this kind in series. Of course, you can do the same thing with a resistor, but a resistor doesn't look as pretty!

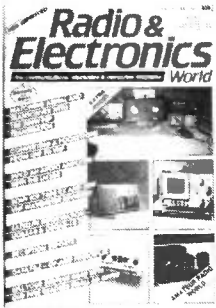
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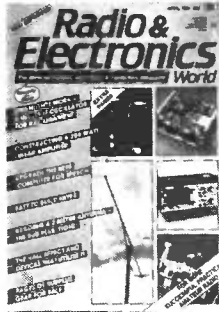
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### MARCH 1984

**Designs** — Modifying the Pye PF1 Pocketfone Receiver; Communications Building Blocks (IF Amplifiers); One Night's Work (Audio-Amp); 200W PEP Transmatch.  
**Features** — Sony ICF 7600D Receiver; Data File on Op-Amps; UOSAT-B; AKD Absorption Wavemeter; Data Brief — Hitachi HA 1197 AM Tuner; Oscar 10 and its Orbit Parameters; Programmable Sound Generator (the AY8910 family); Random Morse Computer Program; ICOM World Clock.



### APRIL 1984

**Designs** — One Night's Work (IF Oscillator); HF Linear Amplifier; The Piano Keyer — only £5 for Perfect Morse; Peak-Reading LED RF Wattmeter; Speech and the Computer — Make the Beeb Micro Talk!; 2 Metre Tiger Antenna.  
**Features** — Hall Effect Devices — Exploiting Magnetism's Effect on Conductors; Data File — CMOS Bilateral Switches and Multiplexer/ Demultiplexer ICs; Data Brief-TD 2002A Linear IC



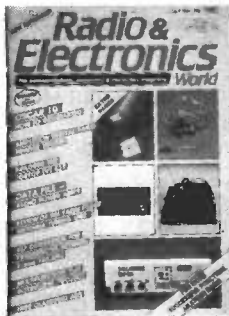
### MAY 1984

**Projects** — One Week's Work (VHF/UHF Frequency Meter); Spectrum Analyser Update; Assembling a Logic Probe Signal Generator; 2 Metre J-Stick Aerial; SX-200 Relative S-Meter.  
**Features** — Data File — 4046B Phase-Locked Loop CMOS IC; Hamey HM203-4 Oscilloscope review; A Beginners Guide to Meteor Scatter Propagation; High & Low Measurements — A Guide to Measuring Outside the Conventional Ranges



### JUNE 1984

**Projects** — Microprocessor Controlled Dot Matrix Printer; One Night's Work — Replacement Plug-in Module for 2532 EPROM; A low-cost Frequency Standard; Radio Frequency Bridge; Modifying the RGB Interface for the Ferguson TX90.  
**Features** — High Speed Data Transmission; Trio-Kenwood TS-430S Transceiver; ZX Spectrum Data Transmission Program; Data File — National Semiconductors LM Range of Dual Audio-Preamplifier ICs; Data Brief — MC 1648 (SL 1648) Voltage Controlled Oscillator; HP41CX Calculator Review



### JULY 1984

**Projects** — VLF converter, a unit for the very low frequency; Teleprinter Terminal Interface; Multifunction Test Instrument, a versatile piece of test equipment; Building the Fortop TVT-437; Improving Indoor Aerials, getting better reception without an aerial amplifier; Logic Probe for CMOS and TTL's.  
**Features** — Amplicon Digital Panel Printer; Oscar 10; Yaesu FC102 Review; Data File — audio power amplifiers; Images of the World, a new publication review.



### AUGUST 1984

**Projects** — High Quality Directional Coupler, a coupler for frequencies above 432 MHz; QV06-40A Linear amplifier, a 100 watt valve linear amplifier; 40ft Tilt-over and extending mast, a home construction project; One night's work, adapting a portable typewriter; BBC Micro volume control; TV and Video interface.  
**Features** — Twenty Questions; Sporadic-E propagation; Data File — Audio amplifiers; BBC Micro Morse tutor; Improving Resistors; Data Communication; Computing Transmission Lines



### SEPTEMBER 1984

**Projects** — Low Power Transmitter, an 80m CW design; AM RAD, an experimental signal generator; Spectrum Analyser, further update on this project; Five Station Scanner, an add on unit for the 720 channel airband receiver.  
**Features** — Computing Inductances, a program for winding coils; Data File, a look at alarm systems; Satellite Update, more information about weather satellites; Noise, a look at this electronic phenomenon; Distance and Bearing Program, an aid for station location; Super-Transmatch, a review of Tau Systems ATU kit.



### OCTOBER 1984

**Projects** — Base Mic, construct this processor controlled accessory; One night's work, build an indoor UHF TV aerial.  
**Features** — Modems, the link between computers and radio; Non-linear elements, a look at multipliers; Data File, continuing the look at alarm systems; SSTV for the BBC Micro, getting started in this mode; Testing! Testing! how to use your test gear; multimeters.

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■ Oscilloscope Tequipment D83 with dual Y and X plug-ins. Delayed timebase, 50MHz, fully transistorised. £600 ono. (Cost new, circa £2,500). Fluke 895A dc differential voltmeter 1mV-1000V, very accurate instrument. £60 ono. Avo IT169 transistor tester. £15 ono. All in very good working order and complete with manuals. Tel: Stoneyburn, Scotland. (05016) 231

■ Hacker Sovereign Mark III, model RP72MB AM/FM portable radio. Mains or battery operation, long, medium and VHF bands. Rosewood and black finish, perfect condition, absolutely as new. Complete with full servicing data. Cost over £80, accept £45 ono. Tel: Reading 883799

■ Radio text books (12). Various titles and dates, from 1935 to 1956, including 1937 edition of Radio Engineering by F E Terman. £10 the lot. Tel: Reading 883799

■ Cobra 148 GTL DX slo, lo, mid, hi split frequencies. Also BV131 linear, converted professionally AM/FM 10watts input, 200 out. SSB input 20watts in, 400 out. Both above equipment in good condition, to be sold together. £160. Contact Dave. Tel: Lincoln (0522) 43642

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■ Cobra 148GTL Dx multimode, plus Bremi 200W linear. £160. Tandy DX100L receiver. £40. Tandy Pro 53 VHF/UHF 8 channel scanner receiver, requires crystals. £25. All items ono. Tel: St Albans 39333

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■ Commodore Vic20, colour micro computer, expanded to 16K. Absolutely perfect condition, comes with approximately £170 of software. Will sell for £200 or swap for general coverage Rx (Yaesu FR7700 or similar). Tony Sheach, 8 Struan Road, Portree, Isle of Skye, Scotland IUS1 9EG.

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■ Fully protected PSUs 30A, £40. 20A, £32. Iambic keyer. £10. RTTY tones gen board. £5. Pye Vanguard, good for spares. £2.75. 2m FM Tx. £10. Hudson Tx/Rx. £9. Morse practice oscillator with Morse key. £4. Over voltage protection module, just fits between rig and PSU, gives instant protection. £5. Large aluminium box for project. £3. Gino Martorano, 81 Sapcote Drive, Melton Mowbray, Leics. Tel: (0664) 500228

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■ BBC micro B DFS Econet, as new, very little used. £325. Also Yaesu FRG-7 communications receiver, good condition. £110. Tel: Pontypool 58108

■ AOR 2001 receiver, with power supply. £295. Tel: Telford. (0952) 814814

■ Icom ICR70 with FM. £380. Heathkit 4amp 13.8 volt PSU. £30. Emoto rotator 103 SAX. £60. Wood and Douglas 2 metre receiver, 40 channels, 10 channel scanner LED channel display built into metal box. £50. SR9 2 metre receiver. £20. Heathkit GDO. £20. Heathkit RF signal generator. £20. Amtech 200 ATU. £15. Tel: (0376) 23604

■ Tequipment 'scopes S51 single beam and D52 double beam, with manuals and circuit diagrams: S51, £30. D52, £50. Both items in working order. Buyer to inspect and collect, if at all possible. Also photocopy manual for Tektronix 545A 'scope. £3 ono, plus postage (quite bulky, weight 1 $\frac{3}{4}$ lb). D Russell, 9 South Beach Road, Ardrossan, Ayrshire KA22 8AX. Tel: (0294) 64144

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■ KW 103 SWR power meter. £20. Datong RF speech processor. £25. Morse RTTY reader. £50. Commodore dot matrix printer. £200. Practical 64 spread sheet disk. £25. Commodore 4040 dual disks with dams interface for 64. £500 or swap 1541 plus £350. Tel: Dave. Hornchurch 55733 (evenings/weekends) or work 01-594 3495

■ Gear for sale - property of Silent Key Colin G8TTA. Heathkit equipment as follows: all complete with manuals. CO1015 ignition analyser (5in CRT) £48. IG 5280 RF oscillator £9. IG 5282 audio generator (sine/square) £11. IPA 5280-1 power supply for IG5280 series £9. IG 4505 oscilloscope calibrator £24. ID(4) 101 electronic switch £12. HD 1250 Solid State dip meter 1.5-250MHz £31. IT 7410 logic probe TTL/CMOS £10. IT 12 signal tracer £12. IM 18 vacuum tube voltmeter & RF probe £27. IT 28 capacitor checker £13. IT 121 FET transistor tester £17. AR 240 HT synthesised 2m transceiver £68. UHF TV colour bar generator £54. AVO model 8 MklII multimeter £57. SMC 150 PL 50 ohm dummy load 150W £15. SMC T3-170L SWR/power indicator £10. Revco MA 200 mag-mount with 2m 1/4 & 1/2 wave Aes £9. Black & Decker metal detector £5. Amplifier 125W 2m in di-cast box (1.5W input) £18. RCA 3in oscilloscope BW flat to 500 KHz £33 (1MHz at 6dB sweep to 350KHz-125Vac mains input). Rs auto transformer 100VA tapped 240/115 etc £15. E & V 250V Meggar (hand cranked in case) £48. 12V 8A power supply £32. 500mA psu tapped 3,4,5,6,7,5,9 & 12V £8. Third hand PCB clamp £2.50. RCA Volt-Ohm milliammeter £12. EICO R & C substitution box £6. Sinclair ZX80 16K RAM pack ZX80 stabilised power supply - best offer secures. RSGB publications as follows: Interference Manual 2nd edition £1. Amateur Radio Operating Manual £2. VHF/UHF Manual 3rd Edition £2.50. Test Equipment 2nd Edition £2. Amateur Radio Techniques 6th Edition £2. Radio Data Reference Book £1. Miscellaneous books as follows: 5 in no-books on Oscilloscopes £2.50. 4 in no - books on Test Instruments £3.9 in no - books on TV Servicing £4.50. 4 in no-books on Radio Servicing £1.50. 11 in no-Bambi paper-back Instruction books £3.50. 12 in no-General Radio books £5.2 in no-books on Gyroscopes £1.7 in no-books on Calculator/Microprocessors £4.50. Sales are to be on the basis of purchaser collects or pays postage in advance. Contact G4DIU or G6QY, both QTHR.

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■ PYE lynx TV camera with lens and remote panel £40. Creed 444 integral loop PSU and TTL drive £45. Teletype 33 spares small quantity available, new. 12V 5A Coutant PSV £10. Unused Digi Data 1/2'9 track tape transport, logic control up to 16K Byte sec two available including manuals, offers. Versatower P40 complete with large 4 bed house £52,000 cannings 23 parkways, Oulton, Leeds LS26 (0532) 828994 after 1700

■ Panasonic DXTV receiver TR-5032G. Bands 1/3/4/5 5.5/6 MHz bandwidth. Works on ac mains, batteries and car. As new. £60 Tel Slough 75780

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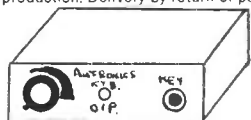
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# ADVERTISERS INDEX

Amateur Radio Exchange .....	44, 45	House of Instrument.....	59
Armon Electronics.....	50	Keytronics .....	12
Black Star .....	36	Number One Systems .....	60
Brian J Reed.....	74	P M Components.....	26, 27
Cathodeon Crystals .....	51	W P Publication.....	62
Cirkit.....	6, 7	Poole Logic .....	50
Commutech (Devon) Ltd .....	62	R A S (Nottingham) .....	50
Danesbury Marketing Ltd .....	28	Reltech.....	18
Display Electronics .....	Outside Back Cover	C R Supply .....	28
East Cornwall Components..	Inside Back Cover	Sendz Components .....	48
Eastern Communication .....	60	Skyware Software .....	66
Edwardschild.....	74	Tall Systems .....	9
ICS Electronics .....	9	Thanet Electronics .....	46, 47
Etetech Ltd.....	21, 25	W P O Communication .....	56
Gardner Precision Instruments.....	21	Weirmead.....	28
Garex Electronics.....	28, 56	Western Electronics.....	69
Grandata.....	60	R Withers.....	15, 16
Greenweld .....	25	Wood & Douglas .....	25
Hart Electronic.....	50		
Hightech Antennas .....	Inside Back Cover		

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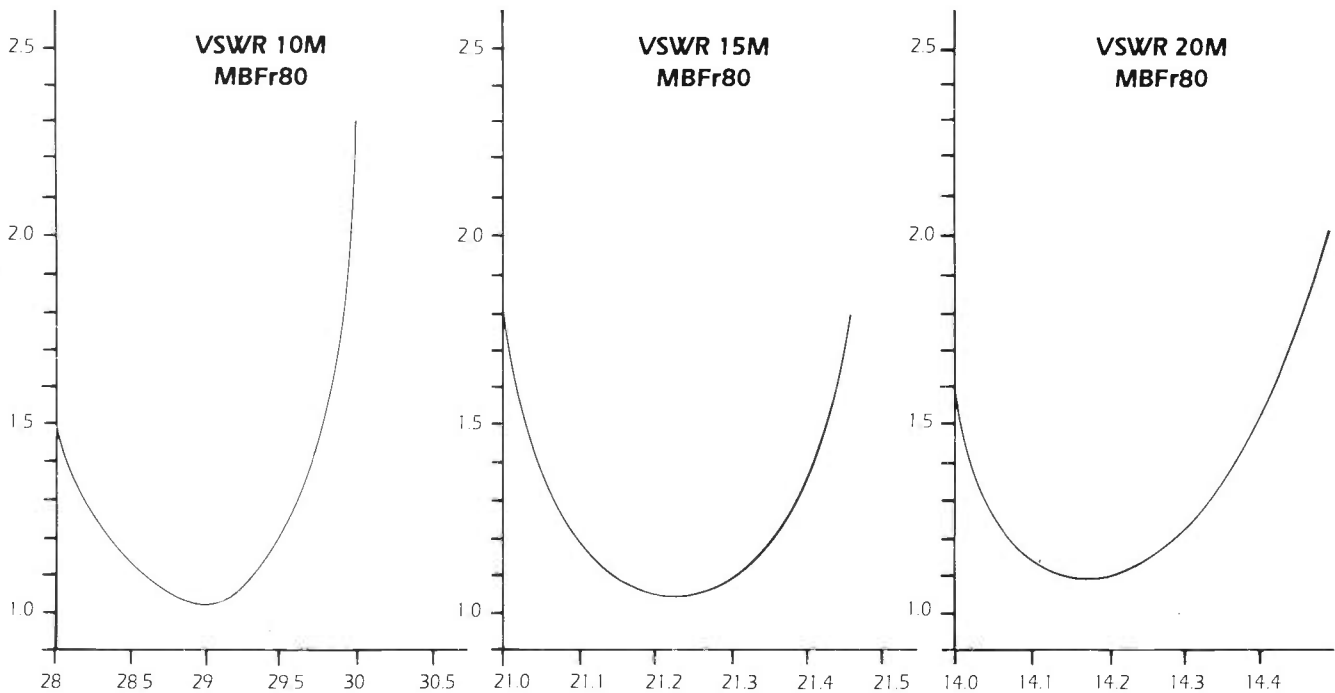
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