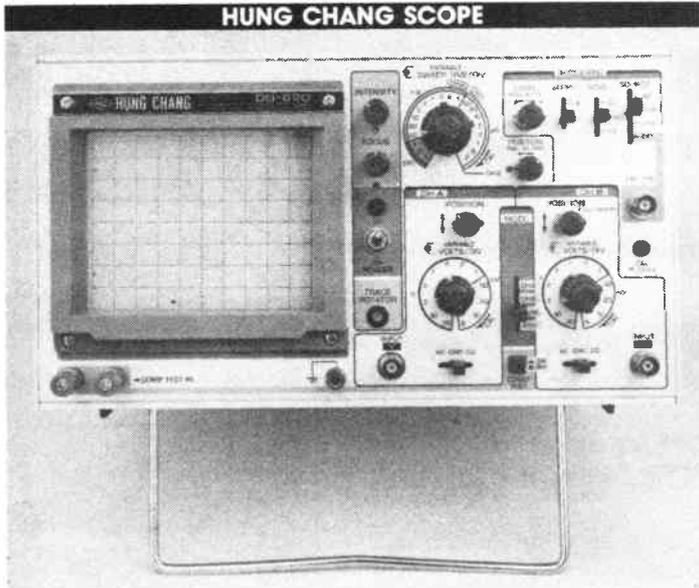


# PRODUCT NEWS

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

## HUNG CHANG SCOPE



The Hung Chang range of oscilloscopes is now available in the UK and the first model in the range is the 20MHz OS-620, which includes a component tester. Vertical -3dB bandwidth is dc 20MHz, with vertical amplifier sensitivity of 5mV/div to 20V/div on each of two channels. Add and invert functions are provided.

The horizontal system provides a timebase of 0.2µs to 0.5s/div in 20 ranges, with fine control and a switched ×5 magnifier on all ranges. In X-Y mode, the OS-620 uses vertical amplifier B to control X deflection, at full specification. Triggering sources may be internal (channel A or B), external, TV frame, TV line, ac or dc coupled, with manual or automatic level control.

A particularly useful feature of the OS-620 is its component tester, which dis-

plays the ac current/voltage characteristic of a component under test, either in or out of circuit. For service departments and field engineers, suspected faults or out-of-range values are quickly revealed without needing removal of the component from the board.

Other features of the OS-620 include a high brightness, flat-face square tube with a graticule 8 × 10cm. Z-axis intensity modulation, front panel trace rotate control and a calibration signal are also provided. Weight is about 7kg, and the unit consumes just 19W from a 240V ac supply.

Price is £295.00 including probes.

*Black Star Ltd,  
4 Stephenson Road,  
St Ives, Huntingdon,  
Cambs PE17 4WJ.  
Tel: (0480) 62440.*

## LCR METER

Thandar Electronics Ltd have announced the launch of a hand-held digital LCR meter.

The TC200 will measure capacitance, inductance, resistance and the dissipation factor over a wide range. The measured values are displayed on a 3½-digit LCD display with automatic decimal point positioning. The display provides warning for low battery and overrange conditions.

The TC200 is supplied complete with test clips and retails at a price of £85.00 plus VAT.

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



## BENCHTOP MULTIMETER

A new benchtop digital multimeter from ITT Instruments, the MX579, is a professional-quality 4½-digit instrument incorporating features such as selectable true RMS measurements and an optional IEEE 488 interface.

Featuring a high-brightness 20mm high LED display, the MS579 offers voltage, current and resistance measurements to resolutions of 10µV, 10nA and 10 milliohms, with a basic accuracy of 0.03%. In addition, a decibel function allows all measurements of ac voltages to be indicated in decibels with reference to 1mW into a 600 ohm impedance, making the MX579 ideal for audio and telephony measurements.

The MX579 incorporates a true RMS converter for accurate measurements on asymmetrical or non-sinusoidal waveforms such as noise, pulses, square waves, or chopped and rectified signals in either ac or ac-plus-dc coupling mode. The measurement of small ac signals or noise superimposed on a dc signal is normally carried out with the dc voltage blocked out (ac mode), whereas the RMS value of a rectified signal would be carried out in the ac-plus-dc mode.

The instrument features a measuring bandwidth of more than 200kHz, which improves the performance of the RMS measuring feature.

*ITT Instruments,  
346 Edinburgh Avenue,  
Slough,  
Berkshire SL1 4TU.  
Tel: (0753) 824131.*

## LIL DEVIL

A magnetic test probe, available from Jensen Tools, can cut time spent troubleshooting solenoid devices by 99%.

The Lil Devil operates simply by sensing the magnetic field in electrical relays, coils, valves and stepper switches, etc. An LED at the end of the probe tells the trouble-

shooter immediately if the problem is electrical and exactly where the trouble lies.

This simple little device is one of Jensen's best-kept secrets. When used properly the Lil Devil can eliminate completely the need for time-consuming hookups and reference to schematics. It operates on both ac and dc

devices and is easy to use. Simply place the tip of the probe on or near a coil or shaft projecting through the device to be tested. If the LED at the end of the probe lights up, the device is energised; if not, the device is de-energised. It also recognises north and south poles.

Two models are available: standard, for larger sole-

noids, and high sensitivity, for subminiatures and reed relays. Both measure ¾ × 3/8ins and come with easy instructions and recommendations for proper use.

*Special Products  
Distributors,  
25/29 High Street,  
Leatherhead KT22 8AB.  
Tel: (0372) 377773.*

# Radio & Electronics

JUNE 1987 £1.35

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The communications and electronics magazine

## World

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YAESU



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SPECIALISTS.

## YAESU FRG9600/RWC MK3 HF-UHF SERIES 100kHz-950MHz IN ONE BOX!

After many months of research and development RWC LTD are pleased to announce their latest HF modification for the Yaesu FRG9600 which now includes LF/HF/VHF/UHF coverage from 100kHz to 950MHz and improved 'S' Meter and a typical receiver sensitivity now  $\geq 2\mu\text{V pD HF}$ ,  $\geq 1.5\mu\text{V 60-950MHz}$  all @ 12dB SINAD (Please contact us for detailed specifications).

We have fitted a High performance HF Front-End made for us by AKD. The new HF section is fitted internally with switching circuits and a small toggle Switch on the rear apron to enable band change whereby the display changes to read actual frequency (100kHz-60MHz). The standard SO239 antenna connector has now been changed for an 'N' connector for coverage from 60-950MHz and an SO239 connector fitted for HF coverage 100kHz-60MHz. (UHF extended coverage is now standard as per our original MK2 modification up to 950MHz).

As an 'N' connector is now fitted to all RWC FRG9600s for VHF-UHF coverage it is possible to use a wide-band discone antenna such as the ICOM AH7000 which is supplied with low-loss coaxial cable and 'N' connectors. A dipole or long-wire antenna can be used for HF coverage with very good results. **This facilitates use of two antennas for all bands.**

All modifications are Fully Guaranteed for twelve months from date of purchase/modification providing our modifications seals are unbroken.

© RWC LTD 1987

• We reserve the right to change specifications due to continuous development and modification of this product.



### YAESU FRG9600/RWC MK3 AM-FM (WIDE & NARROW) LSB, USB. 100kHz-950MHz Broadcast Monitor and Scanning Receiver



Generous part exchange on Shortwave Receivers, EG FRG7 up to £125, FRG7700 up to £225. WHY NOT UPGRADE NOW!?!

**FRG9600 MK2 Model 60-950MHz** 'N' connector @ £519.00 + £5.00 carriage. (Modified unit only).

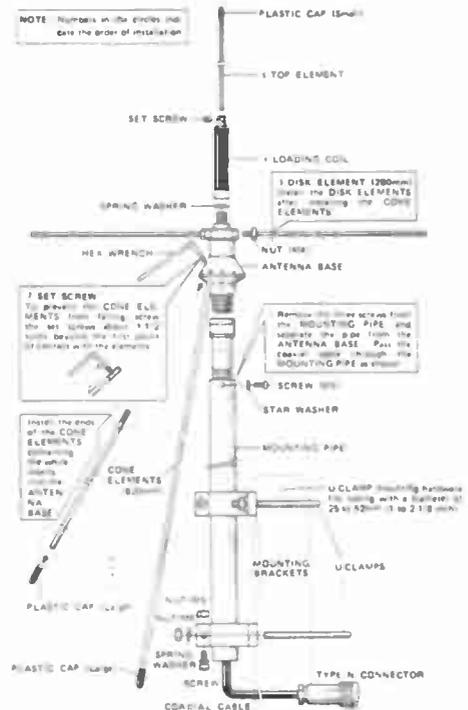
**FRG9600 MK3 Model 100kHz-950MHz** 'N' connector and SO239 for HF @ £625.00 + £5.00 carriage. (Modified unit only).

**RWC Exclusive Base Station Complete HF-UHF Package** FRG9600 MK3 Model, Icom AH7000 ant, G5RV HF multiband, PA4C ac-13V dc adaptor, inclusive carriage UK £725.00.



### ICOM AH-7000

SUPER WIDEBAND  
OMNIDIRECTIONAL ANTENNA



SPECIFICATIONS	
Frequency coverage	Receive 25 to 150MHz
	Transmit 50-144 420 VHF 1200MHz
Input power rating	200 watts
Input impedance	50 ohms
Standard connectors	Type 'N'
Supplied coaxial cable	50-2V (50 ohm)
Type of antenna	Discone
Length	1.7 meters
Weight	1kg

Icom AH7000 @ £82.50 (inc free carriage UK mainland).

#### YAESU/RWC FRG9600 Options

**PA4C ac adaptor** £16.50 inc post.

**FIF232C RS232 computer interface** @ £75.00 inc post.

**Raycom GP900** 900-950MHz 3dB, base station ant @ £22.00 inc post.

**AM-FM wide & narrow IF filters** POA.

**RWC 9600 MK2 owners HF mod** @ £99.00 inc carriage (send unit).

**FRG9600 existing owners HF & UHF mod** - 100kHz-950MHz. Send unit carriage paid @ £129.00.

**YAESU FRG9600 Service Manual** (inc Cat Prog) @ £12.50 inc post.

**Raycom VHF-UHF Discone** 60-600MHz SO239 connector @ £27.50 inc carriage.

**RWC Modified Video Unit**, 6.00MHz IF video (modified from NTSC) @ £27.50 inc post.

PLEASE ASK FOR COLOUR BROCHURE & SPECIFICATIONS.



# 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 - BTI Skyphone aerial at Goonhilly - p12

Bottom - The title screen from Pearsons Computing's G1FTU SSTV program - p8

## SPECIAL FEATURES

### 22 Power Supplies

David Silvester with a beginner's guide to the design of the ubiquitous PSU

### 27 Data File

This month Ray Marston deals with the LM10 high performance op-amp/voltage reference IC

### 32 Beyond the Triode

Roger Alban presents the penultimate part of his article on valves

### 36 CAT Interface

This month R A Penfold concludes his article by dealing with the PCB construction and the CAT interface in use

### 40 LENA Package

James Dick reviews some computer-aided design software for the BBC micro

### 44 Update on Packet Radio

R J Redding discusses the development of this form of data transmission and looks at the future

### 46 DX-TV via Sporadic-E

Something extra from Keith Hamer and Garry Smith as the SpE season gets into full swing

## REGULARS

### 4 Product News

### 12 News Desk

### 15 Amateur Radio World

### 18 ATV on the Air

### 19 Network 934

### 49 Medium Wave DXing

### 51 Latest Literature

### 54 DX-TV Reception Reports

### 57 QSO

### 59 Short Wave News

### 62 Free Classified Ads

## READER SERVICES

### 20 Subscription Order Form

### 31 Amateur Radio Subscription Order Form

### 52 Back Issues Order Form

### 52 Newsagents Order Form

### 63 Free Classified Ad Order Form

### 66 Advertisers Index

### 66 Advertising Rates and Information

## NEXT MONTH

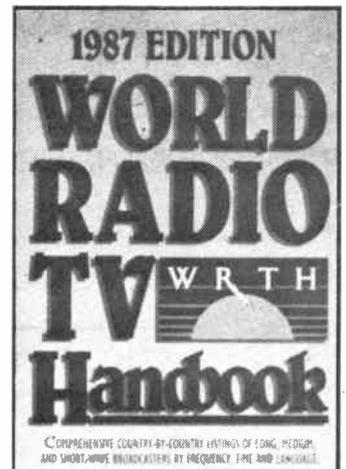
### 48 What's in Store for You

#### Next Issue

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#### Publication Date

Second Thursday of the month preceding cover date



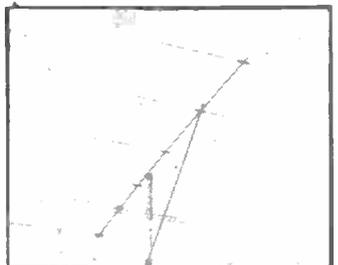
On the shelf - page 51



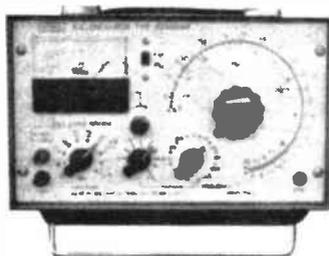
W German TV - page 55



SSTV - page 8



Sporadic - E - page 46



### OSCILLATOR

The Levell low distortion RC oscillator, type TG200DMP, has a frequency coverage of 1Hz to 1MHz in 12 overlapping ranges with continuously variable and vernier controls.

A unique feature of this generator is its patented circuit which allows the variable frequency control to be a single track potentiometer. This avoids the amplitude bounce that occurs on Wien bridge circuits when the frequency is varied.

Frequency accuracy is  $\pm 1.5\%$  up to 100kHz and stability is  $< \pm 0.1\%$  up to 50kHz for a 15% change of supply voltage. Sine wave distortion is  $< 0.05\%$  from 50Hz to 15kHz. A meter monitors the output amplitude which is continuously variable from 7V RMS down to  $< 200\mu\text{V}$  in 7 steps of 10dB plus a variable potentiometer. Amplitude variation with frequency is  $< \pm 1\%$  up to 300kHz. The output may be switched to square wave with a rise time of  $< 150\text{ns}$ .

The TG200DMP is housed in a robust steel case  $8 \times 260 \times 140\text{mm}$  weighing 4.5kg. Power is supplied by four PP9 batteries with a life of 300 hours, or ac mains via a Levell PU33 power unit.

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

### TEST PATTERNS

CAL (Cox Associates Limited) has announced that, following the keen interest in the CAL 5000 flexible video test pattern generator, introduced in September 1986, the design has been upgraded to allow measurements and tests on video monitors with line-scan frequencies ranging from 10 to

### PSU SOLUTION

AQL's new range of automatic test equipment offers sophisticated but small-scale systems which are ideally suited to power supply testing.

AQL offers the benefits of automatic testing to a market which has no requirement for the large, expensive ATE machines with thousands of test nodes and massive data-handling capability. AQL's testers handle applications requiring up to 1024 test nodes, and offer comprehensive test capability allied to very simple programming.

The testers can pin-point all power supply faults including some, such as internal faults in transformers and bridge rectifiers, which were previously very difficult or even impossible to detect. In-circuit test prior to functional test reveals faults which would have caused considerable damage to whole groups of components on switch-on, saving component and labour costs.

An outstanding feature of these new products, Station 10 and Station 20, is their ability to perform continuity, in-circuit and functional testing in a single test cycle. A



continuity test checks for any pattern of connection up to 1024 points, with a highly-flexible choice of thresholds for bare or loaded boards. In-circuit test checks any pattern of components, including resistors, capacitors, inductors, diodes and transistors, a 6-wire measurement system guarding out parallel paths and giving high accuracy.

Functional test allows measurements of dc and ac voltage and frequency.

The testers run on AQL

Symbolic software, an English-based language that is quickly learned and produces easily-read programs in terms that are meaningful to a test operator.

Station 10 is a benchtop unit; Station 20 is an ATE workstation with IEEE 488 interface, built-in disc drives, VDU and printer.

*AQL Automation,  
Durban Road,  
Bognor Regis,  
Sussex PO22 9QT.  
Tel: (0243) 861234.*

65kHz at any vertical refresh rate from 40 to 110 fields/second.

The CAL 5000 is a general purpose test instrument for colour monitors designed for high-resolution graphics systems, medical displays and other applications where non-standard scanning rates are used. It is also admirably suitable for use with HDTV monitors and projector units.

The instrument is based on an infinitely variable sync-pulse generator, in which the horizontal and vertical scanning frequencies are independently adjustable. Automatic frequency and phase interlock gives an exact number of scanning lines, either interlaced or non-interlaced as required. To set up the raster, the operator simply selects the desired number of lines and the desired horizontal frequency as indicated by the seven-segment LED displays on the front panel. This action

automatically sets the vertical frequency, which is also indicated by an LED display.

Six switch-selectable RGB test pattern signals are available from connectors on the rear panel. These patterns are resident in EPROMs, so that a virtually unlimited variety of test signals can be generated to meet customers' specific requirements.

Patterns currently available include: Colour Bars, White Field, Crosshatch, PLUGE, Greyscale, Multiburst and alphanumeric text. All patterns are provided as RGB video signals at standard CCIR voltage levels from 75 ohm output connectors. Mixed sync pulses are available from a separate outlet and also as sync-on-green.

*Cox Associates Limited,  
Cox House,  
Amlerley Way,  
Hounslow,  
Middlesex TW4 6BH.  
Tel: 01-570 8283.*

### TRANSIT BOX

The latest addition to the extensive range of Instator PCB transit boxes has been specifically designed to ensure a constant precise fit for valuable circuit boards.

It features a sturdy inner wooden container which is insulated with protective foam from the robust fibre-board outer casing. The new design ensures that the inner container, and the PCBs held inside, will not flex, warp or bend, however rough the treatment. The two sections are linked by earthing strips to make the container completely conductive, and the transit case has a detachable lid, reinforced corners and plated steel trim.

A range of accessories is available.

*Pressboard Ltd,  
Avening Road,  
Nailsworth,  
Glos GL6 0BT.  
Tel: (045 383) 2334.*



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3 LINES

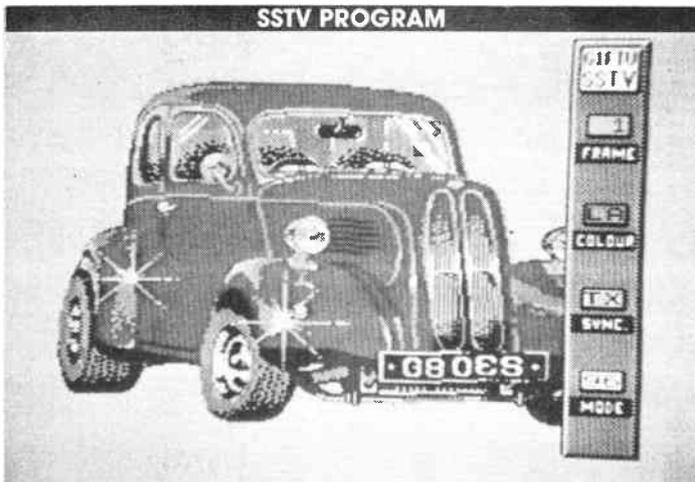
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A2599 37.50	EB4F8 0.65	EL519 0.65	M8225 4.50	QV07-50 55.00	U251 0.75	2C51 0.75	6AN5 4.50	6H6 1.95	12C2X6 1.20	6973 5.95
A2792 27.50	EB4F9 0.70	EL802 3.95	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6AN8A 3.50	6HGHT 1.95	12DQ6B 3.50	705A 8.00
A2900 11.50	EB4F9 0.70	EL821 8.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6AQ5 2.15	6H87 0.95	12DWA4 3.50	725A 275.00
A3042 24.00	EBL1 2.00	EL822 12.95	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6AQ8 0.85	6H87 0.95	12E1 17.95	7703 395.00
A3293 24.00	EBL21 2.00	EL880 22.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6AR5 3.95	6H87 0.95	12E14 36.00	803 14.95
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ACT22 59.75	EC80 9.50	EM81 7.00	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6AS7 4.50	6H87 0.95	12H7A 4.50	807 2.50
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AL60 6.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	829B 14.50
AN1 14.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	832A 14.50
ARP12 1.70	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	833A 95.00
ARP34 0.25	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	866A 6.00
ARP35 2.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	872A 2.50
AZ11 4.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	873 60.00
BL63 20.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	884 5.50
BS45 87.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	892 15.00
BS10 55.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	911A 15.00
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C6A 20.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1299A 0.60
C112G 70.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1619 2.50
C108 65.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1625 3.00
C134 32.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1626 3.00
C148A 118.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1627 3.00
C150/1 135.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1628 3.00
C153A 32.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1629 3.00
CCA 2.60	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1630 3.00
CC3L 3.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1631 3.00
CC3 2.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1632 3.00
CV Nos Prices on request	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1633 3.00
D3a 29.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1634 3.00
D43 1.20	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1635 3.00
D81 22.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1636 3.00
DA42 17.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1637 3.00
DA90 4.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1638 3.00
DA100 125.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1639 3.00
DAF91 0.70	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1640 3.00
DAF96 1.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1641 3.00
DC70 1.75	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1642 3.00
DC90 1.20	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1643 3.00
DCX4-1000 1.20	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1644 3.00
DCX4-5000 25.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1645 3.00
DET16 28.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1646 3.00
DET18 28.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1647 3.00
DET23 35.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1648 3.00
DET24 35.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1649 3.00
DET25 22.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1650 3.00
DF91 1.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1651 3.00
DF92 0.60	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1652 3.00
DF96 1.25	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1653 3.00
DF97 1.25	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1654 3.00
DH63 1.25	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1655 3.00
DH77 0.80	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1656 3.00
DH79 1.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1657 3.00
DH149 2.00	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1658 3.00
DK91 1.20	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1659 3.00
DK92 1.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1660 3.00
DL35 2.80	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1661 3.00
DL63 1.40	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1662 3.00
DL70 2.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50 55.00	U251 0.75	2D21 1.95	6B2 1.90	6H87 0.95	12K8 1.95	1663 3.00
DL73 2.50	EC82 1.10	EM87 2.50	M8225 4.50	QV07-50						



The latest program in Pearsons Computing's range of software for the radio amateur is the G1FTU SSTV Tx/Rx program. It allows the Spectrum computer to both transmit and receive slow scan television pictures, with no interface between the computer and radio, and is compatible with both the old black and white and the new colour hardware such as the SC1 from Germany.

In transmit mode, the program can transmit both text and Spectrum graphic screens in black and white or colour SSTV. All of the Spectrum colours and grey levels

are used to the full; 8, 16 and 32 second frames for black and white, and 24, 48 and 96 second frames for colour transmissions are available. Both line sequential and frame sequential colour transmissions can be made.

Text transmissions can be made in all modes. There are 9 text memories which may be edited before or during transmissions. There is also a personalised CQ memory and a special grey scale and colour bars facility. All text memories are on view at once in a neat 'window' display.

The receive system for the G1FTU SSTV Tx/Rx program

has been developed with performance on both HF and VHF in mind. It has flywheel-type syncing to prevent picture tearing, combined with a noise rejection system that can allow several corrupted frames to combine to produce an enhanced picture.

The received picture neatly fills the screen, and the program features a new linearity system to produce good results on both photos and text displays. Smooth shading is used, and the user has fine control over the contrast and brightness of the incoming picture via 'live' controls and on-screen displays.

The program costs £12 for customers in the UK, £13 for Europe and £14 elsewhere. There is a microdrive version at £2 extra and an Opus disc version at £4 extra. The price includes a 10 page instruction booklet, a second cassette with 20 minutes of sample SSTV audio and a selection of top quality screens as examples for transmission.

*Pearsons Computing,  
42 Chesterfield Road,  
Barlborough,  
Chesterfield,  
Derbyshire.  
Tel: (0246) 810652.*

trate on the UK so that few people will be more than 20 miles from one of them and most are a lot less.

The World Map program has a separate set of nearly 250 world-wide place names.

For both programs, the input is completely automatic; you therefore do not need to specify which type of reference you are using. The base and distant locations are plotted on the map(s) and also the Great Circle between them.

The program prints the distance, beam and return headings, the VHF contest score based on the 50km ring system and for HF DX, if the distance is over 16000km, the long path distance and bearings as well.

The programs display a real-time clock and the local time of place names is shown with their position. The World Map has daylight and darkness zones displayed. These are continually updated as the program runs and, if it is still going at midnight, this pattern is recalculated and redisplayed for the new day.

Other refinements include a choice of colours to suit mono or colour displays, automatic correction for the equation of time (the difference between local mean time and solar time) when displaying the daylight/darkness zones, and automatic insertion of IO or JO when inputting Maidenhead locators for the UK.

The programs are available together for £10 on tape, or £12 on 40 or 80 track disc. Existing users of the World Map program can upgrade with the usual 50% discount.

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

## LOW-COST I/O

The PC-14 programmable interface card for the Amstrad PC1512, IBM PC or other compatible personal computers provides up to 48 input or output TTL lines and three independent 16 bit counter/timers on a single card.

Applications in industrial process control include use as a plotter, printer or other bcd/binary interface, to provide programmable delays, as

a real time clock, to count events or to control machine tools. Each 8 or 4 bit digital port may be configured as input or output under software control and operate bi-directional, uni-directional or to provide interrupt or handshake signals.

The three independent counter/timers may be programmed as event counters, single shot pulse counters, rate generators or as hardware or software triggered

strokes.

The PC-14, priced at £54, is one of 38 economically-priced industrial boards available on same day despatch.

*Amplicon Liveline Ltd,  
Centenary Industrial Estate,  
Brighton,  
East Sussex BN2 4AW.  
Tel: (0273) 570220.*

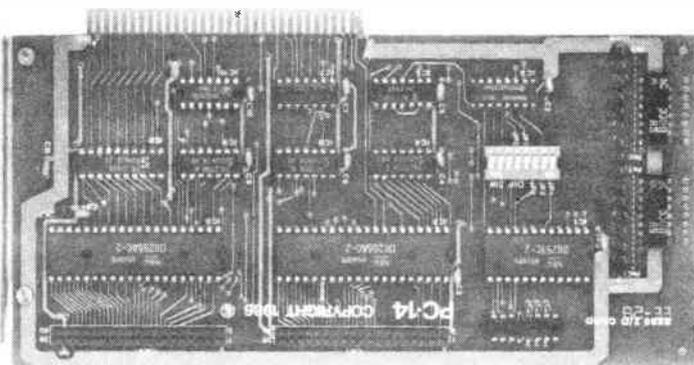
## LOCATOR PROGRAM

Technical Software have announced that their BBC World Map and Locator program now has a companion program to cover the UK and Europe.

This software displays separate maps of the UK and Europe. As in the World Map program, locations can be entered by latitude and longitude, QTH (QRA) or Maidenhead locators, National Grid Reference (for GB only) or one of over 430 European place names, which concen-

## LETTRIX JUNIOR

Ideal Software Ltd, the Surrey-based microcomputer software publisher and supplier has announced an Amstrad PC version of its successful Lettrix software that gives a dot matrix printer multifont letter quality output.



To be known as Lettrix Junior, the new version of the software is being made available at £49.95, half the price of the more powerful original version, Lettrix, at £99.95. Ideal anticipates sales of 10,000 units over the next six months.

Lettrix Junior has seven typefaces, as well as the full IBM 244 graphic character set.

All seven typefaces may be loaded at the same time and reside in the PC's memory between the existing software and printer, responding automatically to spacing, paging, margins, underlining, italics, subscripts and superscripts.

Proportional spacing, microjustification, vertical number alignment, character size and characters per inch may be set from the pop-up menu or using the InLine commands, and add sophisticated formatting to all word processor, database or spreadsheet software.

Lettrix Junior is intended for use with the Amstrad DMP range, as well as all nine pin printers from Citizen, C.Itoh, Canon, Epson, IBM, Newbury Data, Okidata, Olivetti, Panasonic and Star Gemini.

Any purchaser of Lettrix Junior will also be able to upgrade to the full Lettrix package, which includes over 20 fonts and the ability to design their own characters and typefaces.

*Ideal Software Ltd,  
Tolworth Tower,  
Surbiton,  
Surrey KT6 7EL.  
Tel: 01-390 6722.*

**MATHEMATICS**

Mathematicians, engineers and scientists can now purchase a computer program that understands mathematics. Existing computer programs require the coding of mathematical formulae into special computer languages. A new system introduced by Mathsoft International provides the simplicity of a calculator and the flexibility of a notepad on a personal computer.

MathCAD is inexpensive and highly flexible. The user can enter equations and see

**CANON WPs**

Canon has introduced two new screen-based word processing systems to work alongside its AP Series range of electronic typewriters—the VP2500 word processing system and the VP1000 screen editor.

Input for both units is from the familiar electronic typewriter keyboard, and both display text in a reassuring black on white in the exact form it will be printed, including boldface type, underlining, justification and sub or superscripts.

Inbuilt software for instant start-up and a 'What you see is what you get' display make both systems ideal for the office typist who needs to prepare anything from standard business letters to lengthy reports. For minor jobs, such as addressing an envelope, the typewriter reverts to its normal function at the flick of a switch.

The VP2500 costs £1779 and combines the many features of an electronic typewriter with all the powerful capabilities that modern word processing technology has to offer.

A large capacity 3½in floppy disc drive provides storage for 720KB (about 240 pages) of documents, and this can be doubled by the addition of an optional second disc drive. Such storage is possible because no software system disc is required due to

them displayed with all the special symbols and notations as if hand-written on a notepad. Solutions are calculated automatically and the results may be plotted on the screen.

MathCAD operates on the IBM PC (and compatible machines with a minimum of 340K RAM). An IBM graphics printer, Proprinter, H-P LaserJet or compatible printer is required for printing the finished document.

For a full description of MathCAD's capabilities contact the address below.

MathCAD costs £195 and is available by mail order with a money back guarantee.

*Mathsoft International Ltd,  
129 Beaufort Street,  
London SW3 6BF.*



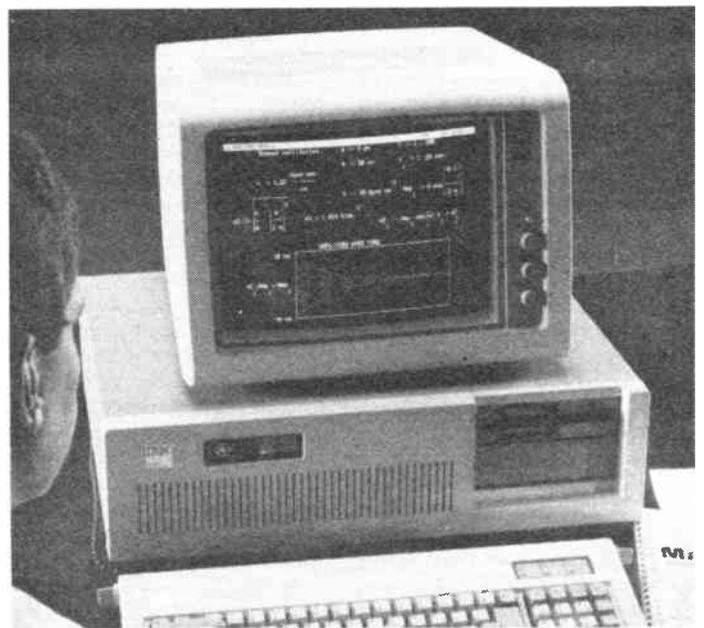
the fact that Canon's special improved version of Wordstar 2000 is built into the machine's ROM (Read Only Memory).

The VP1000 at £799 shares many of the features of the VP2500, but is considerably more compact, with a 'footprint' occupying just 9½in x 11½in of desk space. A 9in editing screen displays 24 lines with up to 80 characters per line, and again shows bold typeface, underlining etc in a WYSIWYG format.

Canon original WP software is ROM-based, and a built-in

32KB text memory can hold up to 16 or more standard pages. This capacity can be increased up to 128KB by adding optional 32KB memory chips, and can become unlimited with an optional inbuilt Micro Floppy Disc Drive with each disc capable of storing 160KB (about 75 pages).

*Canon (UK) Ltd,  
Canon House,  
Manor Road,  
Wallington,  
Surrey SM6 0AJ.  
Tel: 01-773 3173.*



## DON'T INTERFERE



A new mains filter from Rendar eliminates the risk of potentially expensive damage to equipment susceptible to mains-borne interference.

TV, video, home computer, hi-fi, office equipment, and all microprocessor-based

equipment can be damaged by the high voltage and current excursions on the mains supply generated by atmospheric phenomena and inductive switching.

Rendar's Linebloc is available in 4700pF (British standard) and 2200pF (European standard) values. It comes with easily-accessible pillar terminals for simple retrofitting or with two metres of cable and a moulded plug as a ready-wired supply.

Made from tough, flame resistant thermoplastic and offering RF isolation from below 1MHz to VHF, the unit is small and lightweight and is available in black or white.

Current rating is 6A at 40°C, voltage rating 250V 50/60Hz. Operating temperature range is -25 to +70°C.

*Rendar Limited,  
Durban Road,  
South Bersted,  
West Sussex PO22 9RL.  
Tel: (0243) 825811.*

## ENGINEERS KIT

The latest static control product from Anti-Static Technology Ltd, the service engineers kit, was launched at the recent Service Management Exhibition at the Wembley Conference Centre.

The kit gives maximum protection against circuit board damage caused by electrostatic discharge. It consists of a mat, manufactured from a new design of static dissipative material, with a cord to electrically connect it to the frame of the equipment. This brand new matting material is of a multi layer construction which combines strength with excellent electrical properties. Also included is a wrist strap for the engineer to wear that electrically connects him via a coil cord to the frame of the equipment.

The damage occurs when a charge of static electricity builds up on the engineer, and is discharged through a circuit board as he touches it. The effect on the board can be catastrophic, destroying components and rendering the board useless.

The kit works by keeping the engineer, the mat on

which he is working and the equipment itself at the same electrical potential. There can, therefore, be no static build-up and consequently no damage to the boards.

*Anti-Static Technology Ltd,  
18 Worle Industrial Centre,  
Weston Super Mare  
BS22 0BX.  
Tel: (0934) 518777.*

## CRAB-CLAMP

There is now a more convenient and versatile alternative to the outmoded G-clamp which solves problems associated with its simple but often infuriating design. The Crab-clamp is a versatile new universal work clamp, designed and manufactured in the UK. It simplifies work holding and fixing in a wide variety of applications and is now available from Electronic and Computer Workshop Ltd.

The Crab-clamp uses a new approach, with a cantilevered, 'pinch' jaw movement that does not twist work during tightening, always a major problem with G-clamps. The new clamp is just as strong as the old design and features an all-steel con-

## MICRO-TORCH



A self-igniting butane Micro-Torch is now available from Jensen Tools. Instantly

ignited by push-button and built-in piezo electronic starter, the Blazer Micro-Torch has two adjustment valves for precise control of a 2500°F flame for pinpoint soldering, brazing and welding. It delivers up to two hours of continuous flame from a single butane gas cylinder (the cylinder can be refilled from a butane cigarette lighter canister).

The Blazer has a sturdy brass body with rubber cushioned grip to fit comfortably in the hand. It can also be positioned upright in a removable stand (included).

*Special Products  
Distributors,  
25/29 High Street,  
Leatherhead KT22 8AB.  
Tel: (0372) 377773.*

struction with a precision adjuster screw thread that is guaranteed for life against stripping.

Revolving steel jaws offer up to 24 different clamping combinations, including vee slots for secure holding of small diameter tubes and irregular sections. Combinations of tubular, tapered, flat and irregular objects are held together easily. Even two tubes or rods can be firmly clamped at 90 degrees to each other. Push-fit nylon pads are available for protecting work surfaces, and this eliminates the inconvenience of loose packing pieces.

At present, standard jaw range is from 0 to 4½ inches, but larger jaw sizes will shortly be available. The throat design enables work to be carried out close to the jaw without the screw adjuster obstructing the work.

ECW offers the Crab-clamp at a price of £9.99 including post/package and VAT.

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

## QUICK-RELEASE

Amphenol has introduced a range of connectors specifically intended for applica-

tions requiring instantaneous, damage-free decoupling.

Breakaway connectors offer all the advantages of high quality MIL-spec components, compatible with standard receptacles, with an added quick-release facility. Of the three different types available, two can be instantly decoupled at any stage of engagement, the third must be fully mated to disengage. Instant release is effected by an axial pull on a lanyard.

The connectors offer a high degree of environmental resistance and EMI/EMP shielding, with a range of electrical and mechanical features to meet the most demanding requirements.

*Amphenol Ltd,  
Thanet Way,  
Whitstable,  
Kent CT5 3JF.  
Tel: (0227) 264411.*

## DIP SWITCHES

Watts International now supplies an inexpensive range of quality DIP switches featuring an IC-package type that can be used in automatic insertion machines.

The highly durable switches are manufactured by iwatsu of Japan, and are completely sealed IC or piano-key packages. A self-cleaning mechanism and-

gold-plated contact give long-term contact integrity. The cover is ultrasonically welded to the case and then sealed with epoxy resin. As a result, flux intrusion during soldering does not occur. Both package types feature tape-sealed or extended switch-knob versions.

The tape-sealing technique utilises flush switch-knobs. It ensures that the switches are protected from accidental or unauthorised switching and damage.

All the versions can be supplied as 4, 8 or 10-pole on/off modules, having 8, 16 and 20 pins respectively. Ratings are 5V dc/100mA (switching), and 50V dc/100mA (non-switching). Contact resistance is 50mohm max. Insulation resistance is 100Mohm (min) at 100V dc. Mechanical operating life is 1,000 or 3,000 switching functions.

*Watts International Components Ltd, Suite 6,*

*Wyvern House, Bognor Regis, West Sussex. Tel: (0243) 868322.*

**RESISTORS**

Products currently available from CGS include resistors and potentiometers utilising technologies such as wire wound, foil, bulk metal, cermet and polymer thick film. The broad stock options are complemented by a flexible and low cost custom-design service. Manufacturing and test facilities within the company are approved to BS9000 and CECC40000.

CGS supply resistors throughout the spectrum of industry's requirements, typically in automotive, aerospace, military, instrumentation, audio and power. Encapsulations include conformal coatings of plastic/glass or moulding in a variety of materials. Insulation options include screen printed thick film, polymers and glazes.

High energy and high voltage pulse types can be supplied for transmission and telecom applications.

Ohmic values range from 5 milliohms to 1000 megohms. Working voltages are available to 100kV, with power dissipation from less than 1W to 800W. A six-page brochure entitled *Total Capability* is available from CGS giving an overview of its experience, services and product ranges.

*CGS Resistance Co Ltd, Marsh Lane, Lymington, Hants SO41 9YQ. Tel: (0590) 75255.*

receptacles can be supplied with either straight or right-angled terminations. Positive latching of plug to receptacle is incorporated as well as polarisation. These modules can be stacked to give the required connector size and are available in red or green to enable colour coding.

These robust products have many applications in the electronic and electrical engineering industries.

*Components and Electronics Ltd, PO Box 88, Haslemere, Surrey GU27 2RF. Tel: (0428) 54141.*



**PCB CONNECTORS**

Components and Electronics Limited, the new Surrey-based connector supplier, has announced a new range of low cost modular terminal block connectors. Designed for use with PCBs, it is made up of 2, 3 and 4-way modules. The board mounting

**SURPLUS/REDUNDANT STOCKS ELECTRONIC COMPONENTS**

We offer cash for your surplus components including integrated circuits, transistors, memories, microprocessors, I/C sockets, connectors, caps etc, etc. Top prices paid, collection no problem. Please contact us today with your lists by telex, telephone or letter to:

**MARLOW MARKETING**

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**Telex: 946336 MICRO G. Tel: 01-676 0800**

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**SATELLITE TV RECEIVING EQUIPMENT**

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**HARRISON ELECTRONICS**

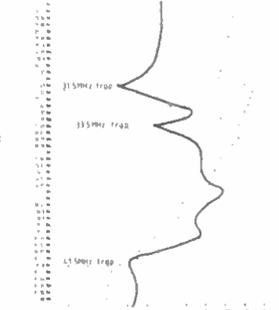
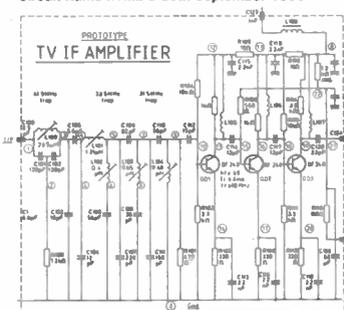
**Century Way, March, Cambs PE15 8QW**  
**Tel: (0354) 51289**

**ELECTRONICS CAD**

**IBM PC (and compatibles), R.M. NIMBUS, BBC MODEL B, B+ and MASTER, AMSTRAD CPC and SPECTRUM 48K.**

Number One Systems Limited  
Linear Circuit Analysis Program ANALYSER II  
Circuit Name IFAMP3 30th September 1986

TELEVISION IF AMPLIFIER WITH TRAPS  
GAIN PHASE P ANY TWO



ANALYSER I and II compute the AC FREQUENCY RESPONSE of linear (analogue) circuits. GAIN and PHASE, INPUT IMPEDANCE, OUTPUT IMPEDANCE and GROUP DELAY (except Spectrum version) are calculated over any frequency range required. The programs are in use regularly for frequencies between 0.1Hz to 1.2GHz. The effects on performance of MODIFICATIONS to both circuit and component values can be speedily evaluated.

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**NUMBER ONE SYSTEMS LTD**  
**REF.REW Crown Street, St Ives, Huntingdon, Cambs PE17 4EB**  
**Tel: (0480) 61778**

# NEWS DESK

## PMR licensing

A new form for applying for a private mobile radio licence has been introduced by the Department of Trade and Industry's Radiocommunications Division.

The new form (PMR1) is easier to complete and is designed to speed up the licensing process. It replaces the old CL1 form and can be used to apply for a new private mobile radio licence or to request amendments to existing systems.

Copies of the PMR1 can be obtained from the Department of Trade and Industry at PO Box 20, London SE1 8TZ. Tel: 01-275 3200.

## Spectrum deregulation

Geoffrey Pattie, Minister of State for Industry and Information Technology, has announced the publication of a report by CSP International (CSPI) called *Deregulation of*

*the Radio Spectrum in the UK.*

Mr Pattie said: 'Radio usage and spectrum management have seen some considerable changes in recent years. New services such as cellular radio telephones have been introduced, others such as low powered devices are being deregulated and demand for radio-based services continues to expand all the time.'

Following a recommendation by the Merriman Review, the DTI commissioned a feasibility study from CSPI in March 1985 on the possible benefits from introducing market forces and the price mechanism into spectrum management.

The department is still appraising the full implications of the CSPI proposals for radio users and for the future development of spectrum management policy. However, Mr Pattie believes

that publication of the report will be helpful in this appraisal and the findings of the study will be of interest to a wide range of existing and potential users of spectrum, service providers and manufacturers of equipment.

As part of its review of spectrum management policy, the DTI welcomes views and comments on the analysis and proposals in the report, particularly the scope for deregulation and frequency planning organisations.

The report by CSP International is published by HMSO at £9.50 (ISBN 0 115139796).

## New CB frequencies

Geoffrey Pattie, Minister of State for Industry and Information Technology, has announced that a launch date for a new Citizens' Band radio service has been set for later this year.

The service, on 26/7MHz, will be available from September 1987 and is based on a recommendation by the Conference of European Posts and Telecommunications Administrations (CEPT). It will be available to all CB licence holders under the

terms of the existing licence.

The introduction of this service is a step towards a common European standard for CB radio. According to Mr Pattie, the existing 27MHz frequency will continue to be offered. The future of frequencies will be reviewed in 1990.

## BTI Skyphone

British Telecom International (BTI) will be holding discussions with airline operators in the coming months detailing the introduction of a new in-flight telephone service for passengers next year, BTI Skyphone.

The satellites for Skyphone are already in service and the special satellite ground station at Goonhilly Downs in Cornwall has been built and the software specification completed.

BTI has to date invested approximately £1.5 million in the project, and further substantial investment is imminent. Contracts worth over \$3 million have been let by INMARSAT to three companies to develop the airborne equipment. BTI has also reached an agreement with the telecommunications service providers in Norway and Singapore to extend the transatlantic Skyphone coverage world-wide.

Two basic types of telephone are being considered: a wall-mounting cordless unit and an integral seat back unit. The method of payment for both types would be via credit or charge card.

Air-to-ground international direct dialling will be the initial service, enabling passengers to contact more than 170 countries. Although a ground-to-air service has been considered, this will not be offered yet due to operational difficulties. However, a ground-to-air service is viewed as a future possibility.

## EUTELSAT II progress

The European Telecommunications Satellite Organisation, EUTELSAT, meeting in Paris in March, actively pursued its preparations for the establishment of the second generation of satellites by awarding a number of contracts for the on-

## Industrial aid

This year's RSGB National Convention, the fifth, was opened with little fuss and few surprises by the Industry Under-Secretary, John Butcher.

He stressed the urgent requirement in British industry for qualified radio engineers, suggesting that young people could be

introduced to such careers via the amateur radio hobby: '...today's enthusiasts are tomorrow's technologists'.

He announced that the DTI would be presenting a prize to recognise achievement among young radio amateurs as an incentive to this age group. This will be presented next year as part of the RSGB's 75th anniversary

celebrations.

British industry did come in for some criticism from the Minister, however, as he highlighted the lack of British firms producing good quality equipment for radio amateurs, despite their success in computer-related fields. He did acknowledge the usefulness of packet radio in this respect, though, as a merger of radio with computer electronics.

He described the DTI as 'sticking its neck out' on certain amateur radio-related issues, citing by way of example the release of 50MHz to the amateur fraternity. Also permission for class B licences to use Morse, plus a pass for life of the CW exam and the increased control of this by the RSGB were mentioned.

Turning to the future, Mr Butcher announced the Department's intention to review the 50MHz band, with the possibility of further relaxations being mentioned.



John Butcher at this year's RSGB National Convention with RSGB President Joan Heathershaw

ground facilities that will be operated with the new satellite system, EUTELSAT II.

The following contracts were awarded: for telemetry, command and ranging (TCR) facilities to Logica (United Kingdom), CPRM (Companhia Portuguesa Radio Marconi, Portugal) and DTRE (DGT France); to the DFVLR (Federal Republic of Germany) for launch and early orbit phase services; to DTRE (DGT France) for in orbit test and earth station verification and assistance (IOT/ESVA) facilities and services.

A large number of EUTELSAT II transponder leases have already been signed or will be signed soon. These include: five non-preemptible 12GHz transponders leased by British Telecom International, with an option for three additional transponders; five non-preemptible 12GHz transponders leased by France; two non-preemptible transponders leased by Spain; two preemptible 12GHz transponders leased by Portugal; two non-preemptible 12GHz transponders leased by Italy.

#### Computers for disabled

A major breakthrough enabling severely disabled people to use computers was unveiled by Derbyshire County Council on March 24th. The TARKA keyboard emulator is the product of more than three years of painstaking research by Paul Marsden, an advisory teacher for computers in education who has made a specialist study of the needs of handicapped and disabled people in the field of new technology.

Aimed particularly at disabled children in schools, the keyboard emulator can be attached to the standard BBC computers used throughout Derbyshire schools and colleges and, powered by the computer, operates by a grid system of cells with individual lights which illuminate as the different functions on the computer keyboard are selected.

The emulator grid can be 'scanned' in six different ways by the operator using simple one-way and two-way switches, or a standard computer joystick. The system

means that a person who would be unable to operate the traditional keyboard can, by quickly scanning the grid and halting the process at each required character or function, use the computer efficiently.

#### Teacher fellowships

British Telecom recently announced the start of a fellowship scheme to give up to 20 teachers practical experience of industry which they can take back to the classroom.

The scheme is part of a continuing programme by the company to tackle the teacher shortage in mathematics, physics and technology, and to help teachers in those subjects gain a 'real world' understanding of the practical applications of science being taught in schools.

British Telecom's fellowship scheme will give teachers the opportunity to spend a month during the summer holidays at top British Telecom establishments, such as its research centre at Martlesham Heath in Suffolk and its satellite earth stations at Goonhilly Downs in Cornwall and Madley in Herefordshire. Each teacher will receive a £500 bursary award for a four week fellowship.

Teachers taking part will be able to pass on their experience to other teachers and to their pupils, and it is hoped that the experience will help them develop curriculums that reflect the current needs of high technology companies.

#### FAX snoopers?

Sensitive or secure documents sent over facsimile links can now be protected against snooping and interception using Racal-Milgo's Datacryptor 64 advanced encryption system.

Datacryptor 64 is already well proven on data links run by financial organisations and other users transmitting highly secure information. Now office FAX machines can use the same technology to guard against unauthorised access or tampering.

Many sensitive documents are sent by FAX every day, including blueprints, sche-



#### Police contract

The Metropolitan Police have placed a contract valued at approximately £2 million with Storno Limited of Camberley for the supply of new Storno radiophones to be used by Officers in police cars and on motorcycles.

The computer-controlled Stornophone 6000, which is the model being supplied to

the Police, has the capacity for both speech and data transmissions and a built-in display for recording in alpha and numeric characters.

Storno has been a supplier of mobile radio equipment to the Metropolitan Police since 1965 and this order is additional to the 8,000 Storno personal radios already in use with London's police.

ematics, payroll records, credit applications, signature verifications and customer files. Transmission of this information over normal dial-up telephone lines renders it vulnerable to disclosure, substitution or alteration.

The information sent down the line is rendered unintelligible by the encryption device, preventing any form of interception. A second Datacryptor 64 at the receiving end, using the same secret 'key' code, recovers the original information intact for reproduction on the receiving FAX machine in the normal way.

Datacryptor 64 uses the high security DES (Data Encryption Standard) coding technique developed in the USA. With even the most powerful computers available, a would-be information thief could spend years trying fruitlessly to crack the codes used.

The security keys used within the Datacryptor 64 to protect and unravel transmitted information are different for every FAX call. This provides a formidable level of security and allows users to have every confidence that their vital information is

being transmitted in secrecy.

#### Spaced out

Marconi Space Systems has been awarded a £300,000 contract by the European Space Agency (ESA) to commence work on the development, assembly and test of a satellite communication terminal.

Such terminals will be required to handle the large volumes of data generated by commercial and scientific payloads to be carried by the various elements of the manned space station complex known as 'Columbus'.

Technological advances are expected to be made in electronic filters and in modulation and demodulation equipment to cater for 500 megabit per second data transmission. A simulator representing the data flow over a relay satellite link to ground will allow system evaluation to be made. A steered multi-frequency antenna is also to be modelled.

The terminal will be compatible with the United States Tracking and Data Relay Satellite system already in operation and eventually with the proposed European Data Relay satellite.

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R22 R47 1R0 1R1 3R0 15R 56R 62R 68R 120R 180R 220R 300R 390R 680R 1K0 1K5 5K1 10K  
W24 or Sim 12W 4 of one value £1  
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# AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

It is always good to see amateur radio featured by the media, particularly when it is portrayed in a sensible, responsible manner. The Channel 4 TV feature 'Sputniks, Bleeps and Mr Perry', screened in March, illustrated how what started off as a hobby interest ended up as a serious project which enabled very useful information on spacecraft activities to be obtained. In fact, it pretty well initiated the highly secretive activity of 'radio spying' which now forms such an important part of a country's defense system.

The activities of amateur satellite watchers at Kettering Grammar School, under the guidance of their science master, Geoff Perry, is a familiar story to those who are interested in spacecraft activities, but the importance of this work is perhaps not fully appreciated by the general public. This dramatised documentary was well done and deserves to be shown again from time to time to remind the man in the street how amateur radio can and does contribute to the community as a whole.

## AMSAT-UK colloquium

The colloquium held at the University of Surrey last year by AMSAT-UK proved so successful that immediate calls were made for another such event to be staged this year. Accordingly, a similar event will be held this year over the weekend 18th/19th July.

Those interested (you do not necessarily have to be members of AMSAT-UK) should apply for details to the Honorary Secretary, AMSAT-UK, 94 Herongate Road, Wanstead Park, London E12 5EQ.

## Ferry disaster

We have learned from the RSGB news broadcast that Raynet was able to provide communications assistance during the disaster which befell the *Herald of Free Enterprise* ferry at Zeebrugge. Raynet members in Kent provided vital communications following the accident. The Kent Raynet controller, Peter James G6HYN, was asked by the Coroner's Officer of the Kent Police to set up a link with the Belgian Police via the Belgian Radio Club station ON6BR, by means of which details of casualties and survivors were passed to both the police and the vessel's owners using 80 metres. Well

done to all who took part in this valuable effort.

A further example of amateur radio's ability to bring help when urgently needed was broadcast from the RSGB news bulletin on 29th March last. On Saturday 7th March, a group of radio amateurs were looking for a site from which to operate during the VHF National Field Day in the Burnham on Crouch area. Whilst doing so, they spotted a yacht stuck on a sandbank. Two members of the group were yachtsmen and recognised the danger the boat was in. They managed to contact a station in Sandwich via the Maidstone repeater and he contacted the coastguards who were able to get to the scene within thirty minutes. The Clacton lifeboat was called out, together with a Sea King helicopter from RAF Manston and a coastguard inflatable from Bradwell. Three ladies were taken off the yacht by the Clacton lifeboat while the helicopter stood by and the yacht, which had engine failure, was towed to safety. The radio amateurs were told by the coastguards that their action had probably saved both the yacht and its crew.

## IARU meeting

The IARU Region 1 Triennial Meeting was held at Noordwijkerhout, Holland, from 10th to 17th April. Your scribe attended this meeting and will report the events in due course. The agenda covered all aspects of amateur radio, and the newer techniques such as amateur television transmissions and amateur radio satellites occupied a considerable amount of time as there were various matters needing urgent decisions in these fields particularly. The amateur satellite service, for instance, is suffering severe interference from other users of these frequencies.

This is particularly so in the case of the latest amateur radio satellite to be put into service. The Japanese satellite Fuji, or FO12 as it is designated, is suffering severe interference from the many 2 metre band FM stations which are now operating from all round the world. A step towards controlling this was recently taken by the Region 2 division of the IARU at its conference in Buenos Aires, Argentina. The delegates at this conference passed a resolution to ask all IARU member societies to remind radio

amateurs of the difficulties caused by transmissions they make on frequencies allocated to the Amateur Satellite Service. At the time of writing it was anticipated that a similar resolution would be moved at the Region 1 conference at Noordwijkerhout.

## Operation Raleigh

This expedition has been mentioned previously in these columns. The latest news of this project is the establishment of the Operation Raleigh Amateur Radio Club at the Operation Raleigh Support Centre in Hull. The objects of the club are to communicate with the expedition flagship, the *Sir Walter Raleigh*, whose callsign is GB0SWR/MM; to disseminate information about the project and amateur radio in general; to communicate with Operation Raleigh projects in the field that are supported by a mobile amateur radio station; to mobilise amateurs in the UK and in countries where Operation Raleigh is active to provide field support. The station is equipped with a Yaesu 75GX transceiver and a TB3 beam antenna. It is hoped to add 2 metre equipment soon and also possibly RTTY. Visitors are welcome at the centre, which is at 47-49 Queens Dock Avenue, Hull.

Currently the station, GB4ORH, is being operated from 1000 to 1300 hours Monday to Thursday:

80 metres 3560 CW, 3732 SSB

20 metres 14060 CW, 14120 SSB when conditions permit

15 metres 21060 CW, 21120 SSB when conditions permit

Expeditions are active in Tasmania and New Zealand and the latter is supported by radio amateurs operating ZL6OR on 7098kHz at 0745Z, 0845Z and 0945Z and on 14120kHz at 0800Z, 0900Z and 1000Z, SSB.

## Gilwell Scouts

More interesting information has come to hand about the Scout Amateur Radio Group at Gilwell Park, who were recently granted the callsign GB2GP on a permanent basis. The group exists for several purposes, principally:

a) To provide an active operational amateur radio station every Saturday so that Scout and non-Scout amateur radio operators in this country and around the world may have a contact with Gilwell.

- b) To explain to visitors of all ages the development and importance of communication and the rudiments of amateur radio.
- c) To train members of the group in electronics and communication with the ultimate aim of their passing the Radio Amateurs' Examination and securing an amateur radio operator's licence.
- d) To provide demonstrators for specific major events in the Gilwell calendar and to operate a British Scout amateur radio station during international Scouting events such as Jamborees.
- e) To arrange and run training courses in communications and allied subjects for local Scouts.

There is now a Scouts' Communicator Proficiency Badge and also an Electronics Badge. By running courses for these, Gilwell Park encourages Scouts to eventually take their RAE. A recent success in this field is that of Nigel Moore, who at the age of fifteen years passed his Morse test to add to his RAE which he had passed at the age of fourteen. He now has the call G0GGP.

The amateur radio station at Gilwell Park is open all day every Saturday, when properly structured visits can be

arranged. Some 6,000 visitors are shown around yearly and in view of the numerous requests received about visits, arrangements must be made beforehand.

Applications must be made to: Bill Livens G2CKB, 10 Cotton Drive, Pinehurst Estate, Stanstead Road, Hertford SG13 7SU, tel: (0992) 558493, or to Terry Lockyer, 18 Allison Close, Waltham Abbey, Essex EN9 3NY, tel: (0992) 716651.

## RSGB's 75th anniversary

Next year marks the Radio Society of Great Britain's 75th anniversary, and the occasion will be celebrated by many events. As president for the year, the society's council has elected Sir Richard Davies KCVO, CBE.

Sir Richard is an extra equerry to His Royal Highness Prince Phillip, Duke of Edinburgh, KG, KT, who is Patron of the RSGB. Sir Richard is an active radio amateur with the callsign G2XM. He has a background in the electronics industry and a wealth of experience.

## NASA honours

The American National Aeronautical and Space Administration (NASA) has honoured three members of AMSAT-NA by awarding them medals.

Dr Tom Clark W3IWI, well-known for his Presidency of AMSAT, was awarded a medal for his outstanding work with networks of large radio telescopes, whereby signals from remote outer space objects can be pinpointed with far greater accuracy than before. Dr Mario Acuna LU8HBG/W3, who was similarly awarded, has been responsible for building precision magnetometers for numerous space projects, including the Voyager and Mariner Space Probes as well as for the UoSAT's Oscar 9 and Oscar 11. The third recipient was Hugh O'Donnell W3FUO.

## Monday Night Award

The RSGB Monday Night Award was initiated by the RSGB VHF Committee to promote activity on the 432MHz band. It ran from April 1985 to March 1986. The response was good, a number of the participants managing to work the required callsigns to get the award. As a result of the interest shown, the VHF Committee has decided to reintroduce the award on a permanent basis.

Contacts have to be made between 1800 and 2400hrs local time on Monday nights. Entry forms from Jack Hum G5UM, 27 Ingarsby Lane, Houghton-on-the-Hill, Leicester LE7 9JJ.

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VP181	100	1 and 2 watt Resistors, assorted values	£1.00

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VP8	200	Ceramic Capacitors Min. mixed values	£1.00
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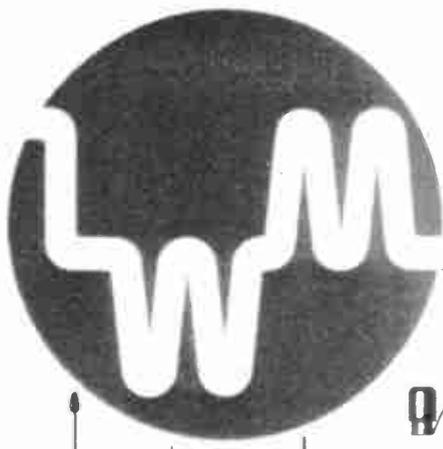
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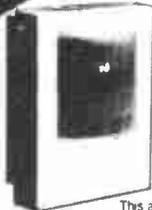
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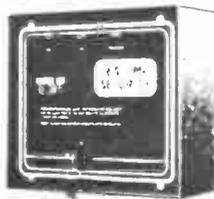
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The television repeater scene has never been livelier – it really is all happening. Here is a summary of what's new...

GB3TV (Dunstable) continues to function well and may have a higher power output stage soon. Another bonus is the use of larger letters on the caption to assist identification during openings. During the last lift, 'guest operators' got in from Stoke, Birmingham, Derby, Nottingham and Margate (among others).

GB3UD (Stoke) is now in full repeat mode, running 5 watts RF. The antenna is scheduled for an upgrade, which should result in increased coverage; already G5KS gets in from Birmingham. Steve G4DVN and Roger G3OHH deserve a credit for putting in a lot of very hard work to get things going. Subs for the repeater group are £5 a year, and the secretary is John G8KUZ.

GB3VR (Brighton) is back on the air and working well from its new site. GB3CT (Crawley) is now licensed and operational.

GB3GT (Glasgow) is also now licensed and the hopes are that it will be operational within a couple of months. GB3AF (Durham) expects its licence shortly. GB3VI (Hastings) is licensed but not operational; there is no further news from them. GB3ZZ (Bristol) expects its licence any day now, as does GB3HV (High Wycombe).

The preparation of equipment for GB3RT (Rugby) is approaching completion and this repeater should be capable of manned relay operation by the time you read this. Its licence application has gone into the current batch. GB3ET (Emley Moor) is expected to have its licence application approved at the next Repeater Management Group meeting.

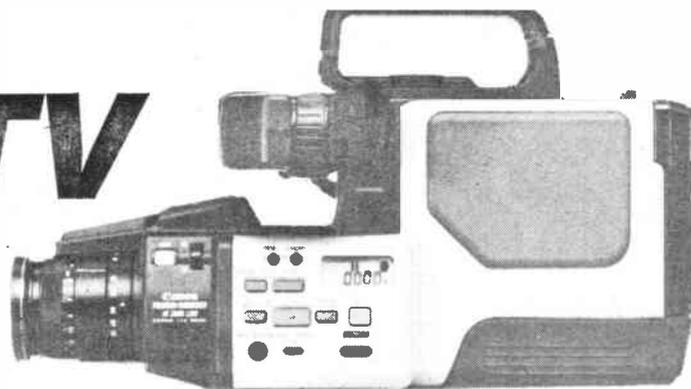
In case you are thinking of your own local repeater and wonder how much work is involved, I hope to give you more progress reports and case studies from time to time. In the meantime you will find that most repeater group chairmen will be only too pleased to share information.

#### NEC news

At the RSGB's National Convention LMW Electronics (Leicester 386364) had on display the 24cm enthusiast's dream: a solid-state power amplifier. Made by Down East Microwave in the USA, it is available in two versions with 18 or 35 watt outputs. The smaller device needs 1 watt drive, while the other requires 7 to 10 watts. These amplifiers use NEC 2SC3452 power transistors and look very well made, with good heatsinking, N-type connectors and solid die-cast boxes. No transmit/receive switching is provided. Power requirements at 13.5V and 3.5 amps for the smaller device and 6 amps for the larger.

Operation is possible at any frequency between 1.26 and 1.3GHz and will appeal to people who dislike high voltage thermionic devices and those who need a dc fed amplifier for mobile operation. A full data sheet is given in LMW's new

# ATV



# ON THE AIR

## Andy Emmerson G8PTH puts you in the picture

catalogue and the only other details you'll want to know are the prices. Take a deep breath and reckon on £188 for the 16W amplifier and £226.50 for 38 watts. Compared with the true cost of building a valve amplifier with cavity, blower and protected power supply from scratch, these prices are not too unreasonable.

There are many other useful goodies on the LMW list, so look out for their stand at select rallies or send 20 pence and a large SAE to 102 Stamford Street, Ratby, Leicester LE6 0JU.

That apart, I noticed nothing of great interest for ATVers at the exhibition; certainly not as many second (third?) user cameras and VCRs as last year. The BATC was not represented as the cost of floor space for the stand was uneconomic. Several other groups and traders had decided that they could no longer justify these rates, it would appear, and the show was quite easy to walk around.

#### Ideas for FM

One organisation which was present at Birmingham was VHF Communications of Germany. On show was their full range of magazines and components, and I noticed that the autumn 3/1986 issue of the magazine had a very comprehensive article on FM TV.

Written by Josef Grimm DJ6PI, the article compares AM and FM techniques and shows in a series of off-screen photos how FM gives a hugely superior signal to noise ratio. There are also some practical circuits and many references, making this a very useful introduction to the subject. There is still no UK representative for the magazine, so to get a copy you'll have to write to VHF Communications, Jahnstrasse 14, Postfach 80, D-8523 Baiersdorf in West Germany. If you ring 010 49 9133 470 you can order by Visa credit card.

#### The return of 'KKD'

Ian Waters G3KKD is delighted to announce that after an absence of nearly ten years he is back on the air with 70cm amateur television. The first QSO from the re-erected station at Stow-cum-Quy (near Cambridge) was on March 3rd to G6OHM at Doddington, with G4BIK

(Earth) and G6FMB (Cambridge) also receiving pictures. The distance, at 20 miles over flat fenland, was not very great, and 'noise-free' pictures were exchanged both ways (black and white from 'KKD' and colour from 'OHH'). G3KKD's pictures were tape recorded and retransmitted. Ian will welcome more vision hook-ups on 70cm – you can contact him on two metres or by phone on (0223) 811477.

The salient details and a brief history of Ian's station may well be of interest, so here goes. The QTH is four miles east of Cambridge and just 24 feet above sea level. Antennas are therefore not much taller, at 58 feet ASL. Vision frequency is well out of harm's way, at 437MHz, and video bandwidth is restricted to 2.5MHz DSB.

Ian reckons it is anti-social to radiate colour on 70cm, and I cannot help agreeing. Transmitter power is 100 watts peak sync power, while the aerials take the ERP to 2.5 kilowatts (sounds more impressive, doesn't it?). Picture sources are a three inch image orthicon studio camera and a vidicon caption camera – this sounds a nice compact set-up!

#### Vintage ATV

Ian first transmitted ATV from Ely on 28th January 1956 as G3KKD/T, with a power of one watt. Although not one of the very first few stations, Ian was quite early on the ATV scene. A two-way vision link was soon established with G2DUS/T near Baldock (a path of 32 miles), for which these operators were awarded the RSGB's Courtney Price trophy.

During the period 1959-1971 the station continued to operate from Ely, increasing the power from 1 to 40 watts and then to 150W, and adding an AM sound carrier 3.5MHz lower than vision, with the two combined to feed a single antenna. This latter was first a 16-element stack and later a 64-element array with a gain of 17dBd. All this was on the old 405 line system, of course.

These were the days of the East Anglian TV net, which included G2WJ/T, G3MHZ/T, G3NBV/T, G3NOX/T, G3OAT/T, G3GDR/T, G3PGF/T, G3BBY/T, G3REH/T, G3PDO/T, G3RIZ/T, G3PEI/T,

G3RGX/T and G6SPH/T. During the reorganisation of 16th June 1964 the station call was changed to G6KKD/T for vision and G8ADE for voice communication.

Vision sources were first a photicon (image iconoscope) camera exhibited at the RSGB exhibition in 1952 and at the Radio Show at Earl's Court in 1954. This was superseded by a station for captions and a 3in image orthicon for 'studio' shots.

#### End of an era . . .

The station was one of those featured at the BATC's CAT-70 convention at Churchill College, Cambridge in 1970. It continued to operate from a new QTH in Ely until May 1971, when a house move brought it to its present Stow-cum-Quy location (reopened August 1972). However, time was passing and technology changing. The 405 line system A

(positive modulation) was giving way to 625 lines system I colour (negative modulation). ATV sound had changed from AM on 70cm to FM on two metres. Communications had changed from AM to channelised FM and SSB.

In short, the station had become out of date and was quite unable to communicate! Family and business commitments, too, left little or no time for a rebuild, so Ian's station went QRT after a video QSO for the benefit of ITN with G3NOX in May 1977.

#### . . . and revival

In 1980 a decision had to be made about whether to give up and scrap the entire contents of the shack or to selectively modernise the better parts and build new items to complete a modern working station. The latter course was chosen, and as Ian builds everything himself rather than buy commercial equipment,

it has taken some seven years to get far enough to go on the air. The old callsign, G3KKD, now without the /T for television, was reissued on 2nd August 1986.

#### Activity today

Although not on the air during recent years, Ian kept a watch on 70cm using the audible vision detector he evolved and described in *CQ-TV* in 1983. Until 1986 this alarm sounded frequently and 70cm pictures were resolved from many parts of the UK and nearer Europe. In the last year 70cm ATV activity appears to have ceased almost completely, at least in range of this station. Have they all migrated to 23cm and FM? Perhaps we will now stir up 70cm activity in East Anglia again. Speaking of 23cm, the Cambridge video repeater GB3PV is expected on the air shortly from Maddingley, so Ian says he expects to start building again soon! [REW]

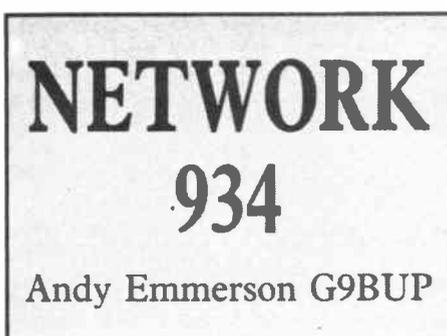
**W**e have something of a bonanza of new goodies to announce next month, so start saving or get ready to smash your piggy bank. Before this, however, some news. Telecomms of Portsmouth have shipped a selection of apparatus to Iceland, where the PTT (regulatory administration) has allowed a six month trial of 934MHz operation, including an in-band repeater. If the tests are successful, we can expect the Icelanders to have a 934MHz system similar to our own. The company has also sent equipment to the Netherlands for evaluation there; the Dutch PTT is believed to be sympathetic to 934MHz, though whether they go for simplex or an automatic PRS solution is so far unclear.

Telecomms is currently testing a new Alford Slot antenna, which offers 7dBi of omnidirectional coverage with horizontal polarisation. The Alford Slot is an unusual aerial, because although it is mounted vertically it produces horizontal radiation (you can read more about it in the RSGB's *VHF/UHF Manual*). This makes a nice base station or mobile aerial for people who wish to go horizontal to avoid interference from cellular radio.

I am told this is the only way that 934 enthusiasts can work in some areas, which is obviously good for them if it means they can enjoy an otherwise unusable band. It does, however, put them out on a limb – in a horizontal ghetto, so to speak. For maximum compatibility most users of the band will wish to stick with vertical polarisation, which is what everyone else uses on 934.

#### Phonepatching again

I have some news on the phonepatch scene. Following detailed investigation, IQD Ltd now accepts that this product is not licensable on 934MHz, although the DTI originally stated that it was! (I have a



copy of the correspondence to support this). What is surprising, though, is that the DTI had not (at the time of writing) informed either IQD or CTVR, even though they had told the Personal Radio Club some time previously. It is quite clear that IQD and CTVR sold the systems already made in good faith, having been misled by the DTI.

Where do existing users stand now? Will the DTI go round tracking down those people who have already bought systems? If so, I hope these existing users will be compensated – we shall have to see.

#### A little knowledge . . .

In my April column I said that the transceivers modified by CTVR Ltd for phonepatch had a tendency to ignore all but S9 signals and thus 'walked straight over the top' of DX and other weak QSOs already set up. This comment was based on the experience of people in the Bristol area, where a phonepatch station was causing a lot of grief among existing 934ers.

Rod Buck, a director of CTVR, has politely told me that I'm wrong and his sets will refuse to stop on any channel showing S1 or more, even if no signal lamps on the Delta are lit. He also points out that a hobbyist working simplex can

just as easily interrupt a QSO where a well sited station is listening to a weak DX station. If the newcomer is down in a dip and cannot hear the DX station he will obviously think the channel is clear and key up.

Mr Buck is, of course, correct, though if you read on, you can see why the Bristol folk had trouble. Those problems have in fact been solved now. What was happening was that the phonepatch station was reportedly using an illegal 25 watt power amplifier and this was causing his signals to crush existing contacts and spread so far and wide. The Radio Investigation Service was informed by a vigilante group and the offending station has now closed down. Good . . . we don't need high-power clever dicks on the band.

As my informant points out, someone has now spent rather a lot of money on a phonepatch system and PA he can't use; a 'professional' pirate would have put the equipment on the 'in-between' channels and would have never been discovered (nor caused so much grief to others). Ah well, it's easy to be wise after the event!

#### Filter report

First in the trade news is the long awaited result of the test on the new filter sold by Selectronic (203 High Street, Canvey Island, Essex SS8 7RN). You will recall (or you should do) that this is a device intended to reduce the effect of interference from cellular radio. If you are lucky enough not to suffer this – and most people are – skip this section.

Right, for the rest of you less fortunate folk, here is the verdict. Yes, it looks quite favourable and use of this filter may solve your problems, particularly if the interference is not too bad. Fortunately, Selectronic are selling them on a money-back basis, so if the filter is less than 100 per cent satisfactory all you have lost is the cost of the postage.

# NETWORK 934

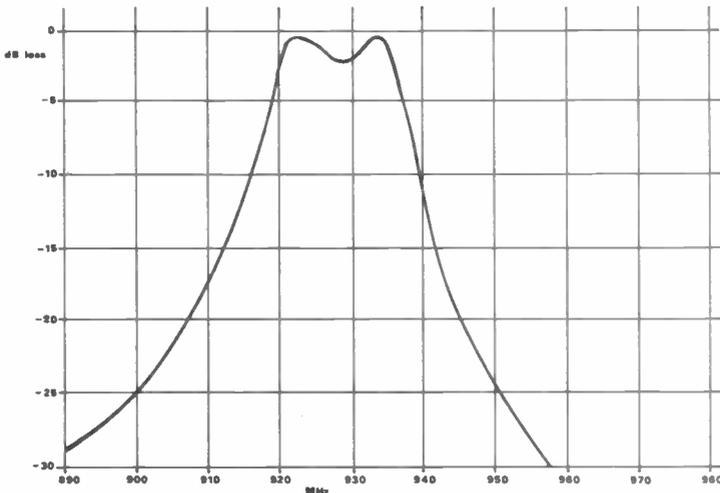
What we are talking about is a three-pole interdigital filter. It is substantial and well made, and is fitted with N-type connectors. One is marked 'Transceiver' and the other 'Antenna', but in fact the filter is entirely symmetrical and it doesn't matter a hoot which way round you connect it (so long as it's between the rig and the aerial feeder). The design of filter is known as an overcoupled line, which gives the double-humped profile shown on the graph below.

What the drawing is trying to show is that insertion loss is around 0.5dB in the 934MHz band. In other words, using this filter will not make any detectable difference to the signals you want to hear. As the curve goes further away from 934MHz it gets steeper, and checking the vertical scale of the graph we see that the insertion loss increases. In other words, the *unwanted* frequencies suffer much more attenuation. For instance, at 920MHz and 936MHz there is

2.5dB attenuation and at 940MHz, 13dB attenuation.

What does this mean in practice? Well, in all probability the filter won't do much to remove interfering 'Voodoofone' signals, but Cellnet should not worry you at all. Why can't they make a filter to remove Vodafone as well? Because it's not possible, at least not with normal technology. This Selectronic filter has a pretty sharp notch shape for a three pole filter, and to get any greater selectivity you would need to use more than three poles. But more poles would increase the loss on the wanted frequencies as well, so you'd be no better off.

This filter is about as good as you'll get, so you could do worse than give it a try. The price is £65, which is cheap if it works for you. Try it and see.



The double-humped profile of an overcoupled line filter

### PRCGB

A little while back I remarked that members of the Personal Radio Club of Great Britain had not seen a newsletter for a long time. Right on cue the spring edition arrived, and it makes interesting reading. If you'd like to spend a fiver and join one of 934MHz's two national clubs, send your £5 to PRCGB, 41 Twyford Avenue, Shirley, Southampton SO1 5NZ.



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# Complete Parts Sets for Top Projects

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FEATURED IN ETI, SEPTEMBER 1986



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The domestic mains supply is riddled with RF interference, noise, transient spikes and goodness knows what else. Computers crash, radios pop and crackle, tape recordings are spoiled and hi-fi sounds 'not quite right'. Why put up with it when the solution is so simple? The ETI mains conditioner is the lowest cost upgrade you will ever buy, and probably the most effective!

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\*Note: the toroid and VDR supplied are superior to the types specified in the article.

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FEATURED IN ETI, JANUARY 1987



### MOTORISTS QUIZ

You are driving along the road one day when the sound of a horn makes you look behind. The driver of a milk float is cursing you for driving so slowly. A while later, an invalid carriage overtakes you, and just as you turn into your drive you hear a tractor driver mutter: 'At last I can get out of first gear.'

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- Fill a £500 Pie-in-ear in-car stereo with digital flex-woolers and 24 band ramification?
- Buy a set of fluffy dice and sticker saying 'My other car is a Macaroni'?
- Give your car in-part exchange for a milk float, invalid carriage, tractor?
- Tune your engine.

The combined tachometer and dwell meter parts set contains case with battery compartments, printed circuit board, all components, switches, plug, socket and test leads, battery connector, full instructions. The answer to the quiz: by the way - is 'e'! Buy a bright red Lotus Esprit!

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FEATURED IN ETI, JANUARY 1987



Have you ever wondered what people do with all those computer interfaces? Put your computer in control, say the ads. The Spectrabeeb has eight TTL outputs. What on earth can you control with a TTL output? A torch bulb?

The ETI Mains Controller is a logic to mains interface which allows you to control loads of up to 500W from your computer or logic circuits. An opto coupler gives isolation of at least 2 500V, so the controller can be connected to experimental circuits, computers and control projects in complete safety. Follow your computer interface with a mains controller, and you're really in business with automatic control!

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FEATURED IN ETI, JULY 1986



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The DIRECT ION ioniser caused a great deal of excitement when it appeared as a constructional project in ETI. At last, an ioniser that was comparable with (better than?) commercial products, was reliable, good to build, and fun! Apart from the serious applications some of the suggested experiments were outrageous!

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# POWER SUPPLIES AND HOW TO DESIGN THEM

BY DAVID J SILVESTER

All electronic projects, from simple transistor circuits to complicated microprocessor systems, need one or more stable dc supplies. In most cases the simple transformer, bridge or capacitor system is unsuitable and we must consider regulated supplies to reject the high levels of 100Hz (120Hz in the USA) ripple. Fortunately, it is simple to produce stable power supply units using negative feedback to compare the dc output with a stable reference voltage.

Unfortunately the reliability of the PSU depends upon the preparation the constructor takes with the technical details of the supply. The PSU is the most highly stressed item in any project, and any lack of care in its design will result in an unreliable project. Even in professionally designed equipment, the PSU is always checked to ensure its correct operation, as many instrumental problems are caused by this unit.

With all power supply units the problems of power dissipation, heatsinking and current limiting, whether this be straight or foldback type, must be considered. We actually have to design a PSU backwards from the output of the device. Although most people think of the power supply as the first part of a project, it is only when the power inputs

to the rest of the circuit are known that the PSU can be designed. We thus need fixed values for the current and voltage requirements of the circuit to be powered, and not only the average value but the maximum value, so that current limiting circuitry can also be included in the PSU.

In our procedure of working 'backwards' we shall first look at the possible designs of regulator that are open to us, and look at a number of regulator types before turning to the subjects of current limiting, dual supplies, constant current supplies and, of course, the design considerations for the basic transformer, bridge rectifier and filter capacitor input system.

## The basic regulator

Although we shall be looking at a range of regulator types, there are two basic criteria for successful operation of the regulator:

- Minimum input voltage.
- Minimum differential voltage between input and output.

The basic regulator, *Figure 1*, consists of a voltage reference, an error amplifier IC1, the high current pass transistor Tr1, a voltage divider of R1 and R2 and a compensation resistor, R3. There are two

possible items that can affect the minimum unregulated input voltage to be used. The minimum input voltage must be sufficient to allow the voltage reference to operate correctly. Secondly, the error amplifier will also have a minimum input voltage for the output to reach 0.65V greater than the regulated output required to overcome the base emitter voltage drop of the pass transistor. The reference voltage passes to the non-inverting input of the error amplifier and a portion of the regulated output to the inverting input. Under normal operating conditions, the two inputs to the error amplifier will be equal and the regulated output voltage will be

$$V_{out} = \frac{V_{ref} \times (R1 + R2)}{R2}$$

R3 is chosen so that the error amplifier sees equal impedances and so

$$R3 = \frac{R1 \times R2}{R1 + R2}$$

The unregulated input at its minimum voltage (see section on ripple voltages later) must be

$$V_{min} = V_{out} + 0.65V + \text{drop-out voltage of error amp}$$

The drop-out voltage is the minimum differential between the positive supply and the output required from the error amplifier, for example 4V for an operational amplifier. This circuit, with the small modification that the voltage reference consists of a simple resistor Zener diode across the regulated output, was designed and built some 15 years ago and is still used today to provide a PP9 battery replacement for a transistor radio.

It is now rare for the error amplifier to be constructed from discrete components and more usual for the design to use some type of operational amplifier. In cases where the output voltage is greater than the maximum output of the op-amp, we will have to add a number of high breakdown voltage transistors. The components to be added to *Figure 1* will be a resistor between Tr1 emitter and

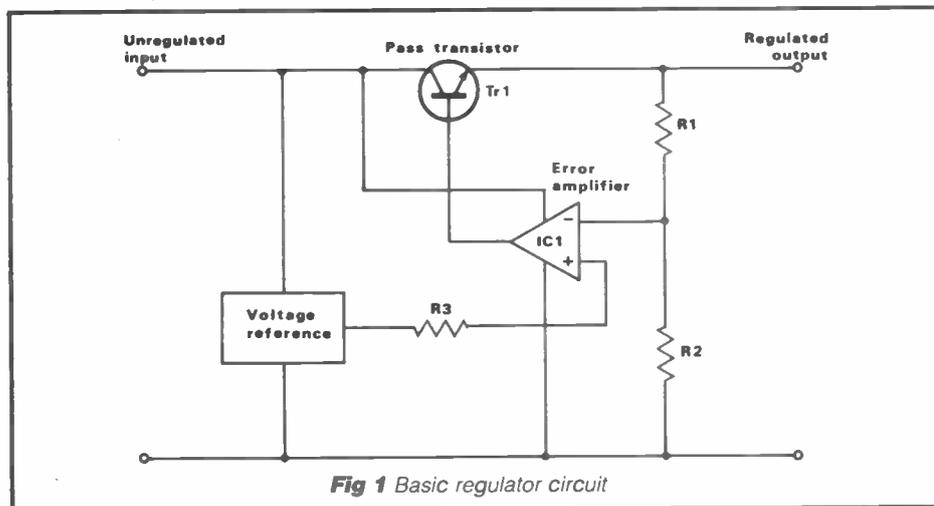


Fig 1 Basic regulator circuit

base which will tend to turn on transistor Tr1. If we now add a second high breakdown voltage transistor with its collector to Tr1's base, its emitter to ground and its base to the output from the error amplifier, by turning on this new transistor we can control Tr1 and hence the output from the whole regulator. The added transistor will invert the output from the error amplifier and we must reverse the two inputs to the error amp for correct operation. We must also provide a Zener stabilised supply to power the error amplifier, as the unregulated input voltage will be well in excess of the maximum input of 36 volts of the op-amps normally used.

### The 723C regulator

The 723C regulator was developed in 1967 and is now a common, cheap and reliable device. It is not a complete regulator, but has to be connected to some external components before use as a voltage regulator. Because of these added components it is easy to make many types of PSU by varying the feedback network and adding external pass transistors when necessary. The data sheet shows that the 723C can be used to make power supplies from  $-250V$  to  $+250V$  with current ratings up to 10 amps. Figure 2a shows the basic internal circuitry of the 723C and it is interesting to note its similarity with the basic regulator of Figure 1. In its basic form the pass transistor of the 723C is only rated to 150mA and the total device dissipation is limited to 800mW. The 723C is available in either the 14 pin DIL package or in a 10 pin metal can. The reference voltage, although given as 7.15V, may in a selection of devices vary between 6.80 and 7.50V.

Figure 2b shows the simplest regulated supply that can be made with the device. Like our basic regulator, R5 and R6 are the potential divider for the output and under normal operation the voltage at the junction of these resistors will be a nominal 7.15V. Similarly R4 is the compensation resistor and R5 is a resistor to provide current limiting. The transistor to reduce the output voltage is internal to the device and a single resistor only gives limiting at a constant current, although foldback current limiting, to be discussed later, can be added with ease.

With a single resistor, when the current through R5 is sufficient to make the voltage across R5 equal to 0.65V, the current limiting transistor begins to conduct and holds the voltage across R5 constant at 0.65V by robbing the pass transistor of drive, and in consequence the output current becomes constant at a reduced output voltage. For higher current output from the regulator we can add an external pass transistor just as in the basic regulator, as shown in Figure 2c. For low output voltages R6 becomes a compensation resistor, R7 is removed

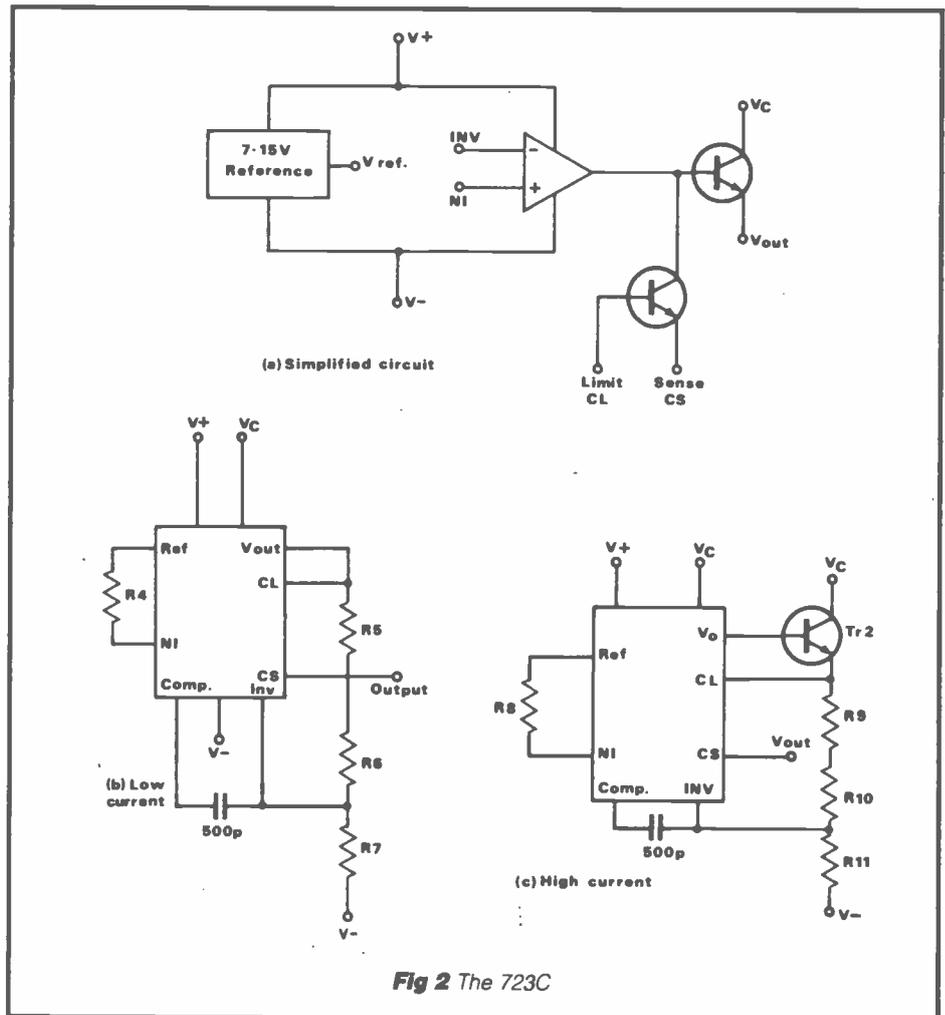


Fig 2 The 723C

and instead we have to reduce the reference input to the non-inverting amplifier input with a potential divider between the reference output and ground.

The 723C has two positive supply inputs shown as  $V+$  and  $V_c$  in Figure 2a. These two inputs allow the internal pass transistor to be powered separately from the reference and amplifier. For low voltage power supplies we must supply at least 9.5V to the reference section if it is to operate correctly. To reduce the power dissipation in the internal pass

transistor, we only need to make the voltage at  $V_c$  3 volts greater than the voltage required at  $V_{out}$ . For a high current supply similar to Figure 2c,  $V_{out}$  will be 1.3V above the PSU output, due to the voltage across the current limit resistor R9 at the limiting current plus the base emitter drop of Tr2. In such a split input supply system it would be normal to use something like 15V to power  $V+$ .

In all of these cases, and incidentally in almost all that follow, the supply can be made to have a variable voltage by using

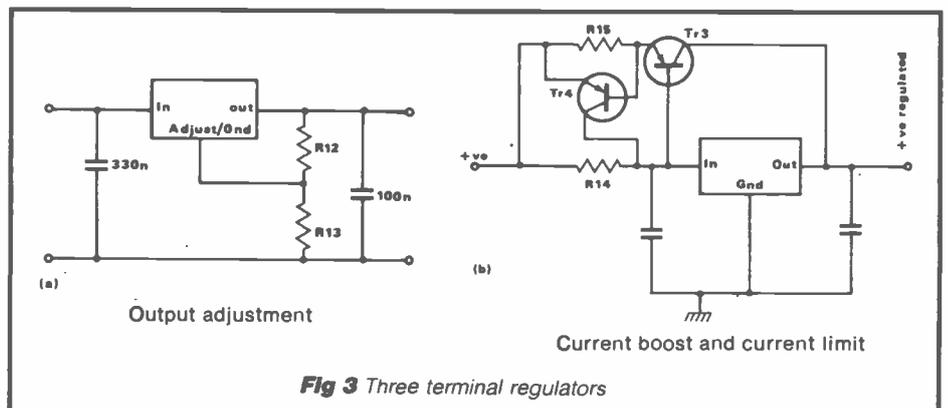


Fig 3 Three terminal regulators

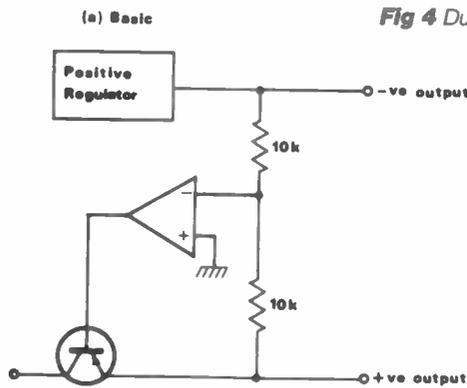
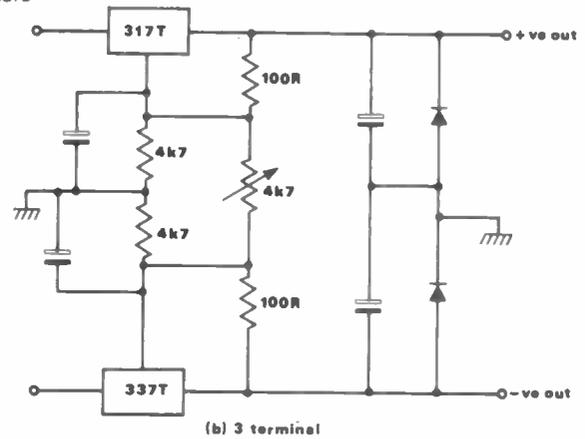


Fig 4 Dual tracking regulators



(b) 3 terminal

Fig 5 Constant current supply (current sink)

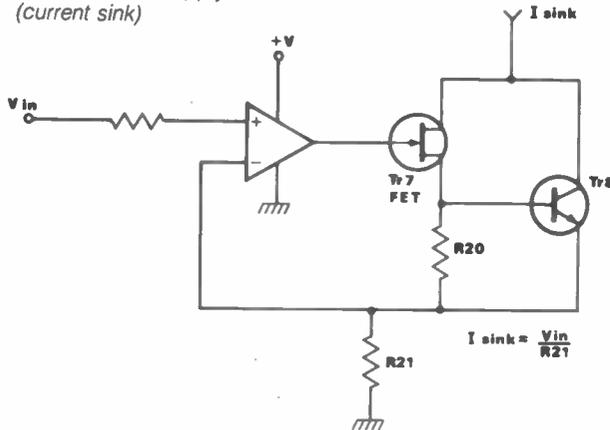
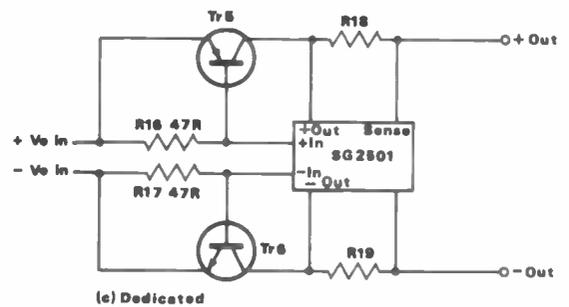
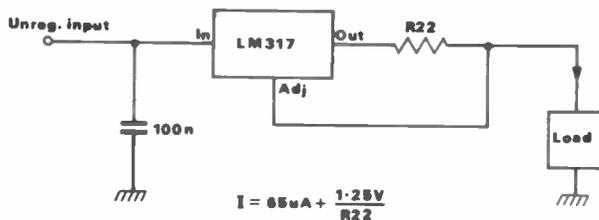


Fig 6 Three terminal constant current (source)



(c) Dedicated

a potential divider chain with a potentiometer as one of the components.

In all, the 723C integrated circuit is an excellent device for making adjustable or presettable power supply units, or in situations where the constructor needs some special characteristic for his or her supply.

### Three terminal regulators

#### Fixed voltage types

The three terminal regulators break into two distinct types, the fixed regulators like the 78XX positive regulator series and the adjustable types like the LM317T.

For the fixed regulators let us have a look at a typical example, the LM7805C. This device is a complete regulator needing no other components to provide an output of about 5V. In actual fact

the output may vary between 4.80 and 5.20 volts. The industrial 'C' type may be operated with chip temperatures between 0 and 125 degrees centigrade, and care is needed over the heat dissipation from the device. The 78XX series can provide a current output of up to 1A and is available in devices of 5, 6, 8, 8.5, 12, 15, 18 and 24 volts nominal output. There is a complementary 79XX series of negative regulators and both types are ideal for on-board regulators.

Normally the 78XX series is operated with one of the terminals marked ground at zero potential, but surprisingly the output can be made adjustable over a small range. If we consider a micro-processor development system, the MPU and all of the TTL devices need voltages between 4.75 and 5.25 volts to operate correctly. At its lowest guaran-

teed output the 7805 could be giving out 4.80V to the circuit, but small resistances in the PCB track could reduce the voltage present at the power input pins of the MPU to below the minimum acceptable. If we slightly raise the ground pin above ground potential using the circuit in Figure 3a then the output from the regulator can be increased slightly until the voltage measured at the MPU pins is 5.00V. This voltage variability only allows us to increase the output, as a voltage equal to the 7805C's nominal output ( $V_{nom}$ ) will be impressed across R12 and if the current into the ground pin of the regulator is negligible compared to the current through R12 and R13 then

$$V_{out} = V_{norm} \left( 1 + \frac{R13}{R12} \right)$$

It must be remembered that the output current is limited by the maximum dissipation of the 78XX or a current of 1A, whichever is the lowest. The output current can, however, be increased by adding an external pass transistor. Consider Figure 3b. The resistor R14 in the input to the regulator will develop a voltage across itself when the regulator is delivering current to the load. Then when the voltage across R14 becomes 0.65V the transistor Tr3 begins to be turned on, and from then on, as the current requirement of the load increases, it is Tr3 which will provide the extra current rather than the regulator

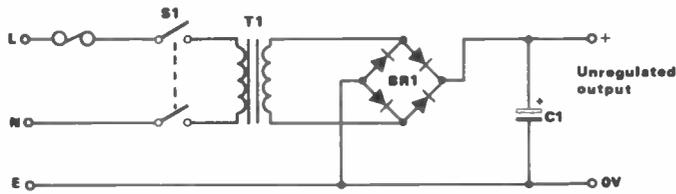


Fig 7a

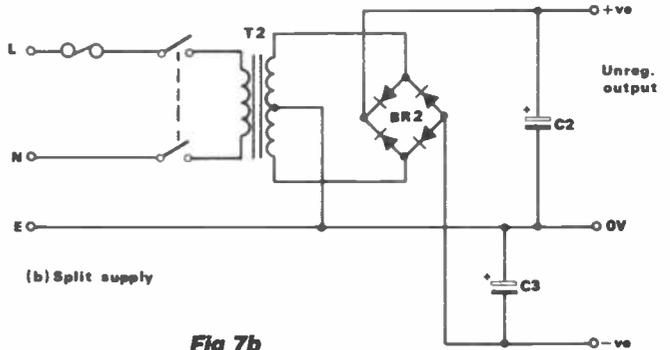


Fig 7b

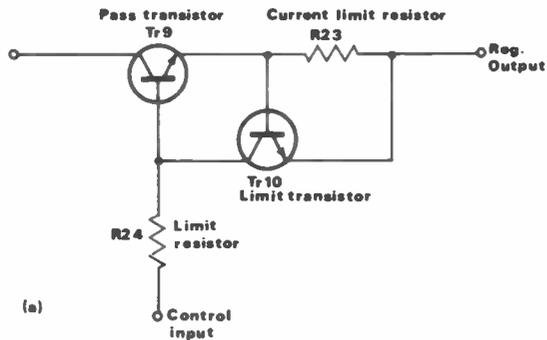


Fig 8a

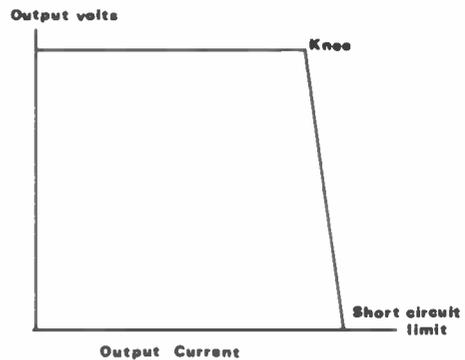


Fig 8b

itself. From the point at which Tr3 turns on, the current through the regulator will increase to only a very small extent, and the in-built current protection of the 78XX will be inoperative. A typical value for R14 would be 2.7 or 3.3 ohms and the regulator will only deliver about 200mA of the current delivered by the whole circuit. To add current limiting facilities we need to add R15 and Tr4. With this addition, when the current through Tr3 is sufficient to make the voltage across R15 equal 0.65V, Tr4 will turn on and rob Tr3 of drive, thereby current limiting the output.

Also available is the low power dissipation 78LXX series with an output current limit of 100mA and a high power series, the 78HXX, which supplies currents of 5A. The high power series is very expensive and the addition of an external pass transistor to a simple 78XX provides a cheap and effective alternative to using the 78HXX series. By using Darlington transistors or power Mos-FETS, simple supplies of, say, 20A are easy to construct, but if the supply is to be connected to an expensive piece of commercial equipment then some form of output overvoltage protection must be included.

### Adjustable voltage types

The most common adjustable voltage, three terminal regulators are the LM317T positive regulator and the complementary LM337T negative regulator. Both of these devices are in the TO220 package like the 78XX series. These units are very simple to use and, except for the resistor values needed, use the same circuits as

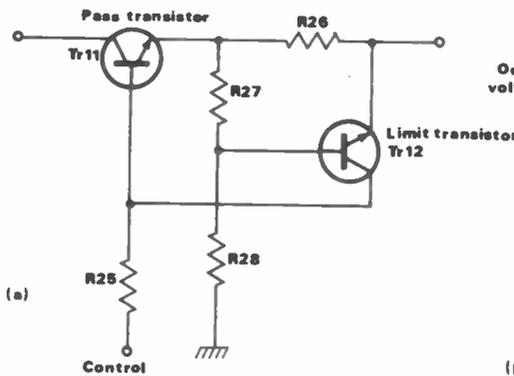


Fig 9a

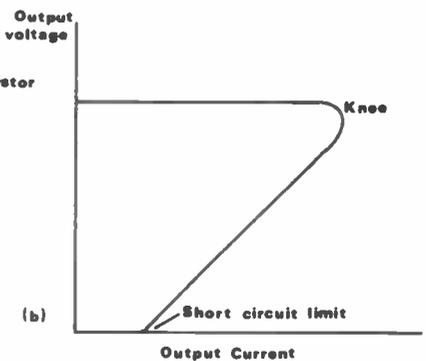


Fig 9b

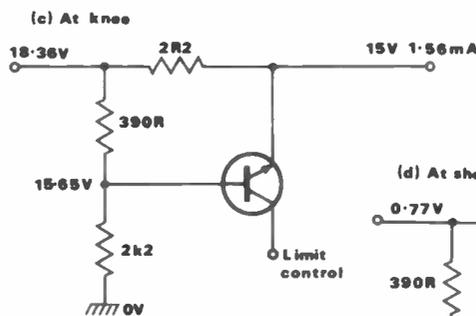


Fig 9c

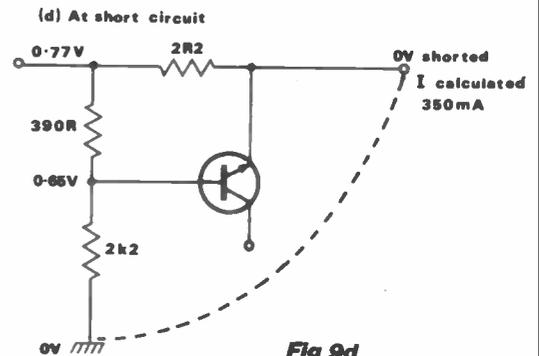


Fig 9d

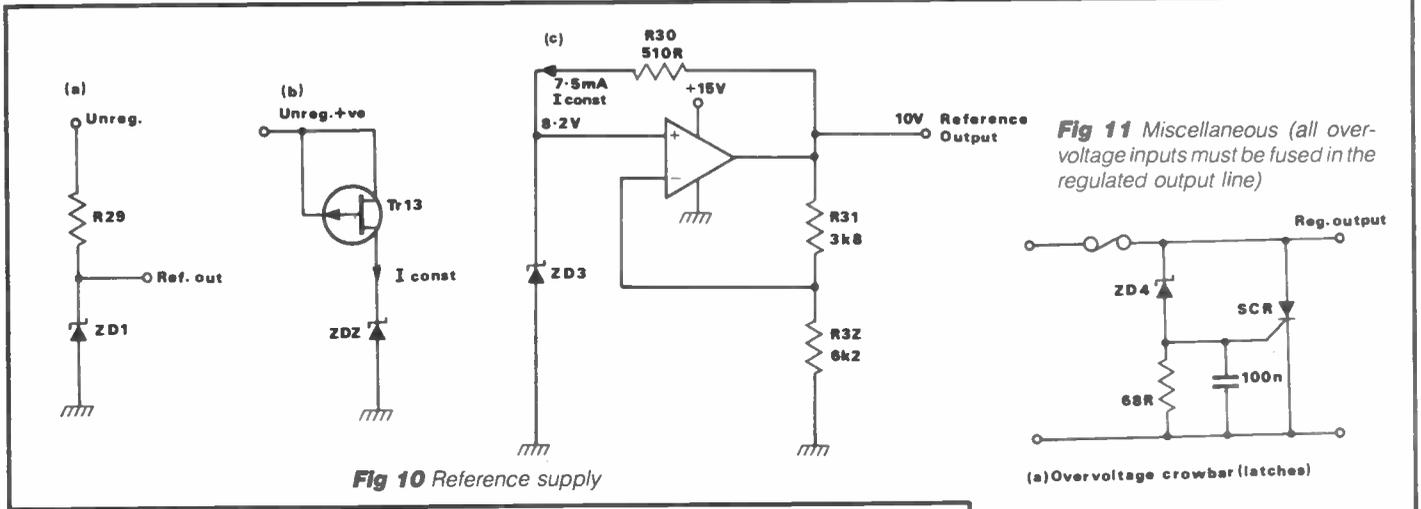


Fig 10 Reference supply

the 78XXs, see Figure 3a and Figure 3b.

In the circuit Figure 3a only 1.25V is impressed across R12 and we are told that the maximum current from the adjustment terminal is 0.1mA. In this circuit, if R12 is made 240 ohms and R13 is a 4k7 potentiometer we can produce a 1.25 to 25 volt variable power supply. The capacitors shown assist in noise reduction and transient response in both types of three terminal regulators, but they are not essential for the regulator's operation. As with the fixed regulators, we can add external pass and current limit transistors. With the variable supply the problem of heat dissipation is serious at the low output voltage end of the range and will need much greater care than a fixed voltage supply if the regulator is not to be overheated and damaged.

With either type of three terminal regulator it is impossible to use remote sensing of the supply voltage. The nominal voltage will only be available at the output pin of the regulator, and at all other points in the circuit PCB track resistances will have to be taken into consideration.

### Four terminal regulators

There is little to add about the four terminal regulators. They contain the reference source and error amplifier of the basic circuit, but only the supply input, output, ground and inverting input of the error amp are available. In the 78GU1C the reference is 5V nominal, and a simple 5V PSU can be made by connecting the output and error amp input together and using the device as a three terminal regulator. For higher output voltages a resistive divider selects a 5V sample of the full output. We cannot make PSUs with output voltages less than the reference as there is no pin available with the reference voltage on it. As with the three terminal regulators, we can add high current pass and current limiting transistors to increase the current capabilities of the PSU. Remote sensing is, however, possible.

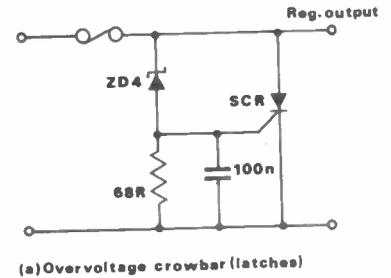
### Dual tracking regulators

Let us spend a few moments looking at the provision of dual power supplies where we have two voltages of equal magnitude either side of a central ground potential. Figure 4 shows some of the possibilities, but let us first examine the basic circuit of Figure 4a. In this figure a positive regulator of a type previously discussed provides a fixed positive output voltage. No current limiting or current pass transistors have been shown as they are not important at this stage.

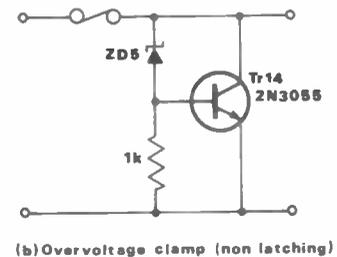
The error amplifier shown in Figure 4a has its non-inverting input connected to ground and its inverting input connected to a resistor chain across the full output voltage. Provided that the two resistors are the same value, only when the two output voltages are equal but of opposite polarity will the two inputs to the error amplifier be the same voltage, ie ground, and the error amplifier be in control of the negative supply. Any change in the positive supply voltage, due say to current limiting, will be reflected in the negative supply. However, if we have added current limiting to the negative supply, any alteration in the negative supply voltage due to current limiting will not, with this circuit at least, have any effect on the positive supply output voltage.

In the previous items where the current limiting has been mentioned, we have used a transistor that is turned on when the system current limits to reduce the drive to the pass transistor and reduce the output voltage at constant current. If we use the current limit transistor to turn on the photo-diode in an opto-isolator, and if it is the negative current limit system that controls the opto-isolator, and the transistor in the opto-isolator is arranged so that when the opto-transistor conducts it turns off not the negative but the positive supply, then if either supply rail current limits, both supply rails will reduce in voltage. This gives us full cross-linked current

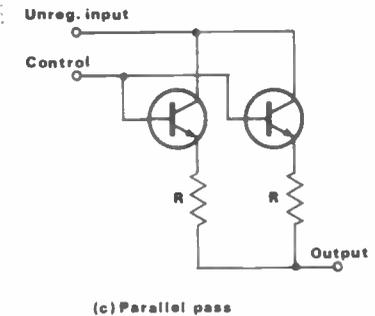
Fig 11 Miscellaneous (all over-voltage inputs must be fused in the regulated output line)



(a) Overvoltage crowbar (latches)



(b) Overvoltage clamp (non latching)



(c) Parallel pass

limiting in both power supply rails.

Figure 3b shows another possibility using three terminal adjustable regulators with dual outputs from 1.25V. One of the most common requirements is for a fixed dual supply of  $\pm 15V$  for use with op-amps and a dedicated chip, the SG2501, is available to make such a supply. On its own the SG2501 can only give an output current of 100mA, although for safety it is recommended that the current is kept to 50mA or less.

Also, like the previous three terminal regulators, we can add external bypass transistors, but unlike the three terminal devices the current limiting capability is built in to the chip.

In Figure 4c, R16 and R17 give the necessary voltage to turn on the pass transistors Tr5 and Tr6. R18 and R19 are the current limit resistors. PREW

## Ray Marston looks at the LM10 high performance op-amp/voltage-reference IC

The LM10 is a unique bipolar linear IC that houses a high performance operational amplifier (op-amp), a precision 200mV voltage reference and a variable-gain buffer amplifier in a single 8-pin TO5 package. The entire device can be operated from supplies from as low as 1.1V to as high as 45V, and draws quiescent currents of only 270 $\mu$ A in all cases. The op-amp output can swing to within a few millivolts of the supply line voltages, or can be used to deliver output currents as high as 20mA.

The LM10 can be used in a wide variety of both conventional and unique op-amp applications, but is particularly suited to applications calling for the use of single-ended or very low voltage power supplies or very low power consumption: it can also be used in many voltage reference and power supply applications. We will look at many practical examples of such applications in this and the next two editions of *Data File*.

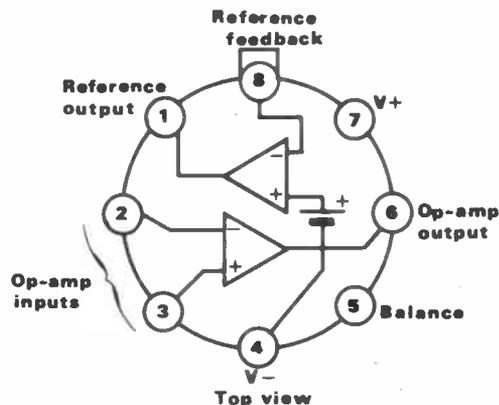


Fig 1 TO5 outline and pin notations of the LM10

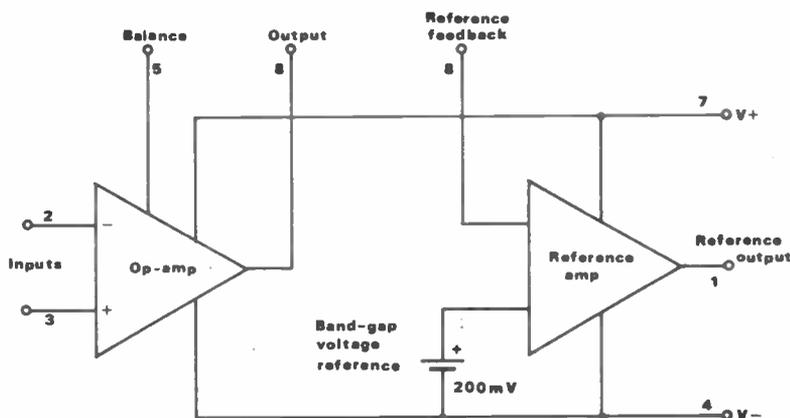


Fig 2 Functional diagram of the LM10

Fig 3 Parameter values of the LM10 series of devices

Parameter	LM10	LM10B	LM10C	LM10BL	LM10CL	Units
Operating temperature range	-55 to 135	-25 to 85	0 to 70	-25 to 85	0 to 70	$^{\circ}$ C
Max total supply volts	45	45	45	7	7	V
Total quiescent current (typical)	270	270	300	260	280	$\mu$ A
<b>Typical op-amp performance at 25<math>^{\circ}</math>C</b>						
Input offset voltage	0.3	0.3	0.5	0.3	0.5	mV
Input offset current	0.25	0.35	0.4	0.1	0.2	nA
Input bias current	10	10	12	10	10	nA
Common-mode rejection	102	102	102	102	102	dB
Supply-voltage rejection	96	96	96	96	96	dB
Unloaded voltage gain	400	400	400	300	300	V/mV
Loaded voltage gain ( $R_L = 1k\Omega$ )	130	130	130	30	30	V/mV
Unity gain bandwidth	0.3	0.3	0.3	0.3	0.3	MHz
Slew rate	0.15	0.15	0.15	0.15	0.15	V/ $\mu$ s
<b>Typical performance of reference at 25<math>^{\circ}</math>C</b>						
Band-gap voltage reference	200	200	200	200	200	mV
Reference voltage accuracy	2.5	2.5	5	2.5	5	$\pm$ %
Line regulation	.001	.001	.001	.001	.001	%/V
Load regulation (0 to 1mA)	.01	.01	.01	.01	.01	%
Thermal drift	.002	.002	.003	.002	.003	%/ $^{\circ}$ C
Feedback bias current	20	20	22	20	22	nA
Amplifier gain	75	75	70	70	70	V/mV

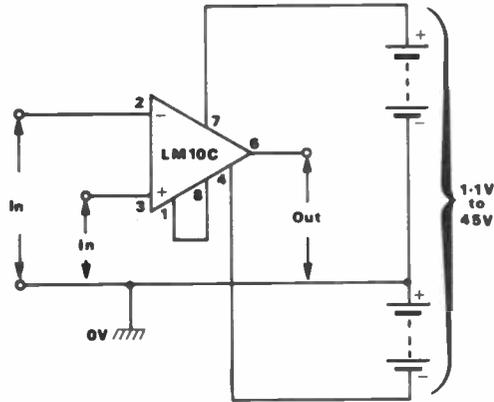
### LM10 basics

The LM10 houses a high performance op-amp, plus a precision 200mV band-gap voltage reference and a 2-input buffer amplifier that has one input terminal permanently tied to the reference unit. Figure 1 shows the outline and pin notations of the LM10, and Figure 2 shows its schematic diagram.

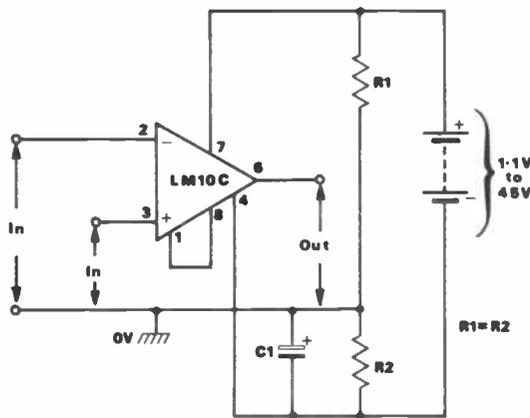
The op-amp section of the LM10 device has a pnp differential input stage that can accept input signals down to zero volts, and has a complementary class B output stage that can swing to within 50mV of the supply lines at 50 $\mu$ A load current, or within 400mV at 20mA load current. The op-amp input is well protected (via internal current-limiting resistors) against damage from excessive voltage, and the output is fully protected against thermal overload and short circuit damage. The op-amp can be used with either dual or single-ended power supplies and can be used in the same way as any normal operational amplifier.

The 200mV voltage reference section of the LM10 is a precision band-gap type with a basic accuracy better than 5% and with a temperature coefficient better than .003%/ $^{\circ}$ C. The reference is externally accessible only via the output of the 2-input buffer amplifier, which can have its gain varied from unity to several thousands via suitable feedback networks, thus giving actual output reference voltages in the range 200mV to about 40 volts.

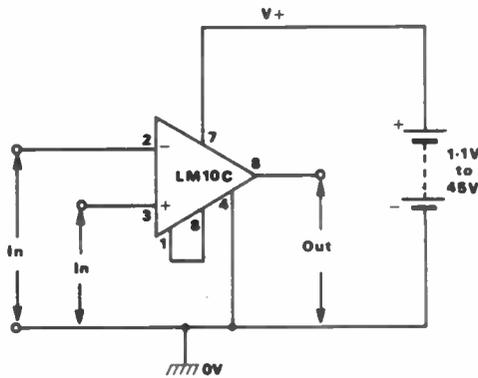
There are five individual members of the LM10 family of devices, and these are categorised by their operating temperature ranges (LM10, LM10B or LM10C) and their maximum supply voltage ranges of either 7 volts ('L' suffix) or 45 volts. Note that the LM10C is a relaxed specification 'commercial' version of the 45 volt unit, and is recommended for use in all LM10



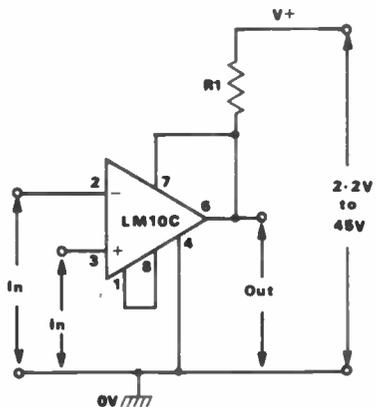
**Fig 4** Method of powering the LM10 for conventional split supply operation



**Fig 5** Method of powering the LM10 for split supply operation using a single supply source



**Fig 6** Standard method of powering the LM10 from a single-ended supply



**Fig 7** 'Shunt' method of powering the LM10 gives some unique circuit characteristics

applications shown in this and the next two editions of *Data File*.

Figure 3 lists the main parameters of the LM10 family of devices; note that all parameters except the unity gain bandwidth (0.3MHz) and the slew rate (0.15V/ $\mu$ S) are exceptionally good (the op-amp is not designed for high frequency operation).

### Power supply connections

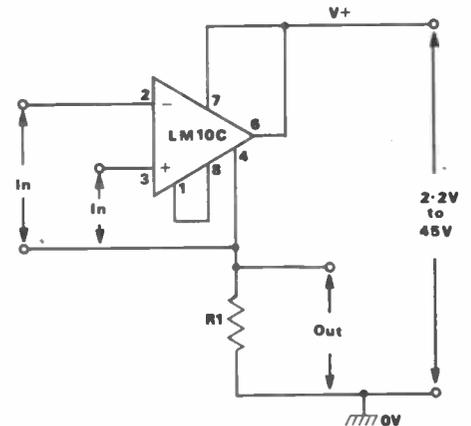
The LM10 is a very easy device to use. It can be powered from either grounded or fully floating single-ended or dual supplies, and can use total voltages anywhere in the range 1.1 volts to 45 volts. Figures 4 to 8 show a few ways of powering the device in basic op-amp applications.

Figures 4 and 5 show ways of powering the unit from dual supplies, for op-amp applications in which the inputs are referenced to the zero volts rail and the output can swing between the positive and negative supply rail voltages. The Figure 4 circuit uses two independent supply rails, and the Figure 5 design uses two rails derived from a single source.

The Figure 4 and 5 supply connections enable the LM10 to be used in all of the standard op-amp configurations, but with the unusual advantages of using total supply voltages down to a mere 1.1 volts at total quiescent currents of only 270 $\mu$ A and of having outputs that can swing within a few tens of millivolts of the supply rail voltages.

Figure 6 shows the standard and self-evident method of powering the LM10 from a single pair of supply rails. The supply can again have any value in the range 1.1 to 45 volts, and the op-amp output can again swing to within a few millivolts of the zero and positive supply rails. A very useful additional feature of this circuit is that the op-amp can handle input signals right down to zero voltage value.

Finally, Figures 7 and 8 show two quite unique and outstandingly useful ways of powering the LM10 from a single pair of supply rails.



**Fig 8** An alternative 'shunt' method of powering the LM10

In each of these configurations the op-amp output terminal is shorted directly to the positive supply terminal of the IC, so that the output 'shunts' the device's supply current, and a current-limiting resistor is wired in series with one of the IC's supply leads.

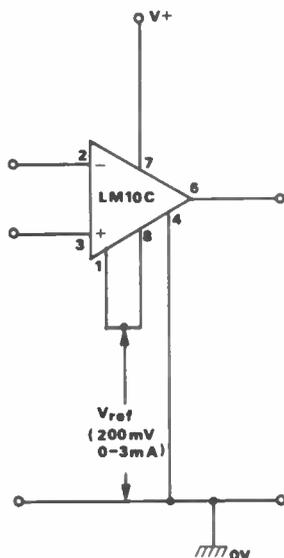
The LM10 op-amp has an output drive current capability that is a couple of orders of magnitude greater than the device's normal quiescent current. This factor, combined with the device's excellent supply voltage rejection figure of 96dB and wide operating voltage range, enables the LM10 to operate quite happily in either the linear or the switching mode while at the same time using its own output to modulate its own supply voltage and current!

Thus, this 'shunt' mode of operation can be used in two-wire remote sensor applications in which the two wires carry both the supply current and the resulting signal information. Note that the minimum supply voltage used in this application must be significantly greater than the normal 1.1 volts value, to enable reasonable data amplitudes to be developed across R1 without reducing the LM10 voltage below its minimum working value.

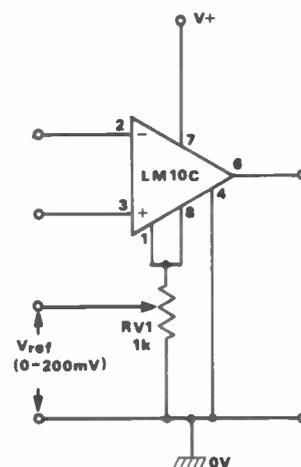
We'll show some practical two-wire remote sensor circuits in the next couple of editions of *Data File*.

**The reference amplifier**

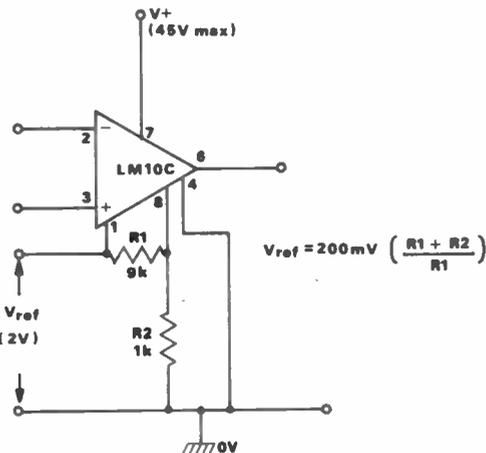
The built-in precision 200mV reference and reference amplifier of the LM10 (see *Figure 2*) add enormously to the device's versatility, and enable the LM10 to be used in a wide variety of precision comparator and voltage regulator applications, etc. If you don't want to use the reference facility in a particular application, or wish to use it simply as a 200mV reference, simply strap pins 1 and 8 of the IC together as shown in *Figure 9*. That gives the reference amplifier something useful to do, and makes a 200mV 0 to 3mA reference available between pins 1 and 4.



**Fig 9** Connection for obtaining a fixed 200mV output reference from the LM10



**Fig 10** Connection for obtaining a variable 0-200mV output reference

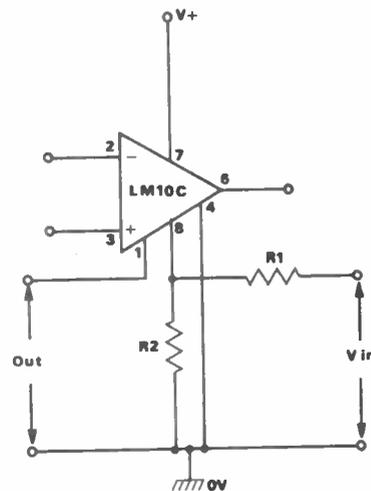


**Fig 11** This connection enables any output reference in the range 200mV to 40V to be obtained

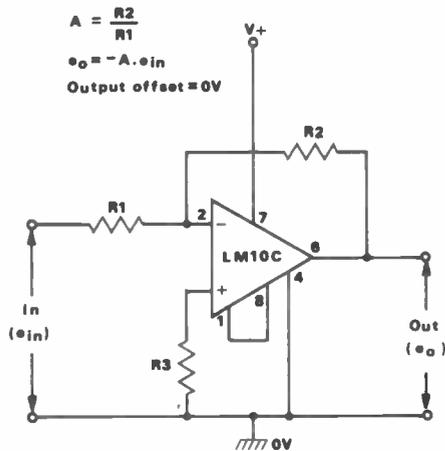
$$V_{trig} = 200mV \left( \frac{R1 + R2}{R2} \right)$$

$$\text{Out} = 0V \text{ when } V_{in} > V_{trig}$$

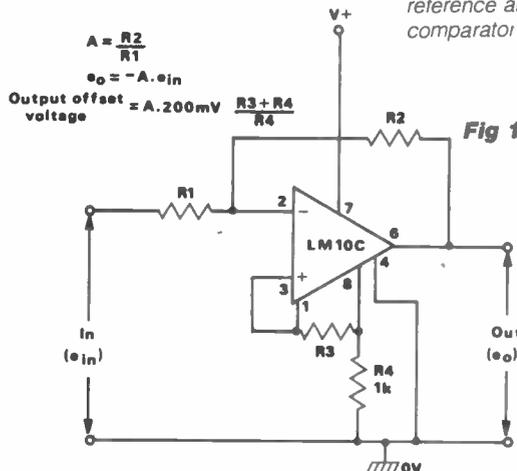
$$= V_{supply} - 600mV \text{ when } V_{in} < V_{trig}$$



**Fig 12** This circuit enables the built-in reference amp to be used as a simple voltage comparator



**Fig 13** Basic inverting dc amplifier

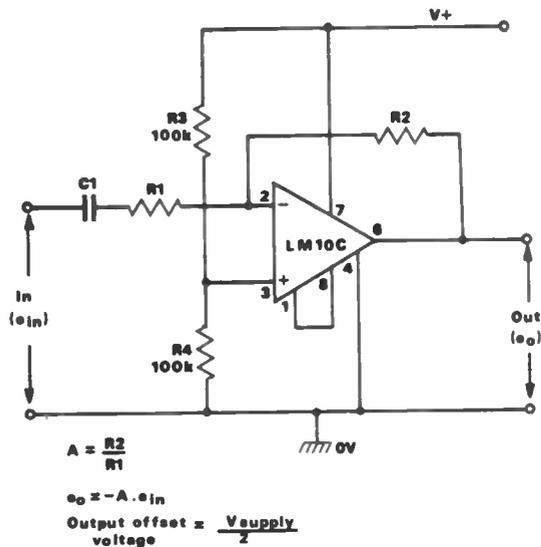


**Fig 14** Method of off-setting the output of the inverting dc amplifier

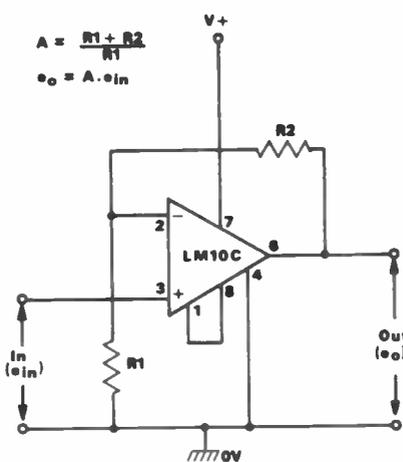
$$A = \frac{R2}{R1}$$

$$e_o = -A \cdot e_{in}$$

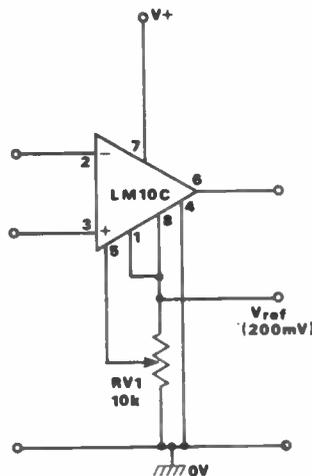
$$\text{Output offset} = A \cdot 200mV \frac{R3 + R4}{R4}$$



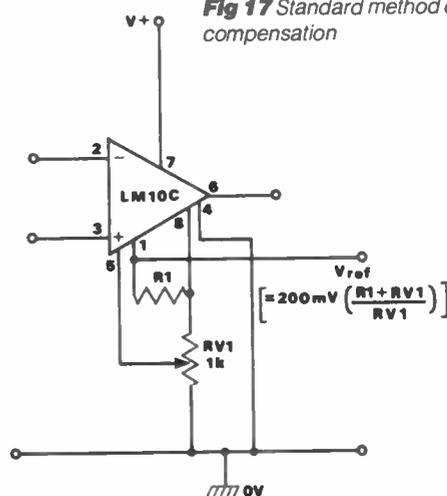
**Fig 15** Basic inverting ac amplifier



**Fig 16** Basic non-inverting dc amplifier



**Fig 17** Standard method of offset adjustment or compensation



**Fig 18** Offset adjustment with boosted reference

If you want a precision reference in the range 0 to 200mV, strap pins 1 and 8 together as described above, and then wire a 1k0 pot (variable potential divider) between pins 1 and 4 and take the output

voltage from between pin 4 and the pot slider, as shown in *Figure 10*.

If you want a precision reference in the range 200mV and 40 volts, use the connections shown in *Figure 11*. In this

configuration the reference amplifier is used as a non-inverting dc amplifier with a fixed input of 200mV and a voltage gain of  $(R1+R2)/R2$ .

A useful point to note about the reference amplifier is that it has a typical unity gain bandwidth of about 500kHz and can be gainfully employed in some special applications as an ac amplifier if a little ingenuity is used in circuit design.

A final point to note is that the reference amplifier can also be used as a simple voltage comparator that can be quite useful in some special applications. *Figure 12* shows the basic connections.

### Op-amp applications

The op-amp section of the LM10 can be used in a wide variety of basic configurations, and *Figures 13 to 18* show a few of the configurations that can be used when the IC is powered in the single-supply mode (many more applications will be presented in next month's edition of 'The File' so don't forget to order your copy).

*Figure 13* shows the basic connections for using the op-amp as an inverting dc amplifier. Note here that since the op-amp output has a quiescent value of zero when its input voltage is zero, this circuit can only usefully accept input signals that are negative with respect to the zero volts rail.

If required, the above circuit can be modified so that it will accept positive dc input signals by using the connections of *Figure 14*. Here, R3 and R4 are used to apply a positive bias voltage to the non-inverting terminal of the op-amp, so that the op-amp output takes up a positive 'offset bias' value when the circuit's input voltage is zero.

*Figure 15* shows the connections for making an inverting ac amplifier. Here, the output is biased to a quiescent value of half-supply volts (for maximum undistorted signal swing) via the R3-R4 potential divider, and the ac voltage gain is determined by the ratios of R1 and R2. The input signal is ac coupled via C1.

*Figure 16* shows how to use the LM10 as a non-inverting dc amplifier that will accept input signals down to zero volts. This circuit can be used as a precision unity-gain voltage follower that will track inputs all the way down to zero volts by simply removing R1 and replacing R2 with a short circuit.

Finally, to complete this month's look at LM10 applications, *Figures 17 and 18* show standard methods of applying offset adjustment or compensation to the op-amp, using the LM10's built-in reference amplifier.

### And there's more!

In next month's edition of *Data File* we'll look at a large selection of practical LM10 application circuits.

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Disc/plate ceramics E12 series 1P0 to 1000P, E6 Series 50V 1500P to 47000P ....	2p
<b>Polystyrene capacitors 63V working E12 series long axial wires</b>	
10 pf to 820 pf - 3p. 1000 pf to 10,000 pf - 4p. 12,000 pf .....	5p
741 Op Amp - 20p. 555 Timer .....	22p
cmos 4001 - 20p. 4011 - 22p. 4017 .....	40p
<b>ALUMINIUM ELECTROLYTICS (Mfda/Volts)</b>	
1/50, 2.2/50, 4.7/50, 10/25, 10/50 .....	5p
22/16, 22/25, 22/50, 47/16, 47/25, 47/50 .....	6p
100/16, 100/25 7p; 100/50 12p; 100/100 .....	14p
220/16 8p; 220/25, 220/50 10p; 470/16, 470/25 .....	11p
1000/25 25p; 1000/35, 2200/25 35p; 4700/25 .....	70p
<b>Submin, tantalum bead electrolytics (Mfda/Volts)</b>	
0.1/35, 0.22/35, 0.47/35, 1.0/35, 3.3/16, 4.7/16.....	14p
2.2/35, 4.7/25, 4.7/35, 6.8/16 15p; 10/16, 22/6 .....	20p
33/10, 47/6, 22/16 30p; 47/10 35p; 47/16 60p; 47/35.....	80p
<b>DIODES (piv/amps)</b>	
75/25mA 1N4148 2p. 800/1A 1N4006 6p. 400/3A 1N5404 14p. 115/15mA OA91.....	6p
100/1A 1N4002 4p. 1000/1A 1N4007 7p. 60/1.5A S1M1 5p. 100/1A bridge.....	25p
400/1A 1N4004 5p. 1250/1A BY127 10p. 30/45mA OA90 6p. 30/15A OA47 .....	8p
Zener diodes E24 series 3V3 to 33V 400 mW - 8p. 1 watt .....	12p
Battery snaps for PP3 - 6p for PP9 .....	12p
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# BEYOND THE TRIODE

## PART TWO

### Valve amplifier

As discussed previously, a valve is able to amplify as a result of the fact that the voltage on the control grid regulates the electron flow between cathode and anode, and consequently causes a large voltage swing to occur at the anode. The valve amplifier is therefore one of the most important devices in electrical engineering. It has made possible radio as we know it today, the long distance telephone, talking pictures, television, public address systems, guided missiles, radar, etc. A surprisingly large part of the technology in the 1960s and 1970s was built around the fact that a valve is capable of acting as an amplifier up to very high frequencies.

Amplifiers are classified in ways descriptive of their character and

properties. One approach is to describe amplifiers according to the nature of the load impedance. This leads to such terms as tuned, untuned, resistive coupled and transformer coupled amplifiers. Another basis of classification is according to the frequency to be amplified. Thus, an audio amplifier is suitable for frequencies that are audible to the ear, while a video amplifier is designed to handle frequencies such as those in a TV signal.

Amplifiers are also sub-divided into voltages and power amplifiers, according to whether the object is to produce as much voltage or as much power as possible to the load impedance. To understand why it is necessary to distinguish between these objectives, consider the problem of obtaining a large quantity of power from a signal voltage that is so small as to require more

amplification than can be obtained from a single valve amplifier. Under such circumstances, it is customary to use a number of amplifiers in cascade, so that each one amplifies the output of the preceding valve and delivers its output to another for additional amplification. In arranging such an amplifier, the best results are obtained by making all the amplifying valves, except the last one, operate as voltage amplifiers, while the last valve functions as a power amplifier. The power valve then has the maximum possible signal voltage applied to its control grid and is therefore able to deliver the greatest amount of power.

Amplifiers are also designated as class A, class AB, class B, class C or linear amplifiers, according to the operating grid voltage bias applied to the control grid.

### Class A amplifiers

The fixed voltage bias applied to the control grid of the valve amplifier determines the operating point from which the signal applied to the control grid varies. From the characteristic curve shown in *Figure 6* it will be seen that the anode voltage against anode current characteristic curve is not a perfect straight line, but is curved towards the cut off point, with an additional curve at the top due to saturation. If an amplifier is to be designed so that it will faithfully reproduce the character of the input signal, the operating point on the curve must be set in the centre of the straight line portion. Furthermore, the amplitude of the input signal must be such that the peaks do not exceed the straight line portion of the characteristic curve.

If the input signal is permitted to go too far negative, the negative half cycle of the anode current will not be the same as the positive half cycle. In other words, the output waveform will no longer resemble the shape of the input waveform, and therefore the output waveform will become distorted.

The fundamental property of a class A amplifier is that the control grid voltage must not advance beyond the point of zero volts, otherwise the control grid will become positive and grid current will flow. This will lower the input impedance of the valve so that additional power will be required to achieve the same voltage swing on the anode. Class A amplifiers are designed such that grid current is not drawn. The control grid is never permitted to become positive.

Class A amplifiers do not operate at optimum efficiency due to the high quiescent anode current that flows without a signal applied to the control grid. Class A amplifiers produce very little distortion.

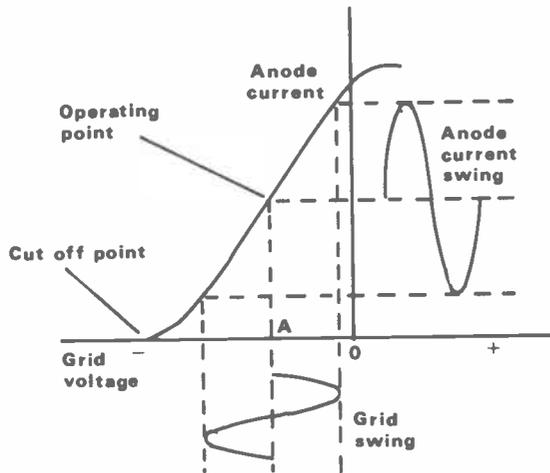


Fig 6 A valve operating as a class A amplifier

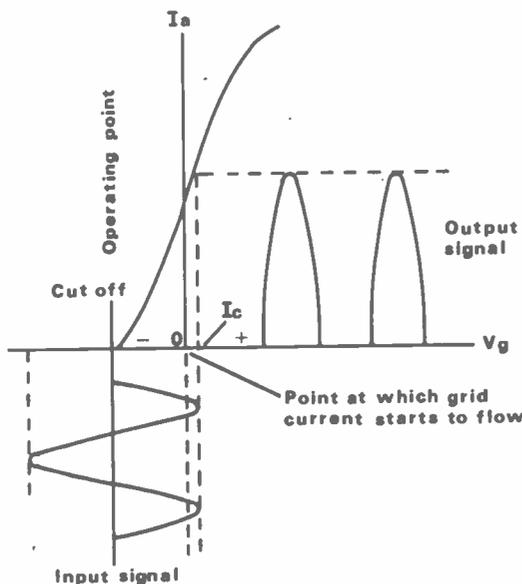


Fig 7 A valve operating as a class B amplifier

## Class AB amplifiers

In the class AB amplifier, the fixed grid bias is made higher than would be the case for a class A amplifier. The quiescent current is thereby reduced and higher values of anode voltage can be used without exceeding the rated anode dissipation of the valve. This results in high efficiency and greater output power.

Class AB amplifiers are sub-divided into class AB<sub>1</sub> and AB<sub>2</sub>. There is no flow of grid current in a class AB<sub>1</sub> amplifier. The peak signal voltage applied to the control grid will not exceed the negative grid bias voltage. In a class AB<sub>2</sub> amplifier the grid signal is greater than the static bias voltage on the signal peaks, and consequently the grid becomes positive and grid current will flow.

It is normal to operate class AB amplifiers in push-pull if distortion of the output signal is to be avoided. Class AB<sub>2</sub> will produce a greater output power for a given pair of valves than will class AB<sub>1</sub>. As the grid of a class AB<sub>2</sub> amplifier draws grid current, this will mean that a power driver stage will have to be employed.

## Class B amplifiers

In a class B amplifier, the bias voltage is advanced to the point where only very little anode current flows. This point is called the cut off point. *Figure 7* shows the characteristic curve and the operating voltages and currents for a valve amplifier operated at class B. It will be noted that only the positive swing of the signal applied to the control grid will be amplified. In the absence of a signal the anode current will be practically zero. Therefore the efficiency of this class of amplifier will in theory be 100 per cent.

The power output is proportional to the square of the grid excitation voltage. In an RF amplifier the output power is supplied to a tuned circuit only on alternate half cycles. The flywheel effect of the tuned circuit will supply the missing half cycle, and the complete waveform will therefore be reproduced across the output tuned circuit.

Class B amplifiers can also be used efficiently in push-pull. If the control grids of the two valves operating in push-pull are fed with signal voltages which are one hundred and eighty degrees out of phase, ie one grid swings in a positive direction as the other swings in a negative direction, the two valves will alternate supply current to the load. Therefore, each valve will operate on one half cycle of the input signal, so that the complete input waveform is reproduced in the common anode load.

Since the anode current is small when no signal is applied to the control grid, the efficiency of the amplifier is considerably higher than a class A amplifier.

There is a much higher steady value of anode current flow in a class A amplifier, regardless of whether or not a signal is present. The average anode dissipation is therefore larger than in a class B amplifier of the same power output capability. The anode current will rise to a high peak value on input swings in a class B amplifier. The demands upon the power supply will be severe. The power supply for a class B amplifier must have the ability to provide good voltage regulation.

## Class C amplifiers

The class C amplifier differs from the others in that the bias voltage is increased to a point well beyond cut off, as shown in *Figure 8*. When a valve is biased to cut off as in a class B amplifier, it draws anode current for a half cycle, or for one hundred and eighty degrees. As this point of operation is carried beyond cut off when the grid bias becomes more negative, the angle of anode current flow decreases.

Under normal conditions the optimum value of class C amplifier operation is approximately one hundred and twenty degrees. The anode current is at zero during the first thirty degrees of the incoming waveform because the grid voltage is still approaching cut off. From thirty to ninety degrees, the grid voltage will have advanced beyond cut off and swings to a maximum in a region which allows anode current to flow. From ninety to one hundred and fifty degrees, the grid voltage returns to cut off, and the anode current decreases to zero. From one hundred and fifty to one hundred and eighty degrees, no anode current

flows since the grid voltage is then beyond cut off.

The anode current in a class C amplifier flows in pulses of high amplitude, but of short duration. Efficiencies up to seventy-five per cent are realised under these operating conditions. It is possible to convert nearly all the anode input power into RF output power by increasing the anode voltage and bias voltage. The RF anode current is proportional to the anode voltage, hence the power output is proportional to the square of the anode voltage.

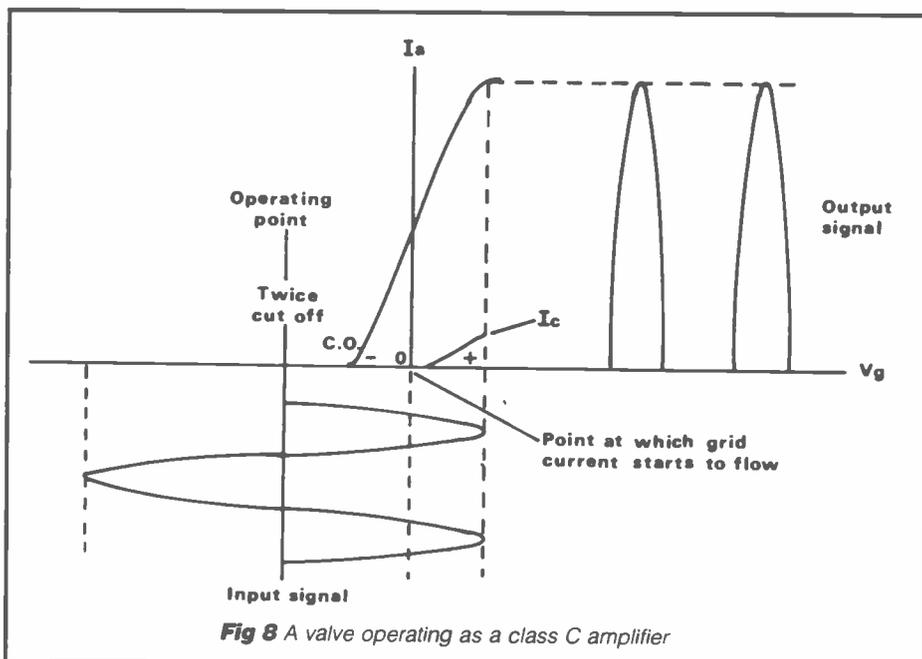
## Amplifier configuration

Most valve circuits are designed with the cathode connected to ground, that is if a cathode bias resistor is used then it will be shunted with a capacitance whose reactance will be low at the operating frequencies of the amplifier.

If a triode valve is used at high frequencies, then something must be done about the inter-electrode capacitance between anode and cathode. If the grid is earthed instead of the cathode, such that the grid acts as an RF screen between cathode and anode, the input impedance of the grounded grid amplifier is normally low, of the order of 100 ohms, and therefore a large input power will be required.

The valve amplifier may also be connected with the anode as regards RF at earth potential. The anode, although connected to the high tension supply, will be decoupled to earth through a low value reactance capacitor. This type of circuit is better known as a cathode follower.

**To be continued**



**Fig 8** A valve operating as a class C amplifier

# The Amateurs' Pro

## 1. IC-2E. 2 metre FM Handportable.

1.5 watts with standard nicad pack. Thumbwheel frequency entry.

## 2. IC-MICRO 2E. 2 metre FM Handportable.

1.5 watts with standard pack. 2.5 watts possible. Toggle switch frequency entry, LCD display, 10 memories.

## 3. IC-02E. 2 metre FM Handportable.

2.5 watts with standard nicad pack, 5 watts from 13.8 volts DC. LCD display, keypad frequency entry, 10 memories, scanning.

## 4. IC-28E. 2 metre FM Mobile

25 watts, 21 memories, scanning.

## 5. IC-27E. 2 metre FM Mobile.

25 watts, 9 memories, scanning.

## 6. IC-290D. 2 metre Multimode mobile.

25 watts, 5 memories, scanning.

## 7. IC-275E. 2 metre Base station.

Multimode operation, 25 watts power output. New DDS system, 99 memories, high sensitivity and dynamic range. Ideal for PACKET and AMTOR.

## 8. IC-271E. 2 metre Base station.

Multimode, 10 or 25 watt models. IC-271H 100 watt model also available, 32 memories, scanning.

## 9. IC-3200E. Dual-band FM Mobile.

2 metre and 70 cm operation. 25 watt on both bands, 10 memories, scanning.

## 10. IC-SP3.

External base-station loud-speaker, 8 ohms.

## 11. IC-1271E. 23 cm Base station.

10 watt power output. 1240MHz-1300MHz Multi-mode operation, 32 memories, scanning.

## 12. IC-PS55. External power supply.

Styled to match IC-735, 20 amp rating.

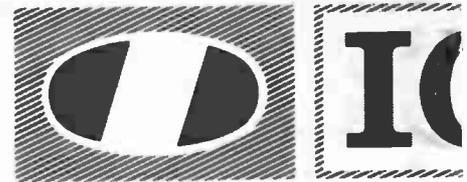
## 13. IC-735. HF Transceiver.

Amateur bands 160-10 metres, general coverage receiver from 100 kHz to 30 MHz CW/SSB/AM/FM modes. 100 watt power output, 12 memories.

## 14. IC-AT150. Automatic antenna tuner.

Styled to match IC-735. 100 watt power rating.

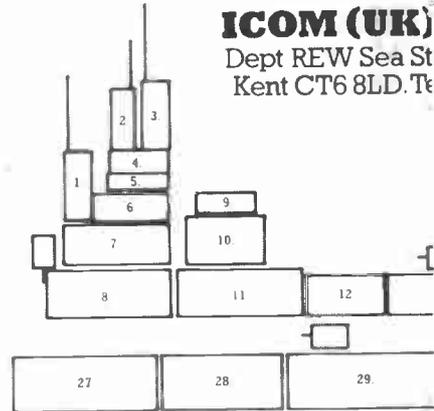
## 15. IC-GC5. Station world clock.



# The World

**ICOM (UK)**

Dept REW Sea St  
Kent CT6 8LD. Te



## 16. IC-AH2a. HF Mobile antenna tuner.

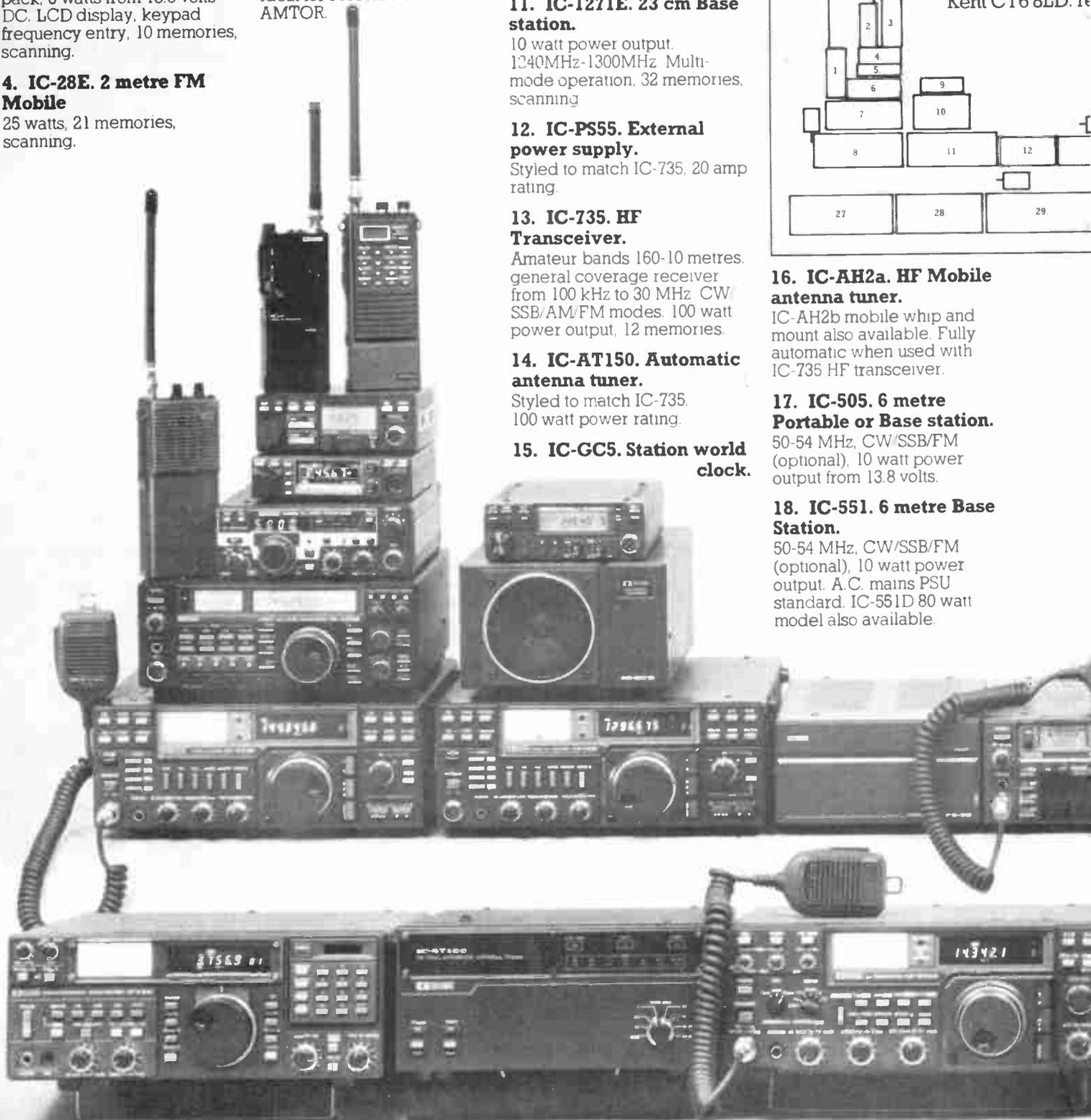
IC-AH2b mobile whip and mount also available. Fully automatic when used with IC-735 HF transceiver.

## 17. IC-505. 6 metre Portable or Base station.

50-54 MHz, CW/SSB/FM (optional), 10 watt power output from 13.8 volts.

## 18. IC-551. 6 metre Base Station.

50-54 MHz, CW/SSB/FM (optional), 10 watt power output. A.C. mains PSU standard. IC-551D 80 watt model also available.

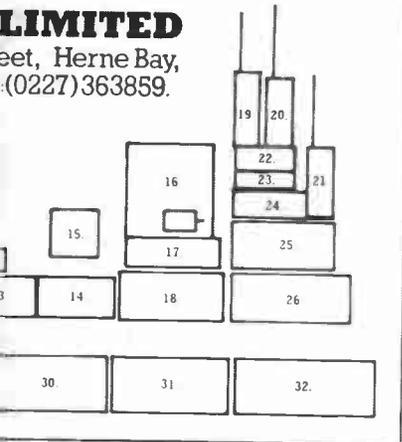


# Professional Friend.

## COM System

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Street, Herne Bay,  
(0227) 363859.



### 19. IC-12E. 23 cm. FM Handportable.

1260-1300 MHz, 1 watt with standard nicad pack. Keypad frequency entry, LCD display, 10 memories, scanning.

### 20. IC-04E. 70 cm. FM Handportable.

2.5 watts with standard nicad pack, 5 watts possible. Keypad frequency entry, LCD display, 10 memories, scanning.

### 21. IC-4E. 70 cm. FM Handportable.

2.5 watts with standard nicad pack. Thumbwheel frequency entry.

### 22. IC-48E. 70 cm. FM Mobile.

25 watt, 21 memories, scanning.

### 23. IC-47E. 70 cm. FM Mobile.

25 watt, 9 memories, scanning.

### 24. IC-490E. 70 cm. Multi-mode Mobile.

10 watt power output, 5 memories scanning

### 25. IC-PS30. System power supply.

25 amp. rating fully protected. Up to 4 ICOM units may be connected.

### 26. IC-471E. 70 cm. Base station.

Multimode, 25 watts power output. IC-471H 75 watt model also available. 32 memories, scanning.

### 27. IC-R71E. HF Base Receiver.

100 kHz-30 MHz CW/SSB/AM/

RTTY/FM (optional). Direct frequency entry. 32 memories, scanning. Remote control option. 12 volt DC. option.

### 28. IC-AT100. Automatic antenna tuner.

100 watt power rating. Also available is IC-AT500 with 500 watt rating. Autoband switching with ICOM HF transceivers.

### 29. IC-751A. HF Transceiver.

Amateur bands 160-10 metres. General coverage receiver

from 100 kHz to 30 MHz. CW/SSB/AM/RTTY/FM modes. 100 watt power output, 32 memories.

### 30. IC-2KL. HF 500 watt Linear amplifier.

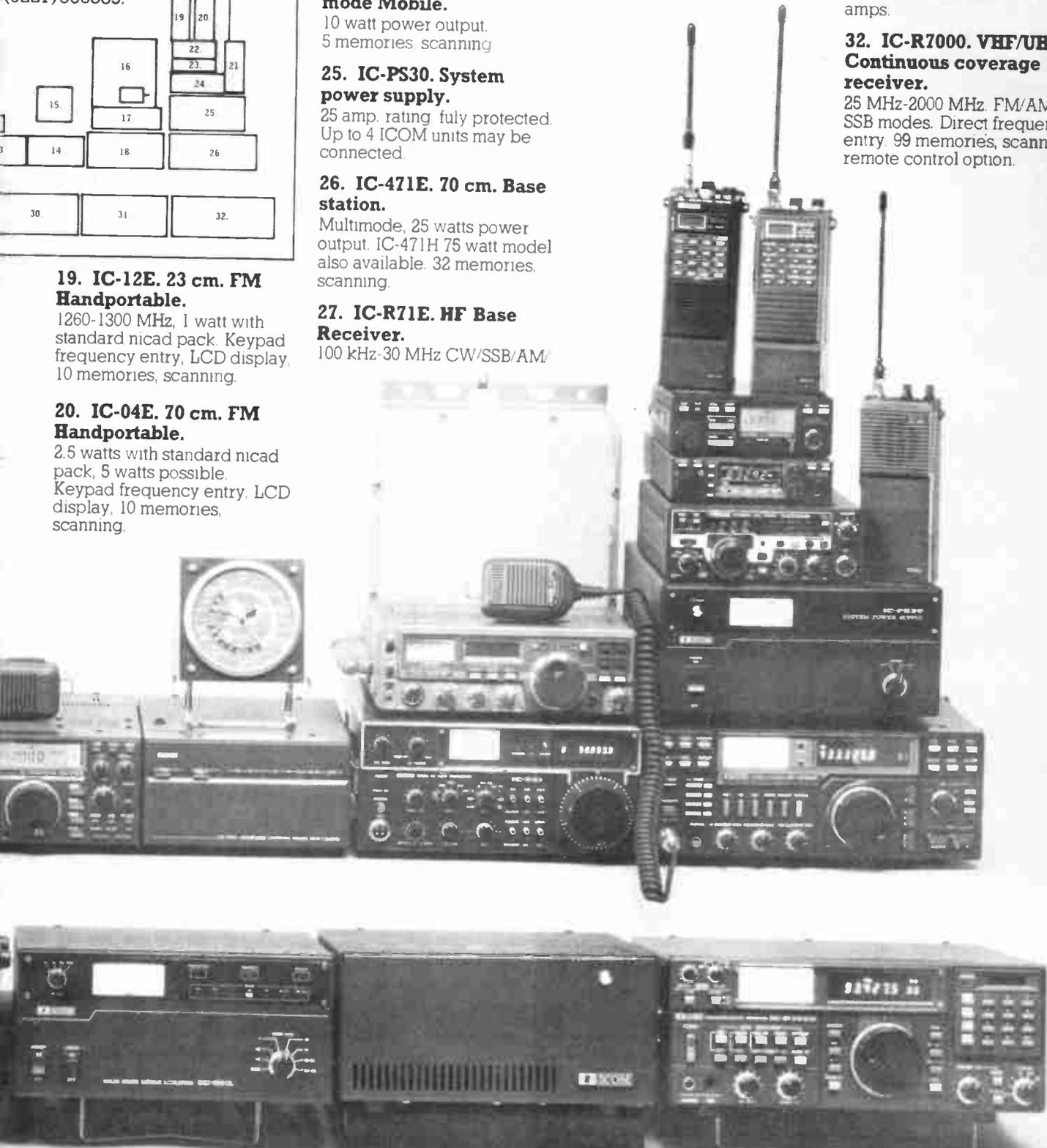
Automatic band switching with ICOM HF transceivers. 2KLPS power supply is required. Solid state broadband tuning.

### 31. IC-2KLPS. AC. Power supply.

For use with IC-2KL. Regulated voltage of 40 volts DC. and metered current of 25 amps.

### 32. IC-R7000. VHF/UHF Continuous coverage receiver.

25 MHz-2000 MHz. FM/AM/SSB modes. Direct frequency entry. 99 memories, scanning, remote control option.



# CAT INTERFACE

## The final instalment of R A Penfold's article on how to obtain a computer-aided transceiver

### Construction

A suitable printed circuit design for the interface is provided in *Figure 3*. There are few components to contend with, and there is little difficulty in constructing the board. Note, though, that IC1 and IC2 are both CMOS devices and require the normal anti-static handling precautions to be observed. Particular care is needed with IC1 which is not amongst the cheapest of integrated circuits. An

integrated circuit holder should certainly be used for this device, and it will probably be necessary to bend the pins inwards slightly before it will fit into the holder.

Be careful not to buckle any pins under the device when pushing it into place. Crystal X1 must be a wire-ended type so that it can be mounted directly onto the board. The specified frequency of 2.4576MHz might seem to be a rather odd

one, but this is a standard frequency which is readily available.

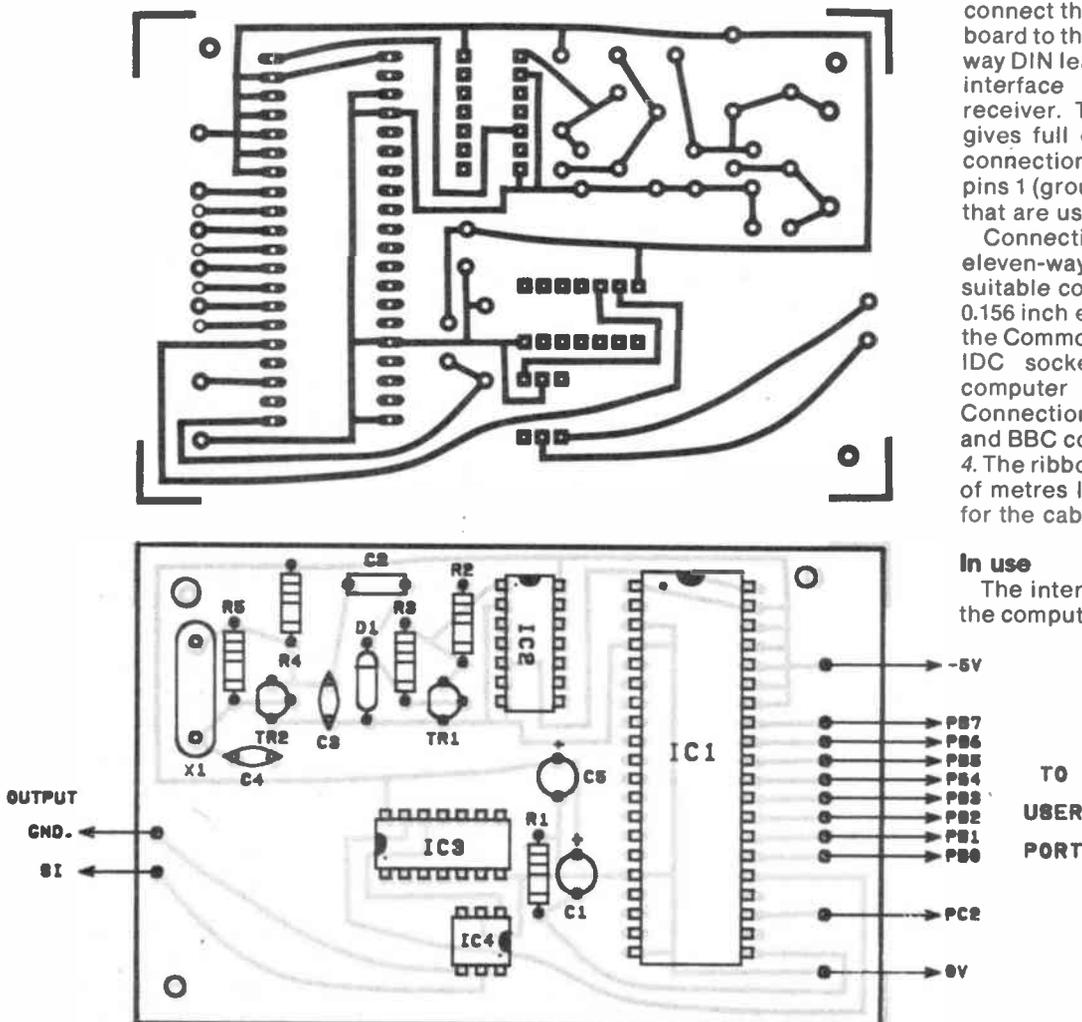
### The case

The prototype is housed in a plastic case having approximate outside dimensions of 150 by 80 by 50 millimetres, and any case of about this size should suffice. Probably the best way of coupling the output signal to the receiver is to mount a six-way DIN socket on the case and connect the appropriate two pins on the board to the socket. A six-way DIN lead is then used to connect the interface to the CAT input of the receiver. The manual for the receiver gives full details of the CAT interface connections, and in this case it is only pins 1 (ground) and 3 (serial input or 'SI') that are used.

Connection to the computer is via an eleven-way ribbon cable fitted with a suitable connector. This is a 2 by 12-way 0.156 inch edge connector in the case of the Commodore computers and a 20-way IDC socket for the BBC Model B computer (and the Master 128, etc). Connection details for the Commodore and BBC computers are shown in *Figure 4*. The ribbon cable can be up to a couple of metres long if necessary. An exit slit for the cable must be filed in the case.

### In use

The interface should be connected to the computer prior to switching it on and



*Fig 3* The printed circuit design

it should then function entirely normally. If it does not, switch off at once and recheck all the wiring.

Each computer requires a simple setting up procedure before it will transmit data written to the user port. In the case of the BBC computer a value of 255 must be written to the data direction register at address &FE62 in order to set the user port lines as outputs, and then a value of 160 must be written to the peripheral control register at address &FE6C to set CB2 to the correct output mode.

Data is then written to the user port at address &FE60. The VIC-20 has the same device to provide the user port (a 6522 VIA), but the relevant addresses are 37138, 37148 and 37136 respectively. With the Commodore 64 a value of 255 is written to the data direction register at address 56579 to set the user port lines as outputs. PC2 has the right operating mode and does not need any setting up procedure. Data for the interface is written to address 56577.

### Dummy bytes

The receiver is controlled by transmitting groups of five bits, with the first four carrying data and the last one specifying the instruction (change frequency, change mode, etc). In most groups the first three bytes are 'dummy' bytes which do not carry any data that is used, but they must still be transmitted as the receiver always expects to receive five bit groups.

Full details of all the codes are given in the receiver's manual. As an initial test try sending the 'Activate CAT' command, which requires three dummy bytes followed by 0 and 0. Note that the CAT interface is not operative until this command is sent and that manual control of the receiver is not possible once the CAT interface has been turned on. Manual control can be regained by sending the 'Deactivate CAT' command, or by switching off the receiver and removing the back-up batteries.

For the BBC computer the set up and activation commands are as follows:

- ?&FE62 = 255
- ?&FE6C = 160
- ?&FE60 = 0

To regain manual control of the receiver the deactivate code group must be sent, and this requires three dummy bytes followed by values of 128 and 0. With the BBC this would be achieved using the commands:

- ?&FE60 = 0
- ?&FE60 = 0
- ?&FE60 = 0

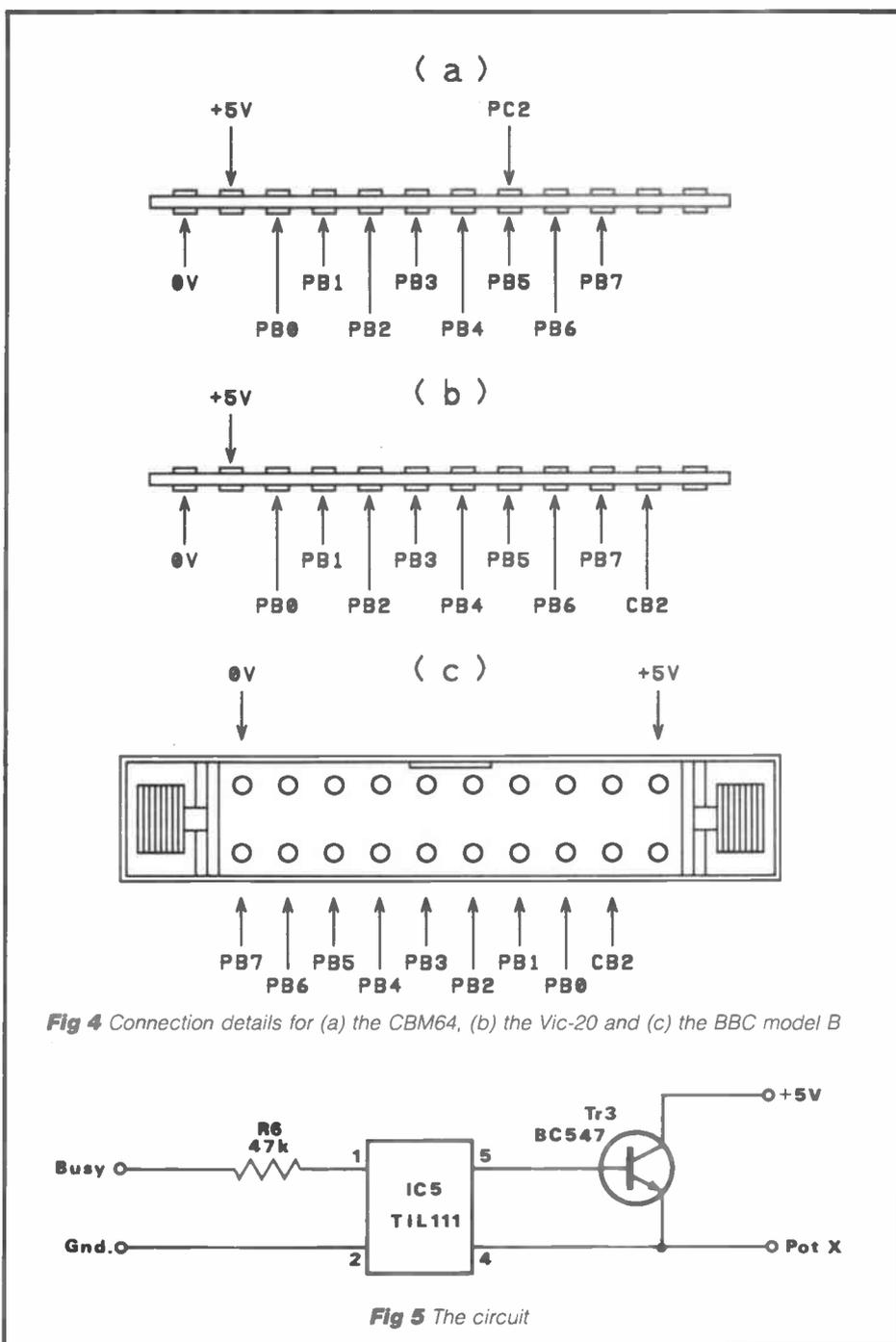


Fig 4 Connection details for (a) the CBM64, (b) the Vic-20 and (c) the BBC model B

Fig 5 The circuit

- ?&FE60 = 128
- ?&FE60 = 0

Most of the control codes are quite straightforward and require no amplification here. The exception is the frequency selection instruction, which requires the digits of the frequency to be sent in BCD form. In other words, each byte provides two digits of the frequency, but with the least significant nibble giving the least significant digit and the most significant nibble providing the most significant digit. In practice, this means that the value sent to the receiver is calculated by multiplying the

most significant digit by 16 and then adding it to the least significant digit. For instance, the digits 35 would be sent as the decimal value 53 ( $3 \times 16 = 48, 48 + 5 = 53$ ).

### Software

There is plenty of scope for writing CAT software to suit individual requirements, but it is probably best to start with something fairly simple to help familiarise yourself with the system. An important point to bear in mind is that the software must always switch back to manual control of the receiver before it is exited.

# CAT INTERFACE

Otherwise the receiver is left in an unusable state (except in the unlikely event that it will only ever be used under external computer control).

The accompanying demonstration program is for the BBC Model B series, and it provides a basic timetable function. It is largely self-explanatory in use, but note that the DATA statements at the end of the program are for demonstration purposes only. The DATA statements provide the timetable, and they provide the switch on time, the switch off time, the frequency and the operating mode.

The format is for a '1' to start with, followed by the time in hours/minutes/seconds format (including leading zeros). Then the frequency is given in kilohertz, followed by two zeros.

## Good resolution

The CAT system can actually handle frequencies to a resolution of 25kHz, but the full resolution has not been implemented on the program as it stands

and a resolution of 1kHz will be adequate for most purposes. However, it would probably not be difficult to implement the two dummy digits so as to give 25kHz resolution if desired. The operating mode is given in the three letter abbreviations used by Yaesu to describe them (AMW for amplitude modulation wide, for example). The last statement must always contain '0,0,0,0,0' which indicates to the computer that this is the end of the sequence.

## A warning

When writing your own controlling software, bear in mind that the receiver sometimes takes a short while to process data and pauses between groups of data are sometimes required. Also, with the BBC machines it is sometimes possible to write data to the interface slightly faster than it can be transmitted, even when using Basic. If necessary, delay loops must be used to slow down the flow of data to a rate that the interface can handle.

## Feedback

In some applications it is useful to have feedback from the receiver to the computer. For example, the receiver could be tuned in sequence to several channels in search of one that provides a reasonably strong and stable signal. This is only possible if the controlling computer has some means of determining the strength of received signals. The FRG8800's CAT interface makes provision for this in the form of an output at pin 5, which is a varying voltage that is derived from the S-meter circuit.

This can be read by the computer via an opto-isolator and a digital to analogue converter, but the output seems to be at a high impedance and only a low drive current can be extracted without having an adverse effect on the S-meter circuit.

## Encouraging results

On trying out the circuit of *Figure 5* with a Commodore 64 computer (the same method should work equally well with the VIC-20 computer) encouraging results were obtained. The output is read by connecting it to one of the games paddle inputs on the joystick port. This input normally reads the variable resistance of the potentiometer in the paddle, but in this case it reads the varying resistance through Tr3 as it is biased more or less hard by the S-meter signal from the CAT interface. For operation with one of the BBC computer's analogue inputs the collector of Tr3 would need to be connected to the 1V8 voltage reference pin via a high value load resistor, since the analogue inputs of the BBC machine respond to voltage and not resistance.

This gives only a rather rough and ready system of monitoring the strength of received signals, but with a little experimentation it should give useful results that would greatly expand the scope of the system. [REVIEW]

Pin number	Low	High
35	Parity enabled	Parity disabled
36	1 stop bit	2 stop bits
37 (pin 38 low)	5 data bits	7 data bits
37 (pin 38 high)	6 data bits	8 data bits
39	Odd parity	Even parity

The table above illustrates the system whereby pins 35 to 39 are used to program the required word format

## PARTS LIST

### Resistors (all 1/4 watt 5% carbon)

R1	47k
R2	1k
R3	1M
R4	2k2
R5	1M

### Capacitors

C1	10µF 25V radial elect
C2	4n7 miniature polyester
C3	100pF ceramic plate
C4	100pF ceramic plate
C5	100µF 10V radial elect

### Semiconductors

IC1	6402 UART
IC2	4024BE
IC3	74LS14
IC4	TIL111 opto-isolator
Tr1	BC547
Tr2	BC547
D1	1N4148

### Miscellaneous

2.4576MHz crystal, HC-33U base  
40 pin DIL IC holder and two 14 pin DIL IC holders  
Printed circuit board  
Ribbon cable, computer connector, two six-way DIN plugs and screened lead  
Plastic case about 150 × 80 × 50mm  
Wire, solder, etc

*If you missed the first part of R A Penfold's article, back issues are available for £1.35 using the form on page 52.*

## Demonstration program

```

10 REM CAT Program for FRG-8800
20 REM BBC model B. JWP 2/87
30 ?&FE6C=160
40 ?&FE62=255
50 DIM send(5)
60 MODE 7
70 PROCset_clock
80 PROCscreen
90 QUIT=FALSE:RFLAG=FALSE
100 VDU23,1,0;0;0;0;
110 REPEAT
120 PRINTTAB(12,13)"Searching..."
130 now=Fntime
140 READ flag,start$,end$,freq$,mode$
150 IF flag=0 RESTORE
160 IF start$<now$ AND now$<end$ PROCreceive
170 PROCkey
180 UNTIL QUIT
190 PROCpowerdown
200 PROCsend
210 PROCend_CAT
220 PROCsend
230 VDU23,1,1;0;0;0;
240 CLS:END
250
260
270 DEF FNBCD(DEC$)
280 BCD=VAL(RIGHT$(DEC$,1))+16*VAL(LEFT$(DEC$,1)

290 =BCD
300
310 DEF PROCset_clock
320 PRINT "Please enter the time" in 24-hour fo
r m.
330 INPUT "Hours",hours
340 INPUT "Minutes",mins
350 INPUT "Seconds",secs
360 TIME=((hours*60+mins)*60+secs)*100
370 CLS
380 ENDPROC
390
400
410 DEF Fntime
420 sec=(TIME DIV 100) MOD 60
430 min=(TIME DIV 6000) MOD 60
440 hour=(TIME DIV 360000) MOD 24
450 sec$=STR$(sec):IF LEN(sec$)=1 sec$="0"+sec$
460 min$=STR$(min):IF LEN(min$)=1 min$="0"+min$
470 hour$=STR$(hour):IF LEN(hour$)=1 hour$="0"+h
our$
480 time$=hour$+" "+min$+" "+sec$
490 PRINTTAB(12,9)time$
500 =time$
510
520
530 DEF PROCreceive
540 RFLAG=TRUE
550 PROCauto
560 REPEAT
570 PROCkey
580 UNTIL Fntime>end$ OR QUIT
590 RFLAG=FALSE
600 PROCend_CAT
610 PROCsend
620 ENDPROC
630
640
650 DEF PROCsend
660 FOR V=1 TO 5
670 ?&FE60=send(V)
680 NEXT V
690 ENDPROC
700
710
720 DEF PROCinit_CAT
730 send(4)=0
740 send(5)=0
750 ENDPROC
760
770
780 DEF PROCend_CAT
790 send(4)=128
800 send(5)=0
810 ENDPROC
820
830
840 DEF PROCpowerup
850 send(4)=254
860 send(5)=128
870 ENDPROC
880
890
900 DEF PROCpowerdown
910 send(4)=255
920 send(5)=128
930 ENDPROC
940
950
960 DEF PROCconvert(freq$)
970 length=LEN(freq$)
980 freq$=STRING$(8-length,"0")+freq$
990 send(4)=FNBCD(LEFT$(freq$,2))
1000 send(3)=FNBCD(MID$(freq$,3,2))
1010 send(2)=FNBCD(MID$(freq$,5,2))
1020 send(1)=FNBCD((MID$(freq$,7,1)+"0"))
1030 send(1)=send(1)+1
1040 send(5)=1
1050 ENDPROC
1060
1070
1080 DEF PROCscreen
1090 CLS
1100 PRINTTAB(12,2)CHR$(131);CHR$(141);"CAT TIMET
ABLE"
1110 PRINTTAB(12,3)CHR$(131);CHR$(141);"CAT TIMET
ABLE"
1120 PRINTTAB(5,7)CHR$(131);"Time Now:"
1130 PRINTTAB(5,11)CHR$(131);"Current status"
1140 PRINTTAB(5,19)CHR$(131);"CONTROL KEYS:-"
1150 PRINTTAB(0,20)CHR$(131);"M - temporary manua
l control"CHR$(131);"A - return to auto control"
CHR$(131);"Q - quit program"
1160 ENDPROC
1170
1180
1190 DEF PROCkey
1200 k$=INKEY$(1)
1210 IF k$="M" OR k$="m" PROCmanual
1220 IF k$="Q" OR k$="q" THEN QUIT=TRUE
1230 ENDPROC
1240
1250
1260 DEF PROCmanual
1270 PROCend_CAT
1280 PROCsend
1290 PRINTTAB(12,13)"Manual... "
1300 REPEAT
1310 now=Fntime
1320 UNTIL INKEY-66 OR INKEY-17
1330 k$=INKEY$(0)
1340 IF k$="A" OR k$="a" AND RFLAG THEN PROCauto
1350 ENDPROC
1360
1370
1380 DEF PROCmode
1390 IF mode$="AMW" send(4)=0
1400 IF mode$="AMN" send(4)=8
1410 IF mode$="LSB" send(4)=1
1420 IF mode$="USB" send(4)=2
1430 IF mode$="CWV" send(4)=3
1440 IF mode$="CWN" send(4)=11
1450 IF mode$="FMW" send(4)=4
1460 IF mode$="FMN" send(4)=12
1470 IF mode$="" send(4)=0
1480 send(5)=128
1490 ENDPROC
1500
1510
1520 DEF PROCauto
1530 PRINTTAB(12,13)"Receiving..."
1540 PROCinit_CAT
1550 PROCsend
1560 PROCpowerup
1570 PROCsend
1580 FOR D=1 TO 500:NEXT D
1590 PROCconvert(freq$)
1600 PROCsend
1610 FOR D=1 TO 200:NEXT D
1620 PROCmode
1630 PROCsend
1640 ENDPROC
1650 DATA 1,01:01:00,01:02:00,1425400,LSB
1660 DATA 1,01:02:30,01:04:00,263500,AMW
1670 DATA 0,0,0,0,0

```

# L·E·N·A PACKAGE

**L**ENA is an acronym for Linear Electronic Network Analysis, so the name serves as a good description of what this package can do for you. It is a recently introduced computer aided design (CAD) package for the BBC series of home/business/school computers. The software will run on the standard BBC as well as the more advanced Master version; a floppy disc unit is assumed to be available and is essential to allow LENA to load in modules of software as they are required. It is distributed by Business Information Software Systems of West Drayton.

As more and more people become interested in electronics so the demand has increased for software tools that allow designs of an electronic circuit to be tested without the designer having to actually build the circuit. In some ways this package – and others like it – are an electronic hobbyist's dream come true. You can sit down and sketch out a design on paper and with some time spent with LENA you can test out your design. No solder, no fuss. If it does not work, at least you have not wasted any hardware!

## Getting started

As is often said, the proof of the pudding is in the eating. So, let us design a simple circuit. First, we need to draft it out on paper. *Figure 1* shows a simple, passive circuit. It is driven by a current source, has two resistors, one inductor and a capacitor. The numbers which are placed beside parts of the circuit are the node numbers. A node number is just a convenient way of allowing LENA to know which components are connected at any given point – if you were actually building the circuit, a node would correspond to a single bit of copper on a printed circuit board. All components which would connect to that bit of copper are said to either start or end on that node.

To tell LENA what the circuit looks like, we have to type in the list of components in the circuit. LENA gives us a numbered list on the screen and, as we type in the

## A review of this computer-aided design package by James Dick

components, puts them up for display. We tell LENA the type of device (eg L for inductor), the start and end node numbers (eg 1 and 0 for the left-most resistor or 2 and 0 for the inductor), and the value of the component (1.0E-2 for a 10mH coil). Once all the components have been entered, LENA then allows us to request which type of analysis we wish to have done on the circuit.

LENA will calculate the voltage between two points, the voltage gain, the trans-impedance and the trans-admittance of sections of our circuit. It then plots on the screen how our chosen parameter varies with frequency. The user may specify the start and end frequencies over which the analysis will be done, how many spot frequencies within that range are to be used in the calculation and also how the y-axis is to be scaled (choice of linear or logarithmic scale in dB). The graph is drawn very clearly and, for instance, might show the voltage gain in dB of a simple circuit as well as the phase shift which the circuit imposes on the signals passing through it. If you need more accurate information, the package allows you to position a cursor at a frequency chosen and then read off the gain and phase at that frequency.

All this information is very useful for the vast majority of circuits and particularly so in designing filters or amplifiers which have to have a known frequency response.

If you have an Epson FX series printer or one which is compatible with the FX control codes, LENA will allow you to plot out the frequency response. If an FX compatible printer is not available then you can still get hard copy of the circuit in the form of a component list with values and start/end nodes, etc.

## The full range

Quite a large range of components may be used with LENA. The simple passive devices are all there – resistors, capacitors and inductors. Power sources may be current sources or voltage controlled current sources. Transformers are also available. When it comes to active devices, only three are available. These are the bipolar junction transistor, the field-effect transistor, and the frequency-compensated operational amplifier.

You can make up a library of devices simply by responding to options given in the menus used by LENA to guide you through the operation of the package. This is very useful for active devices because you can store away different types of transistor and call them up as you need them to make your circuit. When you create any of the active devices described above, LENA will prompt you for the characteristics of the device. For example, you need to know  $g_f$ ,  $C_{gs}$ ,  $C_{gd}$ ,  $C_{ds}$  for a FET device. Once the device has been specified, LENA, according to the manual, should store it away on disc for future use.

The parameters required for FETs and op-amps are simple enough to find from the data given in the catalogues of most suppliers. However, the data required to specify a bipolar transistor is a little more detailed and you might need a data sheet from a manufacturer. The documentation supplied does explain what is necessary with sufficient care that users should not be unaware of the problem or what they need to do to solve it.

## Appraisal

There is no doubt that a CAD package is a very useful tool for any designer, and LENA is no exception. Intending users of any CAD system – whether it is LENA or a simple word processor – should realise that it will allow them to quickly refine their original ideas into a finished product. Of course, just as a word processor will not turn you into a best-selling author, so LENA will not

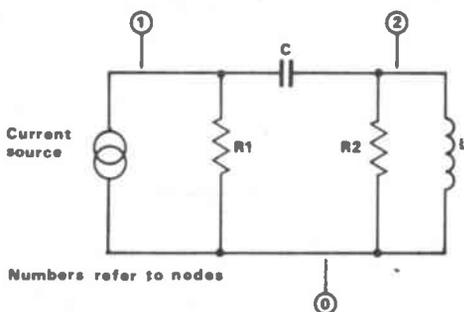


Fig 1 Example circuit layout

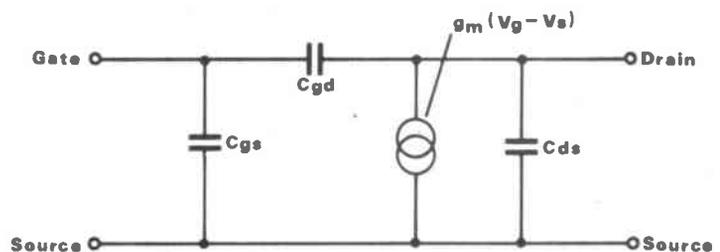


Fig 2 FET model used by LENA

# L·E·N·A PACKAGE

metamorphose you into a gifted designer. This is not the fault of LENA! But you do need to have a good idea of how a circuit design should be tackled before sitting down with a CAD package.

While designing a one-off circuit might take an experienced designer about as long to do by hand as it would do to type in the circuit description, if the circuit has to be changed or tuned to a new application then a CAD system will allow those changes to be quickly checked.

It will also allow the designer to find out how sensitive the circuit is to small changes in component values which might be caused by, say, temperature.

LENA is not without its faults, however. The version that I was supplied with would not allow me to create active devices – attempts to do so resulted in a disc access error.

Over a period of about two weeks I tried to contact the suppliers but was only confronted by an answering machine regardless of when I telephoned. This limited my ability to thoroughly check out the package. But I imagine that a solution will be forthcoming with the next release of the software.

There are some weaknesses in the package, too. The number of active components available is rather small – there is no provision for diodes, Zener diodes, unijunction transistors or SCRs. I suppose that these are all non-linear devices and LENA does only claim to be a linear electronics analysis package.

For circuits where the designer might be more interested in the response with time rather than frequency, LENA does not provide a facility for specifying the input voltage to a circuit so that the corresponding output response can be found. This prevents testing the response of, say, filters to a voltage step or transient spike.

There is a rather small limit on the circuit size which LENA can handle. A maximum of 40 nodes is imposed – although 100 branches (nearly analogous to components) may be used. This is obviously a limitation caused by the size of the BBC micro and so should not be regarded as a fault of LENA.

## Device models

In order to allow the behaviour of circuits with active devices to be calculated, these devices, typically transistors, are described by a model which is comprised of capacitances, resistances and voltage-controlled current sources. For example, the model used by LENA for the FET is shown in Figure 2. It shows the three internal capacitances and the current source, which is controlled by the voltage difference between the gate and the source of the device.

A more accurate model is shown in

Figure 3. This time, a resistor is placed across  $C_{ds}$  and the current source. It is  $r_d$ , the drain resistance, which is intrinsic to the FET. The drain terminal of the device is, of course, usually connected to one supply rail via  $R_d$ , the external drain resistor. The voltage gain of the circuit is a function of the characteristics of the current source multiplied by the value of the total drain resistance seen, ie  $r_d$  in parallel with  $R_d$ .

When  $R_d$  is small, ignoring  $r_d$  does not have any effect at low frequencies, but as  $R_d$  is made bigger, the gain of the circuit is limited by  $r_d$ . So including  $r_d$  is really quite important for an accurate model.

Figures 4 and 5 show similar models for the bipolar transistor. In this case, the difference is less noticeable.

## User-relations

One of the most important areas for any software writer to get right is that of the user interface – both in terms of the software and the documentation. LENA does well on this score. The software is easy to use with most of the activities that anyone will want to do being controlled from the series of menus which guide you through the functions of the package.

The documentation is well presented

in an A5 format booklet. It is all easy to read and understand with sufficient examples to guide the inexperienced. The layout is fairly logical, too. While it is purely subjective, I felt that the manual had been written by someone who did understand what they were talking about – both from the point of view of operating the package and also the underlying electronic theory. Needless to say, the documentation is not a treatise on how to design circuits (nor should it be) but is a sensible balance of background and operating information.

## The future

When the software arrived, it came with brief details of LENA for MS-DOS systems like the IBM PC. The distributors say that the MS-DOS version will be available in the near future. The features of this new version include many of the items mentioned above. Over 255 nodes can be handled and step function and group delay analysis have been added, to name some of the improvements. Equivalent circuit drawing is also named as a new feature.

With the price of PC-compatible systems falling, I can see that MS-DOS LENA will become as popular as the BBC version can be expected to be. REV

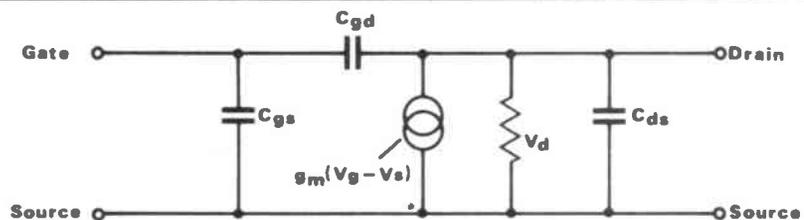


Fig 3 More accurate FET model

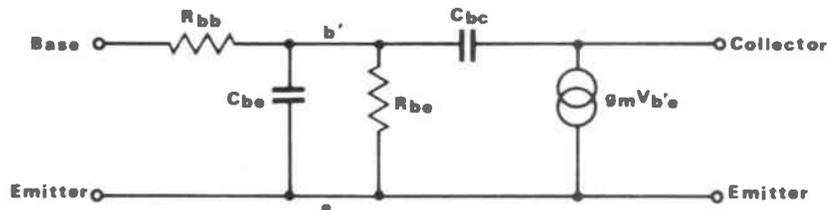


Fig 4 Bipolar transistor model used by LENA

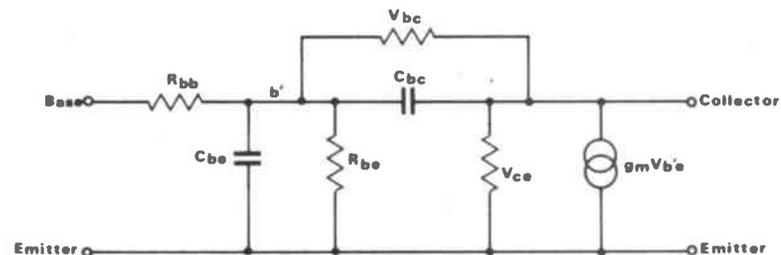


Fig 5 More accurate bipolar model

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# update on packet radio

By R J Redding G3VMR

One disadvantage of writing regularly for magazines is that some readers remember what you wrote some years ago! In December 1965 I cast doubts on the future of packet radio in the UK, but now that repeaters are formally licensed and operational, and the RSGB is talking about a packet network covering the whole of the UK, I am happy to see that it is here to stay.

There are, in fact, dozens of mailboxes and bulletin boards operating on 144.650 and 144.725MHz and I will discuss this development in relation to my earlier article, *Data on Radio*, in the June 1984 issue of *R&EW*.

## Error-free transmission

The great feature of packet radio is that everything received is error-free, and this has captured the imagination of people who tried earlier forms of data transmission. Further, all activity is on one or two channels so that no time is lost in searching and tuning.

If the station is within range it comes in work perfect. In fact, if one wants to carry on a conversation, the 'TNC' has to be set to lock out the signals you don't want. The secret behind this is the X25 protocol used in telephones, which has been very successfully moved over to suit radio operation, hence the X25 name. At present it employs some fairly expensive integrated circuits, but these are gradually being taken over by software; it would appear that soon packet will require little more than a program to suit the computer concerned. Again, telephone type modem techniques are being used, although this is under criticism and much simpler arrangements have been proposed. However, that is another story.

What matters most at present is operating experience and good behaviour on the existing channels and repeaters in order to consolidate the official blessing that we have to the best long term advantage, and there is considerable criticism of the bulletin boards which have sprung up. Because we are using telephone practice it is comparatively easy to modify telephone systems to work on radio, but the wisdom of this is doubtful. Bulletin boards tend to be wordy and have a large number of

options to do all sorts of things. This is perhaps anti-social on a common shared radio channel. Furthermore, many have the facility of a mailbox for leaving messages, either to everybody or to named individuals. Theoretically, the 'to' and 'from' callsigns are all that is necessary for a message to find its way anywhere through the ether. However, we must be careful to decide whether this is the best use of our frequencies before we start.

## The cellular principle

The term 'cellular radio' has become popular with the new phone system, but in fact the principle has long been the basis of amateur VHF communication. Each frequency is used time and time again in different areas without problems, and we should be doing the same thing as far as data is concerned. I could go further and suggest that we should be using radio instead of local telephone lines, and so get rid of a load of other problems, but that is for debate another time.

Packet radio should be mainly concerned with local communications between amateurs, with the occasional repeater station and gateway to other more appropriate channels, such as satellites and HF links for long distance hops when we get to that stage.

We need, therefore, to organise ourselves to make the best use of VHF for local communications, leaving articles to the magazines. This does not mean that the draft of an article shouldn't be sent by radio to one's friends and colleagues for comment before publication, but that packet is not necessarily the best way to do this; ASCII file dumps are much better and have no legal impediment.

## Mailboxes

The special advantage of packet on VHF is the possibility of one-to-one communication and experimentation with repeaters to cover distances where a single hop is not possible.

It is when one comes to 'store-and-forward' systems that we need to ask what is the purpose. If we set up one enormous database for all information, or a universal mailbox, we will have the equivalent of Prestel or Telecom Gold,

with all the problems, too.

We need to think in terms of local cellular operation where each individual item within the cell should be unique and doing its own thing. There are obviously great advantages to be gained when someone with a specialist knowledge or someone seeking advice on a particular topic is able to communicate with others on the same network.

Even the worst of us has some knowledge to offer others, and I give a personal example. I take part in a number of local clubs and have become a good source of information on what's on and where. If I make this available via packet radio, then people can get the information without bothering to telephone me, etc. Further, if we set a regular pattern then folks get to know where to get information of this type locally.

The following is an outline of how we are endeavouring to provide a Thames Valley notice board for meetings.

I make great use of the Tandy model 100 lap-top computer as a personal notebook and workslate. A bulletin board for packet operation had been made available in the public domain by a US amateur, N1AED. This is an 8K basic program especially tailored to run on the 24K of memory which is normally available. This is quite an achievement, and the discipline shows in the succinct operation of the Mini-BBS.

It allows up to 16 messages, so we tried devoting these to various clubs, giving them initials like AMRAC, etc. The trouble with this is that one has to alter one's callsign to AMRAC in order to read the message, which is rather inconvenient! There is, however, a facility for messages aimed at anybody and, by extending this facility to the initials for various radio and computer clubs, one can read details of the forthcoming meetings. The procedure is best shown by what happens when you call the G3VMR notice board.

Notice the simplicity of the system. One can send a message to a named station or a general message, the former being automatically erased when the station specified has read his message so that the number in use is kept to a minimum. The beacon states what messages are available.

The program keeps a complete log of all messages. A further 'error log' records errors as they occur, to avoid locking up the system. All files are set up automatically and dated and timed to the second by the internal clock in the computer, giving a complete record of all transmissions. You can even see who ought to be turning up!

Local packeteers have already shown the possibility of mobile operation and the next stage is, of course, 'pedestrian portable' - I think I am well on the way to that! Think what it would mean to be anywhere in the UK and have details of local meetings and events at your fingertips.

### Meetings over the airwaves

Apart from publicity and notice boards, radio can greatly facilitate the actual club meetings and events. A local net can consolidate the activities of a club - if it is well conducted. If it isn't there are several 'subtle' actions that can be taken, particularly on VHF. One can cut in on anyone who pontificates or waffles and make remarks in the background, or even leave the culprit talking to himself without embarrassment if the majority agree. I have even suggested holding committee meetings on the air with the idea that, if anyone is really interested, he can join the audience as in best democratic circles!

Seriously, though, we are talking about communication, and it is up to us to justify our allocation of the valuable spectrum; there is no better way than to explore the future. Many organisations start with a flourish, but die because people dare not turn up at the AGM for fear of being driven into the active hot seats.

Years ago I suggested to a computer club that they should try to write a program for the automated 'club secretary', who could be accessed by telephone and who would download minutes, programmes and so forth upon request. The high cost of modems and telephones killed that idea, but I suddenly realised that we had done something like this recently on the air.

The local Sunday morning 2m net included people who objected to so much talk of computers, so we arranged a separate net for the evening. This developed into sending files, first at 300 baud and then 1200 baud, and discussing the deeper implications of data. Within a year, packet became prominent and, although we all took part in this, we still carried on with the Sunday net for the personal contact. The number of people interested in packet led to meetings being arranged via these nets and from these the Thames Valley AMRAC materialised. We now have a regular monthly meeting at Reading University on the second Wednesday evening of each month, but how should we develop? If we

become formal and publish a constitution and programme, we become just another club with the age old problems.

I feel we should concentrate on developing the unique radio communication facet, making the meetings purely social ones where we compare notes and talk face to face. We have adequate verbal communication by radio. People not yet on packet would be encouraged to listen and resolve data, even if they can't send any.

The local cellular notice board provides a newsletter and an interchange of telegraphic notes between members. Other contact can take place in speech or as continuous data on separate

frequencies by arrangement. I can send this article to half a dozen interested people in less than a minute at 1200 baud, and the recipients can then study it and be free to discuss the contents at some convenient time. New contacts and debate on current issues arise out of conversation at the monthly meeting. Anyone who wants to start a special interest group or 'net' on another subject can best air it on such occasions.

This system adds up to no records, no balance sheets, no AGM and no paper. It is just a local embodiment of what *Radcom*, *Connect International* and the hobby magazines are trying to provide!

REW

### Example packet transmission

Screen as seen by G3ONR. Bold legends show his input

```

Hello BARRY. Welcome to the G3VMR NOTICE BOARD from MAIDENHEAD XXXCON
24929
H for HELP. 1 For System Info; There are 8 Msgs On the System
*** CHECKING MAIL... I
*** SORRY..NO MAIL
G3ONR de G3VMR at 1623z on 870311 B,H,I,K,R,S,T, >

This NOTICE BOARD is run on a 32K TRS80 Model 100, developed
from
NIAED's MINI-PBBS which was written to work within the memory
restraints of the Model 100. It's main purpose is to provide
details of local meetings...73 BOB G3VMR
G3ONR de G3VMR at 1623z on 870311 B,H,I,K,R,S,T, >

The command Syntax is:
B<CR> - Bye (DISC) K<CR> - Kill Your Mail H
H<CR> - This HELP File I<CR> - System Information
R<CR> - Read YOUR mail R ALL<CR> - Read mail addressed
to 'ALL'
S<CR> - Send mail T<CR> - Pages BOB for 30 sec
G3ONR de G3VMR at 1623z on 870311 B,H,I,K,R,S,T, >

R-TVCC
TR TO From Date Time
S TVCC G3VMR 870217 1626
STEVEN COLE WILL TALK ON DISC OPERATING SYSTEMS ON MARCH 3rd.-
Laversham -CHURCH HOUSE.

*** WHAT NEXT? ***
R-AMRAC
TR TO From Date Time
S AMRAC G3VMR 870308 2117
NEXT MEETING MARCH 11th AT READING UNIV. PSYCOLOGY DEPT 7.30
FOR SP M. TIM MOORE G1JUV ON LOW-COST T N C's.

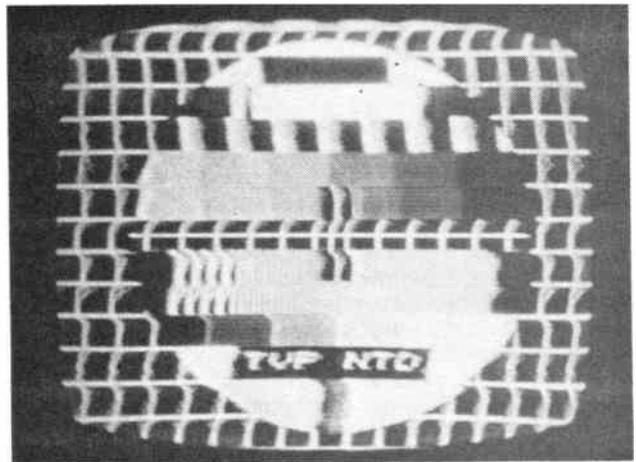
*** WHAT NEXT? ***
G3ONR de G3VMR at 1625z on 870311 B,H,I,K,R,S,T, >
R-MADRC
TR TO From Date Time
S MADRC G3VMR 870217 1621
MEETING - 17 FEB-DESOLDERING TECHNIQUES BY G3VTS.
MARCH 5- REGIONAL REP'S VISIT. MARCH 17th A G M .
DETAILS FROM G8RYW. QTHR.

*** WHAT NEXT? ***
G3ONR de G3VMR at 1625z on 870311 B,H,I,K,R,S,T, >
S-G3VMR
Enter Message. Cntl-H to end:
*** DONE
G3ONR de G3VMR at 1626z on 870311 B,H,I,K,R,S,T, > T
Paging BOB... (for about 30 Sec.) >
BOB is at the keyboard...Standby! >
OI BARRY FINE
G3ONR de G3VMR at 1627z on 870311 B,H,I,K,R,S,T, > B
G3ONR de G3VMR: 73 ,CUL
LUNDF OFF
***DIS
MAIL FOR: MADRC TVCC ALL AMRAC G3VMR
CONDI ON

```

# DX-TV VIA SPORADIC-E PROPAGATION

Keith Hamer and Garry Smith  
with something extra for the  
SpE season



Unsteady test card from Poland caused by fluctuating disturbances in propagation

**Y**ears ago, if you mentioned to someone that you were a 'TV-DXer' then chances were they wouldn't have had a clue as to what you were talking about. Explaining that you received foreign television transmissions as a hobby usually branded you as a raving loony. It was the combination of a characteristic sideways glance and a subtle edging away movement which said it all.

Fortunately, the presence of CB radio and satellite broadcasts over the past few years has increased public awareness about hobbies connected with communications.

TV-DXing is the hobby associated with the reception of ordinary broadcast television signals over immense distances aided by atmospheric disturbances. Unlike satellite broadcasts, which ensure reasonably consistent results, DX reception cannot reliably be predicted in terms of quality or even the origin of the transmission. So what is its attraction?

## Transmission standards

TV-DXing dates back to the mid-thirties when television was first introduced. During the sunspot peak of the late thirties, television receivers were shipped from the UK to America in order to see if the 405 line signals from Alexandra Palace on channel 1 could be received. The experiment was successful.

As television grew throughout Europe during the sixties, most viewers in this country encountered TV-DX signals without realising it. It was the dreaded 'Continental Interference' which blasted *Dr Who* and, more seriously, Wimbledon tennis from our screens during the summer. The disruption was caused by a phenomenon known as 'sporadic-E'. Unfortunately, instead of foreign pictures appearing, the BBC picture would be reduced to a mass of white sloping lines. There would also probably be buzzing on the sound channel, especially where channel 2 was used.

The British VHF channels used 405 lines with positive-going video modulation, while European stations

used 625 lines with negative-going video. Consequently, foreign pictures couldn't be resolved simply because of the different TV standards used abroad. That was until a few bright sparks, usually in the TV repair trade, began to juggle about with system switches fitted to the dual-standard receivers which started to come onto the UK market with the introduction of BBC2 in 1964. Once the switch was internally set to receive VHF channels, but at 625 lines, all one had to do was sit back and wait until a strange test card emerged from the snowy screen.

There was, and still is, something intriguing about running a TV set on a vacant channel knowing that something may appear from almost anywhere in Europe.

Most established TV-DXers tend to agree about this. It seems to be one of the attractions of the hobby. It's not so much the programmes, but the origin of the signal and the chance of experiencing the station transmitting its test card as proof of reception.

## DX-TV made easy

Nowadays, it isn't even necessary to modify an old receiver. Quite a few imported receivers already cater for the extra channels at 625 lines which are required for DX reception via sporadic-E ionisation. Some domestic video cassette recorders already have these extra channels. The recorder is simply switched to the Band I setting (for reception via sporadic-E) and used in the E-to-E mode, that is, using the VCR's tuner to select the television picture. A more attractive and beneficial approach is to use a special type of converter which plugs into the aerial socket of a domestic receiver.

Of more importance, for sporadic-E DX, aerials needn't be too elaborate as we shall see later. This is perhaps a greater comfort to your neighbours than yourself.

Strange as it may seem, it is more difficult to resolve the sound signal than the vision. The main reason is the spacing of the transmitted sound carrier from the vision frequency. In the UK and

Eire, the difference is 6.0MHz and the intercarrier sound circuitry within the receiver is designed to respond to this spacing. Two other intercarrier sound spacings exist, namely 5.5MHz in Western Europe (France is an exception; 6.5MHz AM is used with positive-going video modulation) and 6.5MHz which is used by Russia and Eastern bloc countries.

It is possible to tweak the intercarrier sound IF stages in a receiver to retune to a different system although a certain amount of in-depth knowledge is required in order to avoid misaligning the vision IFs, chroma decoder, teletext circuitry and every other circuit in sight! Many established TV-DXers concentrate on the visual aspect of the hobby with very little interest shown towards reception of the sound. During many sporadic-E openings, the signal bandwidth becomes so reduced that the sound (and colour) is absent anyway. On the other hand, when the signal quality is good, the extra dimension of sound does add more excitement, even if you don't understand any of the lingo!

## The sporadic-E season

Every year between May and September (in the Northern Hemisphere), many part-time DX-TV enthusiasts come out of winter hibernation in time for the sporadic-E season.

As many readers will know, short wave radio communication is possible due to reflections within the various layers of the Earth's atmosphere, including the 'E' layer. This particular region lies approximately 75 miles above the surface of the Earth. Although it is capable of reflecting short wave signals, television transmissions normally pass straight through it and are subsequently lost forever in space. However, during the summer months the E-layer becomes highly ionised. If the electron density is sufficiently high, TV signals within Bands I and II (approximately 40-100MHz) will be reflected or, more accurately, refracted back to Earth.

Because DX-TV reception via sporadic-E is entirely dependent upon

the ionisation process, we should mention here what is meant by *ionisation*. Due to various effects such as heat, friction, electrical current, electromagnetic and ultraviolet radiation, etc, an electron circling the nucleus of an atom can be separated. Such an atom is known as an *ion*. The loose electron is called a *free electron*. The ion is charged more than the electron, resulting in electrically charged layers within the Earth's atmosphere, especially if the ionisation process is sufficiently strong.

Patches or 'clouds' of ionised gases within the E-layer move about at great speeds, sometimes approaching 300mph. Because of this movement, several transmissions (even from different countries) can be received simultaneously on the same channel, the stronger and more stable signals being accompanied by one or more 'floaters'. But signal bandwidth can be severely restricted and sometimes strong video will be present without sound and chroma signals. There is a tendency for the lower Band I channels to suffer more from this peculiarity than channels above approximately 60MHz.

### Random reception

As the name suggests, reception is very sporadic and can occur at any time of the year (day or night) although conditions are less favourable outside the main season. Signals via this mode of propagation cannot be relied upon for entertainment-quality purposes and the countries likely to be received cannot be predicted. Reception on the higher Band I channels and in Band II tends to be more stable with slower fading signals, and resembles transmissions enhanced by tropospheric propagation.

Since signals are refracted back to the Earth, a skip distance is involved which is typically 700 miles. Consequently, transmissions are normally received within 1,000 miles of the station although double-hop or even multi-hop reception is possible. Sometimes countries in the Middle East are received such as Jordan, Syria and Iran.

On rare occasions, very short skip sporadic-E has been noted from Band I transmitters located at only 230 miles away. One example is the reception of the Gort channel B transmitter located in Eire. This has been received more than once in central areas of the UK.

Depending on the state of the E-layer, reception can last from just a few minutes to several hours. Signals propagated by sporadic-E can attain very high field strengths during openings and consequently impressive results can be achieved using basic equipment and simple aeriels. Some countries (in particular Spain, Italy and the USSR) can often be received with good quality pictures using nothing more than a piece of wire connected to the aerial socket of

the receiver.

Under very favourable SpE conditions, transmissions in Band III may also be present. So, when activity in Bands I and II is good, always keep a check on the lower frequency channels in Band III. You may be pleasantly surprised by what you see!

### Simple aeriels

A dipole cut to the centre of Band I (see *Figure 1*) is adequate during many openings and this should be mounted horizontally since most Continental transmissions favour this polarisation. Each rod should be 50 inches in length and preferably take the form of half-inch diameter alloy tubing. Waterproof dipole junction boxes are available for this type of dipole assembly, which may easily be attached to a stub mast fixed to the chimney or even a garden shed. Note that aerial height isn't of great importance due to the signals arriving at an angle. However, it may be advisable to achieve a minimum height of 16 feet to be clear of local obstructions such as next door's apple tree!

As the hobby takes hold, most enthusiasts develop a yearning for a more ambitious aerial system for Band I DX reception. Despite their size, wideband arrays consisting of 3, 4 or even 5 elements are sometimes pressed into service. This increases the gain of the system as well as making it more directional but bear in mind that some means of rotation will be desirable. Such a set-up is ideal for chasing the more elusive DX signals.

### Receiver requirements

So far we've mentioned propagation via the E-layer and the type of aerial system required to collect the DX-TV signals. Unfortunately, connecting the aerial to a typical UK receiver won't display the required signals because most such receivers will be fitted with a tuner covering only UHF frequencies, namely Bands IV and V; the expected DX

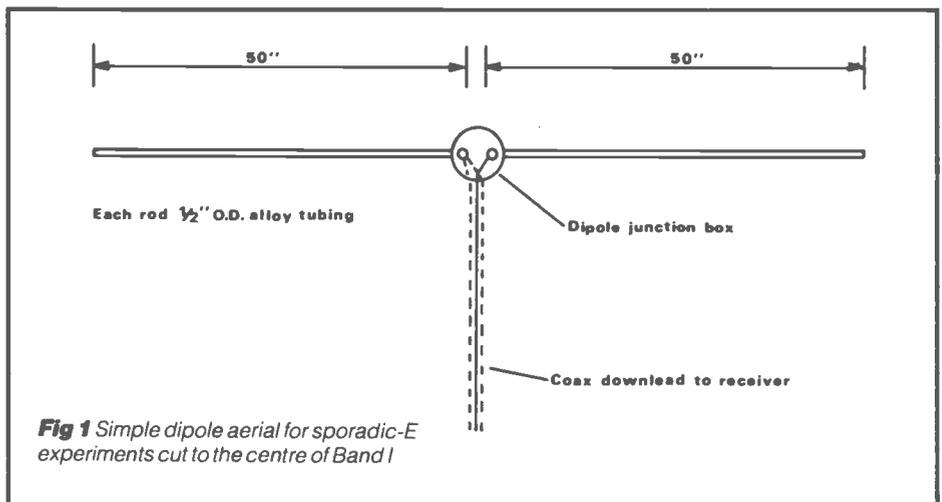
signal will arrive at Band I.

Some imported receivers have a multi-band tuner fitted as standard and just a flick of the bandswitch is all that's required to produce a DX monitor. Of course, a multi-band tuner could be substituted for the existing one in a UHF-only receiver, but be warned: Many receiver designs have a chassis at a lethal potential and any extra switches and controls may make the whole operation unsafe. It is best to leave well alone unless you feel competent in carrying out a safe modification of this nature.

### DX-TV converters

A converter which feeds the aerial socket of a standard receiver is safer and a much better prospect. One particular unit in use by many enthusiasts throughout the world is the D-100 DX-TV converter. An added bonus of this particular system is its ability to operate with a narrowed IF response. This method of operation is desirable since the overlap effects from neighbouring DX channels can be reduced. Different converter options are now available, one of which allows the unit to be used as a sound monitor when coupled to an FM radio receiver. This is useful since, apart from the various intercarrier TV sound channels propagated during intense openings, there are Italian private radio links which can be listened to as well as the OIRT (Eastern bloc) FM radio band and cordless phone frequencies used throughout Europe.

Details regarding the availability of D-100 converter units may be obtained by writing to HS Publications, 17 Collingham Gardens, Derby DE34FS. An 18p stamp should be enclosed to cover postage. This company, which specialises in DX-TV, can also supply various DX publications, including *A TV-DXer's Handbook* at £5.90, including UK postage. The dipole junction boxes mentioned earlier are also available at £2.75, including postage and packing.



**Fig 1** Simple dipole aerial for sporadic-E experiments cut to the centre of Band I

# NEXT ISSUE

## *Radio & Electronics* The communications and electronics magazine **World**

### MORSE AND RTTY DECODER

Colin Tallis presents an extension of the Morse decoding system for the ZX Spectrum described in the June 1986 issue

### THE ICOM IC-R7000

Ken Michaelson looks at this VHF/UHF general coverage receiver, reviewed here with the JT602 serial interface from Jaytee Electronics

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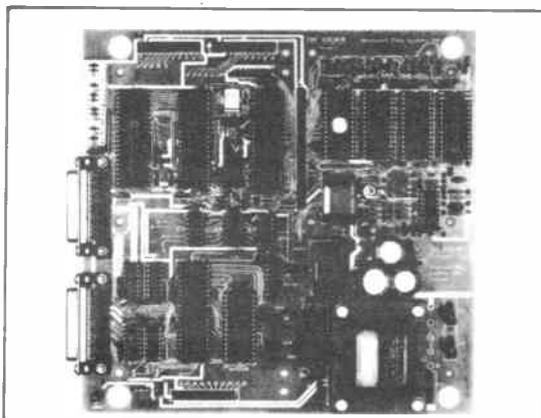
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# MEDIUM WAVE



## DXING

by Steve Whitt

This month the MW column has become something of a DX special. I firstly have a report on a medium wave DXpedition, followed by some tips for the DXer who would like to have a go himself; putting up aerials thousands of feet long in order to chase rare DX is really quite easy!

### DXpedition report

I have recently returned from a DXpedition to Anglesey where, together with three other MW enthusiasts, we established a listening post for a week. At the end of last year in this column I reported on the first such trip to Anglesey, but this second visit was intended to build upon what we had learnt first time round. Indeed, despite only average radio propagation conditions, we were able to log considerably more stations on this visit.

This trip was timed to roughly coincide with the spring equinox, a time of the year that is often favourable for MW-DX, but since the farmhouse which became the DX nerve centre had to be booked some time in advance we had to live with the prevailing propagation conditions, be they good or bad.

In order to make the most of a DXpedition a certain amount of advance work is needed, but with a little organisation (especially if there are several participants) things can run smoothly. On our day of arrival, with only a couple of hours of daylight left, we had to erect at least two aerials for that night's listening. This was somewhat easier said than done, since the weather had been atrocious. The farm was waterlogged and knee-deep in mud, but fortunately I had taken the precaution of waterproofing the bamboo canes which we used to support the Beverage long wire aerials. *Tip:* impregnate the bottom 10-12 inches of a bamboo cane in marine/outdoor varnish or molten wax to stop the aerial support becoming soggy and collapsing in wet soil.

By the start of our second day we had constructed four aerials ranging in length from 250 metres to 450 metres beaming to various parts of the Americas plus one pointing south to West Africa. A few days later we decided to experiment by lengthening our Beverage beaming to the east coast of the USA, since it was this area that was being favoured by propagation conditions. A quick site survey revealed that, by a complete stroke of luck, we would be able to extend this aerial from 350 metres up to 650 metres if we could cross a road with the aerial wire and connect it up to a brand new length of barbed wire fencing on the other side that ran in the right direction. *Tip:* A barbed wire fence will make a good Beverage aerial, but make sure that it is continuous in a straight line (gates need to be bridged with a bit of wire), that there are no short circuits to

ground at any point along the wire and that the wire is not connected to other lengths of wire forming the adjacent edges of a field.

Unfortunately, there was quite heavy traffic on the 'A' road which we needed to cross, but a simple practical solution was to drop the aerial wire down to the road surface to which it was securely taped. As expected, when the additional 300 metres of barbed wire was connected to the original aerial, it became noticeably more directional.

Well what did we hear? Radio conditions, as gauged by the Geomagnetic Indices, indicated a fairly high level of polar absorption of MW radio signals, which meant that from N America only stations east of the Great Lakes were audible. Additionally, S America was not really being favoured and as a result some of the most interesting DX was from the Caribbean and Central America. Our DX highlights are included in the table and can be summed up thus: 150 stations positively identified (104 from North America). 10 UK firsts (stations never before heard in UK or Eire). 25 countries heard (Africa: 4; Asia: 1; N America 4; Central America 12; S America 4).

One of the most impressive effects of

listening on the west coast of Britain (something new for me, since I normally do my listening in Ipswich) was the influence of dawn-induced fade out on European interference. Anglesey is beyond the reach of the ground wave signal of most European stations and so in the few hours around dawn when Europe is already in daylight but the Atlantic path to the Americas is still dark, it is possible to hear DX signals almost totally clear of European interference. Since Europe is being bathed in sunlight at this time, the skywave signals from there are being absorbed in the highly ionised D layer region of the ionosphere. However, since the DX path to the Americas is still dark, there is little absorption in the D layer and instead signals are reflected back to the ground via the higher F layer. Even more surprising was how late fade out of the stronger transatlantic occurred; local sunrise was around 0630hrs UTC but it was still possible to hear CJYQ (930kHz) in Newfoundland at 0830, Caribbean Beacon (1610kHz) from Anguilla at 0905 and the Atlantic Beacon (1570kHz) on the Turks and Caicos Islands was heard as late as 0922hrs!

You certainly don't have to plan a full scale DXpedition to try out a Beverage

### Expedition DX highlights

620kHz	ABS, St Johns, Antigua
700kHz	JBC, Montego Bay, Jamaica
700kHz	R Sucre, Guayaquil, Ecuador
940kHz	XEQ La Nueva Tropi-Q, Mexico City, Mexico
1160kHz	Bible Broadcast Network, Hamilton, Bermuda
1349kHz	ORTM, Nouakchott, Mauritania
1360kHz	R Catatumbo International, Maracaibo, Venezuela
1370kHz	R Mundial, Bogota, Colombia
1430kHz	R Tiempo, Caguas, Puerto Rico (only 500 watts)
1450kHz	R Antilles, St Vincent
1460kHz	CJOY, Guelph ON, Canada
1470kHz	WTKO, Ithaca NY, USA (only 500 watts)
1520kHz	R Liberacion, unknown location, new clandestine anti-Sandinista/Nicaragua station - possibly a CIA-funded station in Costa Rica
1521kHz	R Beijing (Russian Service), China
1555kHz	R Cayman, Gun Bluff, Grand Cayman, Cayman Islands
1590kHz	WJBQ, Goreham ME, USA

# MEDIUM WAVE DXING

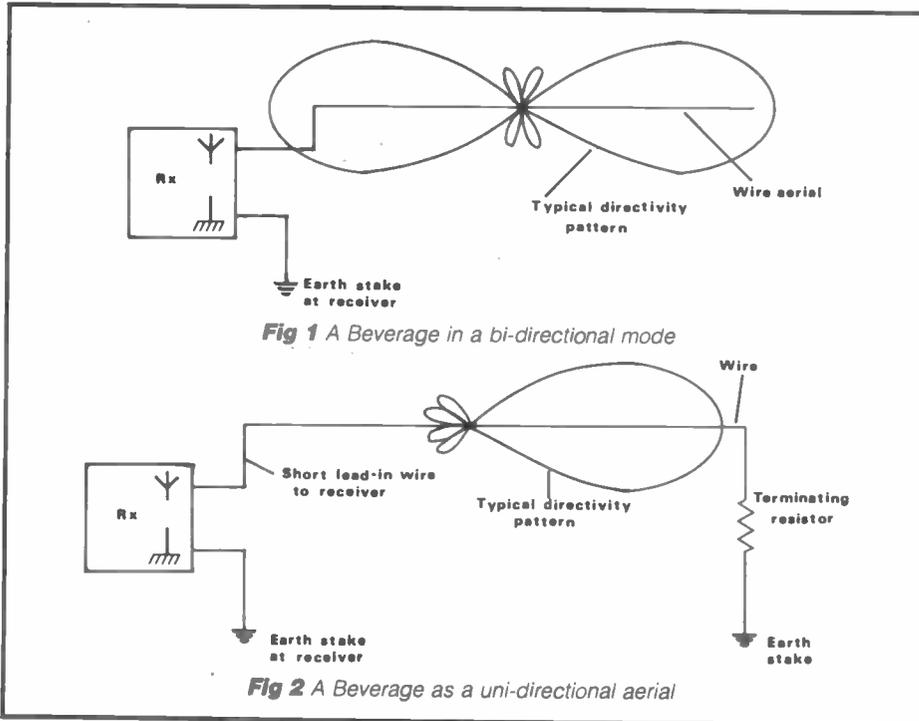


Fig 1 A Beverage in a bi-directional mode

Fig 2 A Beverage as a uni-directional aerial

type aerial, and if you are fortunate enough to live in or near open countryside experimenting with this sort of aerial should be relatively easy. For a Beverage to be reasonably effective it needs to be between 1 and 10 wavelengths long, which on the MW band implies lengths between 200 and 5000 metres. The longer it is relative to the wavelength of interest, the more directional the aerial becomes; this may partly explain why in Anglesey the best DX was heard on the higher frequencies in the MW band. Remember that a Beverage has its maximum signal pick-up along its length and that the aerial should point along the great circle path towards the desired reception area. Here's what you need to put one together and to have a go.

### Do-it-yourself

**Wire:** Hard-drawn copper wire is best for a permanent aerial since it won't

break, but it is not cheap and is quite heavy. I tend to use 7/0.2mm multi-stranded insulated wire for temporary DXpedition type aerials. A continuous barbed wire fence (galvanised steel) is also OK, as long as it's not too rusty to make good electrical connections.

**Supports:** Gardeners-style bamboo canes (4-6 feet tall) are cheap and good for the job. Just cut a slit at one end with a penknife or junior hacksaw to hold the wire. Lightweight wire (eg, 7/0.2mm) needs a support every 15 metres or so. If a straight hedgerow or fence runs in the desired direction you can dispense with the bamboo canes; likewise it is possible to support wire in trees as long as a reasonably constant height above ground can be maintained.

**Earth stake and terminating resistor:** If a Beverage is operated just as a long wire it will be directional but will pick up signals from both ends of the wire (Figure 1), but if the end of the wire

furthest from the receiver and nearest the target reception area is terminated in a non-inductive (eg, carbon) resistor equal in value to the aerial's characteristic impedance (usually about 500 - 600 ohms) the aerial becomes unidirectional (Figure 2). For best results it's a good idea to experiment with the resistor value but even a fixed resistor of, say 560 ohms, connected between the aerial and the ground stake will do the job. Do not forget that for best results an earth stake at the receiver is also needed.

**Receiver:** If you aren't planning a full scale DXpedition from, for example, a farmhouse, you'll need portable equipment. One good portable receiver that performs very well with Beverage aerials on the MW band is the Sony ICF2001D. This radio can run off its internal batteries, but alternatively an SW/MW communications receiver that runs off 12V could be used. Just imagine the simplicity of driving up to your aerial, parking in a lay-by off the road, and then all that you need to do is pass the aerial wire through the car window, connect it to the receiver and you are ready to go! With a bit of ingenuity and a few simple bits and pieces you could be DXing with your very own Beverage aerial; you certainly don't need to own several acres of land.

It might be said that by now the DX season would be well and truly over since the long winter nights have been left far behind, but if you listen to your radio at the right time DX will still be there. Indeed, this should be especially the case since solar activity is still near a minimum. In fact, the longer and warmer days should be more conducive to aerial experimentation and if you do try to put up a DIY Beverage aerial it might be best to point it towards Latin America or the Caribbean, as DX from these regions tends to dominate during the summer months.

Finally, if you do try out the Beverage, or any other aerials for that matter, do drop me a line c/o *Radio and Electronics World* telling me how you fared and what you heard. 73s till we meet again. 

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# Latest Literature

## GUIDE TO BROADCASTING STATIONS

by Philip Darrington

This is the nineteenth edition of a publication which has sold over 300,000 copies. It provides a useful guide to the vast subject of world broadcasting, listing long, medium and short wave stations by frequency, geographical location and alphabetical order, making it a most logical and useful book for anybody with an interest in the subject.

In addition to this data, several interesting articles have been included by well-respected authors. Richard Lambley of *Electronics and Wireless World* gives advice on choosing a short wave receiver, and there are also contributions from Pat Hawker of the IBA and Jonathan Marks of Radio Nederland Wereldomroep.

Heinemann-Newnes, £6.95.  
ISBN 0-434-90303-5

## WORLD RADIO TV HANDBOOK

edited by Jens M Frost

The 1987 edition of what is widely recognised as one of the most comprehensive and up to date publications for the broadcast enthusiast has been redesigned for easier access.

Long, medium and short wave broadcasters are listed by frequency, time and language. However, although WRTH is essentially concerned with lists of data, the inclusion of many interesting general features makes it readable as well as informative.

Special features include test reports on short wave receivers, a section on high frequency broadcasting reception conditions for the year, information on solar activity, maps of principal transmitter sites, and more.

Although this publication is undoubtedly more comprehensive and in-depth than Philip Darrington's *Guide to Broadcasting Stations* discussed earlier, at a price of £17.95 it may prove a

little too expensive for some pockets.

Billboard Ltd, £17.95. ISBN  
823059-18-9

## GETTING STARTED WITH BASIC AND LOGO ON THE AMSTRAD PCWS

by F A Wilson

This book is intended for PCW users who have overcome the complexities of the unit's Locoscript word processing package and who wish to explore the computing software.

It is, however, not intended as a replacement for the user manuals, but rather as a back up to them. It takes the form of additional explanation plus simple exercises to familiarise the user with the various operating procedures and prepare him for the more complicated aspects.

However, this publication is for beginners and deals only with the fundamental principles. There is therefore little chance of the reader getting out of his depth and this book can only contribute to his enjoyment of his machine.

Bernard Babani (publishing)  
Ltd, £5.95. ISBN 0-85934-162-3

## MICROPROCESSOR ENGINEERING

by B Holdsworth

This book is essentially an undergraduate text which should prove useful to students of electronic/electrical engineering or computer studies, having been developed from courses run at the Electronics Department of Chelsea College. However, it is felt that practising engineers with no previous digital experience or dedicated electronic hobbyists may find something of practical value in the text.

It has been written to provide a fairly in-depth explanation of the structure and operating techniques of a small computer and a basic understanding of assembly

language programming.

The book is divided into ten chapters. The first two cover basic arithmetic and logic processes, the third deals with memory devices and the fourth with microprocessor architecture. The next three chapters are concerned with the software aspects of machine operation, and chapters 8, 9 and 10 discuss the relationship of the microprocessor with the outside world.

The author has concentrated on the Intel 8085A, with reference to other 8-bit microprocessors as necessary to give thorough instruction on the design and programming of systems using those processors as central elements.

Butterworths, £15.95. ISBN 0-408-01361-3

## VHF/UHF AIRBAND FREQUENCY GUIDE

by Bill Laver

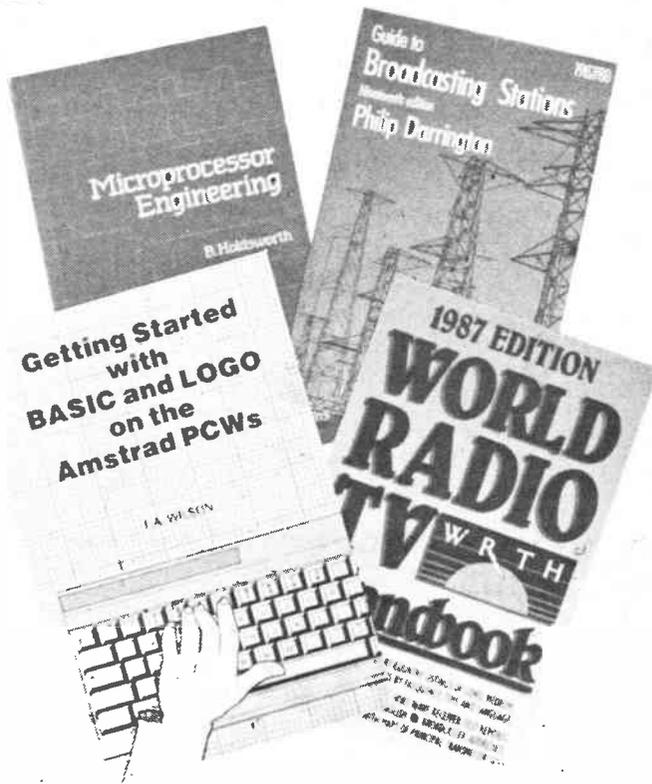
The fourth edition of this publication from Waters and Stanton Electronics is the largest and most comprehensive yet. It covers both civil and military frequencies from the

smallest grass fields to the largest of our international airports. It also includes full airways listings and many other frequencies in the aeronautical bands 118-136/225-400MHz.

The large format presentation makes for easier reading and will enable the reader to make amendments to the frequencies should any of them change subsequent to publication date. As there are constant small changes in the allocation of frequencies in the aeronautical band, each book is supplied with the latest update. It is planned to continue this service at regular intervals. Any readers who have purchased the latest edition can obtain subsequent updates free of charge providing they send the company their old update plus a stamped addressed envelope. New updates will be issued in June and December.

The book is available direct from the company or from most amateur radio dealers and specialist bookshops.

Waters and Stanton  
Electronics, £5.95 + 70p P&P.  
ISBN 1-870329-00-7



# Latest Literature

## Icom Ham Catalog

Icom recently released this catalogue, which deals solely with the company's range of equipment for the radio amateur.

This full colour, 24-page publication lists all Icom's base, mobile, hand-held and repeater equipment, plus accessories. Every item is illustrated.

**Thanet Electronics Ltd,**  
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## Kit news

Cambridge Kits recently released the latest issue of their *Kit News* leaflet which gives details of the range of equipment currently available.

Included in the leaflet is the range of Cambridge Kits antennas, ATUs, sound meters, oscillators, speech

## CATALOGUE CORNER

compressors and converters as well as useful tips for the amateur.

Copies of the leaflet are available by sending an sae or two IRCs to *Free Kit News* at the address below.

**Cambridge Kits,**  
45b Old School Lane,  
Milton,  
Cambridge CB4 4BS.

## Extra

Rapid Terminals recently published the first edition of a new magazine-styled catalogue known as *Extra*.

This 24-page, full colour publication is divided into nine sections: news, printers, terminals, plotters and digitizers, data communications, personal computers, software, technical talk and business comment. Over 100 products

from DEC, IBM, Hewlett Packard, Mannesman Tally, Gandalf, Summagraphics and other companies are included.

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## Testing time

The new Maplin catalogue features many new testers for the laboratory and workshop.

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multimeters, including: the pocket digital at £24.95, hobby digital at £28.95, push-button digital at £39.95, high precision digital at £41.95, auto-ranging digital at £45.95, and the multi-purpose digital at £64.95.

Maplin can also provide the battery power required to keep the test gear up and running: the Maplin standard nickel-cadmium battery charger has been reduced to just £6.95. The unit features a battery-test facility. Also, reduced in price to £7.95, is the popular Maplin universal charger.

All Maplin products are available by mail order or from the local Maplin stores. *The Maplin 1987 Buyer's Guide to Electronic Components* is also available in high street shops.

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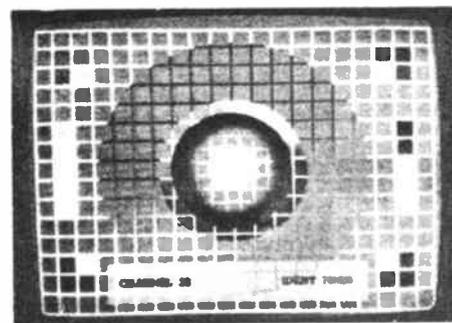
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February got off to a glowing start thanks to tropospheric propagation which lingered around from the previous month. Band III and UHF channels were awash with signals, mainly from the Benelux countries. There was, however, an instance of Norwegian reception in Band III noted by an enthusiast in Leeds. The signal came from one of the coastal transmitters. Unfortunately, conditions became quiet again on the 2nd, although sporadic-E activity relieved the boredom on many dates throughout the month.

# DX-TV RECEPTION REPORTS



Compiled by Keith Hamer and Garry Smith

## DX-TV log for February

This month we are featuring the DX log sent in by Simon Hamer of Powys. February 1st was obviously a very good day for tropospheric reception!

**1/2/87:** TDF (France) with Canal Plus on channels L5, L6, L7, L8 and L9; TDF t1 (first network), Antenne 2 and FR-3 on L22, L23, L25, L35 and L48; NOS (Netherlands) 1st network E5, E6, E7, E29 and E39; BRT (Belgian Flemish speaking service) 1st network on channels E10 and E43; RTBF (Belgian French language service) 1st network on E8; WDR (West Germany, Westdeutsches Fernsehen) 1st network on channel E9 with 'WDR1 LA9' FuBK test pattern from the Langenberg transmitter. WDR was also noted on E30 with 'WDR1 NH30' FuBK from the Nordhelle transmitter and on E46 with 'WDR1 KL46' FuBK from Kleve; WDR3 on E40, E48 and E49; NDR (West Germany, Norddeutscher Rundfunk) 1st network on E53 with 'Tagesschau' news programme; NDR-3 on channel E54 and E57 with the 'NDR 3 HMBG' FuBK; ZDF (West Ger-

many, Zweites Deutsches Fernsehen) 2nd network on channel E37; HR (West Germany, Hessischer Rundfunk) 3rd network on channel E52 carrying the 'HR3 FFTM' FuBK test pattern; SWF (West Germany, Südwestfunk) on channel E8 with the 'SWF 1' FuBK test pattern; RTL (Luxembourg) with the 'RTL PLUS' network showing the PM5534 test pattern on channel E7 from the Dudelage outlet; DR (Denmark) on E5, E7 and E10; SRG (Switzerland with the German language network) on E6 from the Rigi transmitter and on E7 from Säntis; TSI (Switzerland with the Italian language network) on channel E34 from Säntis or La Dôle.

**6/2/87:** NRK (Norway) on channel E4 with the 'NORGE KONGSBERG' PM5534 from the Kongsberg transmitter; SVT (Sweden) 1st network on E4 showing the 'TV1 SVERIGE' PM5534 test pattern; TVE (Spain) 1st network on E4 with a film

which was identified by on-screen 'tve' identification in the corner of the picture.

**8/2/87:** TSS (Russia) on channel R1 with programmes using Cyrillic captions.

**12/2/87:** TVP (Poland) on R1 with the 'dark background' PM5544 test pattern.

**13/2/87:** RUV (Iceland) on channel E4 with the 'RUV ISLAND' PM5544 at 0029 GMT!

**15/2/87:** NRK E3 on with programme called 'NRK I KVELD' ('NRK Tonight'); also RAI (Italy) on channel IA with programmes.

**16/2/87:** CST (Czechoslovakia) R1 on 'RS-KH' EZO test pattern.

**17/2/87:** ORF (Austria) E2a with 'ORFFS1' PM5544 test pattern from the Jauerling St Pölten transmitter.

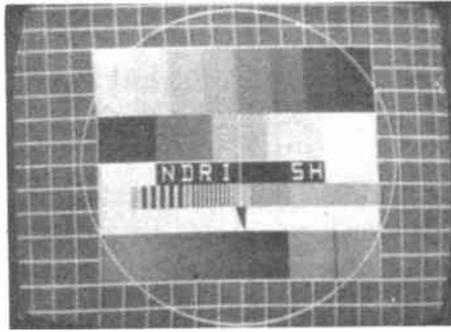
**19/2/87:** TVP R1 on PM5544.

**20/2/87:** Unidentified programme on channel E2 at 2255 GMT about computers.

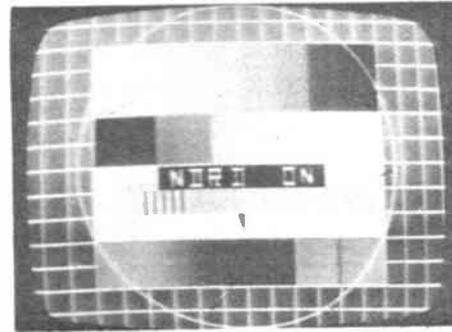
## PHOTO FILE ● PHOTO FILE ● PHOTO



**Fig 1** FuBK test card radiated by Norddeutscher Rundfunk in W Germany



**Fig 2** Test card from the Schleswig-Holstein region



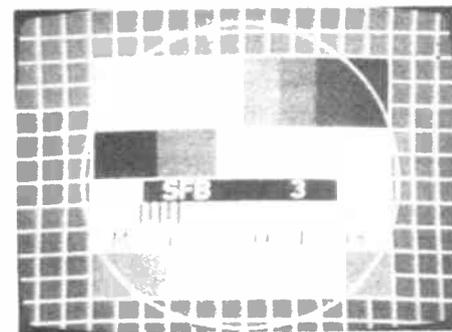
**Fig 3** NDR-1 transmission from the Niedersachsen Fernsehen region



**Fig 4** Test card used by NDR's 3rd network centred in Hamburg



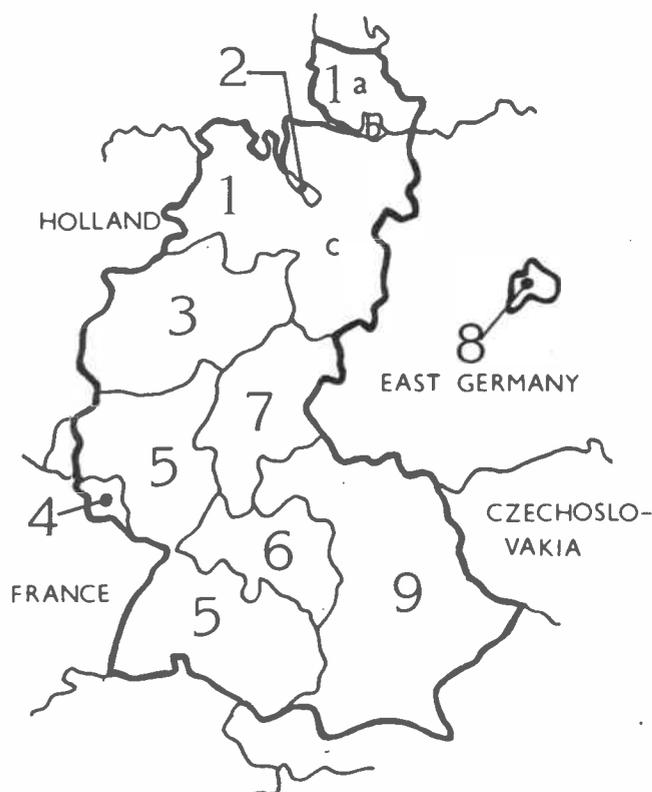
**Fig 5** Identification caption from the combined 3rd network services



**Fig 6** FuBK test card used by sender Freies Berlin

### West German TV Regions

- |                                     |                                 |
|-------------------------------------|---------------------------------|
| 1) Norddeutscher Rundfunk (NDR)     | 4) Saarländischer Rundfunk (SR) |
| a) NDR Schleswig-Holstein Fernsehen | 5) Südwestfunk (SWF)            |
| b) NDR Hamburg Fernsehen            | 6) Südkleutscher Rundfunk (SDR) |
| c) NDR Niedersachsen Fernsehen      | 7) Hessischer Rundfunk (HR)     |
| 2) Radio Bremen (RB)                | 8) Sender Fries Berlin (SFB)    |
| 3) Westdeutsches Fernsehen (WDR)    | 9) Bayerischer Rundfunk (BR)    |



### Reception reports

Kevin Jackson of Leeds has turned in a log report full of enviable exotics, as usual! The 525-line channel A80 transmitter operated by the American Forces Network at Soesterberg in the Netherlands was logged on February 1st. Despite earlier reports that the French 'La Cinq' and 'TV6' services would be closed down at the beginning of 1987, they seem in fact to be alive and well. Kevin noted these on channels E30 and E58 respectively.

The early morning reception (0029 GMT) of Iceland on channel E4 was quite a surprise for Simon Hamer of New Radnor. Fortunately, other DX during the month was fairly easy to identify, since most reception was of test cards or subtitled programmes which made logging relatively easy. However, one mystery did occur. It consisted of a programme about computers at 2255 GMT on channel E2 on the 20th. Did anyone else see this?

An interesting letter arrived from Steven Robinson who lives at Rotherham. He's been TV-DXing for

three years and fully enjoys the hobby. The tropospheric opening at the end of January, which overlapped into February, was a 'record breaker' according to his letter. Dutch signals were well received on channels E4 (Lopik), E7 (Markelo) and E39 (Wieringermeer) with 1st network material. The Dutch 2nd network was also seen on channels E27 (Lopik) and E45 (Wieringermeer). West German, Belgian, French and Danish stations were also present. For UHF DX a Triax 'bow-tie' grid is employed while for tropospheric work in Band III an 8-element wideband array is used, manufactured by Jaybeam. Both arrays are equipped with an Antiference UP 3301 masthead preamplifier. For sporadic-E DX in Band I, a 2-element array is in use. Two television receivers have been pressed into service for monitoring DX-TV signals. One is a Waltham monochrome portable; the other is a JVC colour portable.

Mark Dent of Leeds was the lucky DXer to see the Norwegian outlet of Lyngdal on channel E9 during February 1st. Danish transmitters were also noted on

various channels throughout Band III, for example Sydsjaelland on E6, Sonderjylland E7, Aarhus E8 and Vestjylland E10. Other interesting DX came from West Germany. Several transmitters were received, situated in the north of the country in the Norddeutscher Rundfunk service area. These included Kiel E5, Heide E10 (vertically polarised), Mölln E53 and Hamburg E56. All these outlets carried 1st network material. Third network transmissions received included Aurich E43, Eiderstedt E44, Cuxhaven E48 and Flensburg E53. Moving down to Band I channels, sporadic-E signals were present on the 4th when an unidentified music programme was seen with co-channel colour bars between 1115 and 1128 on channel E3.

### In memory

We were very sorry to learn recently that Harold Brodrigg of St Leonards-on-Sea passed away last Christmas at the age of 76. Regular readers of this column will have read of his DX results.

Harold was a keen DXer and was extremely interested in monitoring the VHF bands with a wartime sound communications receiver, which proved an excellent way of receiving the Eastern European VHF radio stations located in Band I. No doubt readers will join with us in extending our deepest sympathies to Mrs Brodrigg.

### Focus on West German TV

During tropospheric openings, West German transmissions are often received. These chiefly originate from outlets located along the borders with Belgium and the Netherlands with signals predominantly from Westdeutsches Fernsehen and Norddeutscher Rundfunk. During more intense openings, outlets further afield are received from other West German TV regions. The broadcasting authority is known simply as 'ARD'. This is a convenient abbreviation for 'Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland'!

The regions are made up of the following organisations: Westdeutsches Fernsehen (WDR), Norddeutscher Rundfunk (NDR), Südwestfunk (SWF), Süddeutscher Rundfunk (SDR), Bayerischer Rundfunk (BR), Hessischer Rundfunk (HR), Saarländischer Rundfunk (SR), Sender Freies Berlin (SFB) and Radio Bremen (RB).

Programmes for the first network are transmitted on a regional basis rather like the IBA set-up in the UK. Commercials are shown but are restricted to certain hours of the day. The second network, which is operated by Zweites Deutsches Fernsehen (ZDF), is radiated nationally rather like BBC2 in the UK. ZDF, like ARD, also carries commercials. The third network of ARD is radiated on a regional basis and, in the north of the

# DX-TV RECEPTION REPORTS

country, NDR, Radio Bremen and Sender Freies Berlin combine to form one 'third region'.

## Norddeutscher Rundfunk

For the first network it is interesting to note that the NDR area is split into three regions for TV transmissions: NDR Schleswig-Holstein Fernsehen in the east and NDR Niedersachsen Fernsehen in the west. A third region is centred on Hamburg and is aptly named NDR Hamburg Fernsehen. All these radiate 1st network programmes with some regional variations.

The FuBK test pattern will at times carry identification according to the region, namely NDR 1 followed by two identifying letters. These are 'SH' for Schleswig Holstein, 'HH' for Hansestadt Hamburg, 'ON' for Ost-Niedersachsen and 'WN' for West-Niedersachsen. Note that the latter two identifications are both applicable to the NDR Niedersachsen Fernsehen region.

For the third network, the test pattern identification will vary depending upon the originating source. Recently, NDR 3 and SFB 3 patterns have been received carrying the identification 'NDR3HMBG' and 'SFB 3'. The latter also carried a digital clock and date insert.

## Service Information

**France:** The following 'Canal Plus' main transmitters are now in service: Gex Mont Rond (Channel 7, vertically polarised, 4kW); Menton Cap Martin (68, H, 2kW); Nice Mont Alban (66, H, 1kW); Troyes Les Riceys (7, H, 10kW); Carcasonne Pic de Nore (3, V, 20kW); Marseille Grande Etoile (5, H, 20kW); Caen Mont Pincon (9, H, 20kW); Bourges Neuville les deux Clochers (8, H, 20kW); Dijon Nuits Saint Georges (9, H, 4kW); Besancon Lomont (3, V, 4kW); Brest Roc Tredudon (10, H, 20kW); Bordeaux Bouliac (8, H, 10kW); Rennes Saint Pern (7, H, 20kW); Lyon Mont Pilat (10, H, 20kW); Nantes Haute Goulaine (9, V, 20kW); Mende Truc de Fortunio (68, H, 1kW); Reims Hautvillers (9, V, 5kW); Nancy Malzeville (8, H, 4kW); Metz Lutange (5, V, 4kW); Lille Bouvigny (5, H, 20kW); Clermont Ferrand Puy de Dome (5, H, 10kW); Toulouse Pic du Midi (5, H, 20kW); Strasbourg Nordheim (10, V, 3kW); Mulhouse Belvedere (5, H, 20kW); Le Mans Mayet (5, V, 10kW); Paris Tour Eiffel (6, H, 20kW); Rouen Grand Couronne (7, PH, 10kW); Niort Maisonnay (6, V, 20kW); St Raphael Pic de l'Ours (10, V, 4kW); Lomoges Les Cars (10, H, 10kW).

**Spain:** The following main transmitters are used by the private TV service,

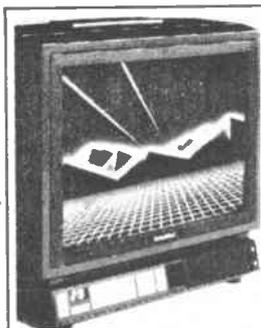
'Televisio de Catalunya' (TV3): Tibidabo on channel 44 with 10kW ERP; Rocacorba on 52 with 10kW; La Mussara on 63 with 10kW; Alpicat on 52 with 10kW; Montcaro on channel 29 with 5kW ERP.

There are over 70 relay stations with effective radiated powers ranging between 0.625W and 200W.

**United Kingdom:** Europe's newest satellite TV station opened on January 30th. Known as 'Super Channel', it is currently being received by 6.5 million viewers in 14 European countries. Programmes, which are broadcast around the clock, are a mix of what Super Channel calls 'The Best of British'. Viewers in Britain can only see the new station if they have a receiving dish or if they are linked to cable TV.

Super Channel can be received as far north as Finland, east to Czechoslovakia and south to North Africa. Programmes are beamed from London to a communications satellite then back down to receiving dishes owned mainly by cable TV companies. It is expected that the new channel will cost between £15 and £20 million each year to operate.

This month's service information was kindly supplied by Gösta van der Linden (Rotterdam) and the Benelux DX Club (Netherlands). 



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Extra facilities can include Video/Teletext; NTSC; 12/24DC volt operational package. (SAE for detailed leaflet.)

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## You've been had. . .and we apologise

Those of you reading Dr Van Parc-Vizz's article, *A Miniature Multiband Aerial*, in the April issue may have spotted the connection between certain statements in the article and the cover date.

However, for those readers who were confused by the antenna's description, and especially by the nonsensical formula at the end of the article, worry no more - this was a spoof article (hence Dr Van Parc-Vizz's callsign, SP100F) designed to uphold the great April Fool's tradition.

It appears, however, that many of you took the article at face value and have as a result been writing to the address given in the title, High Walls, Princetown, Devon HMP PT1. This was obviously too subtle for those of you not familiar with the location of Dartmoor Prison (High Walls - get it?), but

apparently this was not the case for the local Post Office workers, who have been delivering letters from some confused R&EW readers to the prison itself.

This has created a situation where the prison staff have wasted a lot of time trying to sort out this mail, and we apologise wholeheartedly for any inconvenience caused.

### The early days

The old-timers amongst our readership will probably feel a pang of nostalgia at these reminiscences of K W Hunt of Lutterworth in Leicestershire.

"I was greatly interested to read in the April number, under the title *Notes from the Past*, a description of the not easy but very exciting early days of broadcasting. At that time, as a keen thirteen year old radio fan, I was privileged to listen in to the first broadcasts from the Marconi experimental station 2MT at

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

Writtle. A friend of my family who had been a radio operator in the Royal Navy, on being demobbed in 1918 built himself a three valve receiver, comprising a regenerative detector stage, followed by two stages of low frequency amplification, using three Marconi V24 valves consuming 6 volts, 2 amps each.

"Almost all the component parts had to be hand-made, such as the variable tuning condenser, the tuning coils, fixed condensers, variable filament rheostats and the two low frequency transformers. I was invited each week into his radio den in the attic, where I sat entranced whilst he deciphered incoming Morse signals in 'CW and spark' at what seemed to me to be a rapid speed. He would often tune in to the Marconi experimental station, 2MT, at Writtle.

"One day in February 1922, I received the exciting news that a weekly telephony transmission would commence the following week. Would I like to come and hear it? Would I just! I shall never forget the moment when the announcer (was it Captain Eckersley, who later became the chief engineer of the British Broadcasting Company?) opened the transmission as follows:

"Hello CQ, hello CQ, this is station 2MT, 2MT, Writtle calling..."

"When one considers that a radio station transmitting a power of 10 watts could be heard clearly in Leicester, one hundred miles distant, on a home-made receiver, I think we must all agree that the radio amateurs of sixty-five years ago accomplished much."

### 405 Line Society

The aim of the 405 Line Society is to preserve and restore all items of 405 line

television history.

Following the closure of the world's first high definition television service at the end of 1984, it became apparent that many enthusiasts had preserved a considerable quantity of 405 line equipment, dating from 1936 onwards, which was now obsolete and unusable. Consequently, a number of enthusiasts decided not only to preserve this equipment for future generations, but to keep it in working order.

Annual subscription is £2 plus four stamped addressed envelopes for the quarterly newsletter which, amongst other things, will carry free advertisements for members wishing to buy, sell or exchange 405 line equipment.

The contact address for the 405 Line Society is 7 Blair Avenue, Poole, Dorset BH14 0DA. Tel: Parkstone 748072.

### The pretender

The callsign of one of our authors, Richard Marris G2BZQ, is currently being pirated on 80m CW by somebody signing as G2BZQ/QRP 'Rich'. It is possible that the pirate is also using Richard's call on other bands.

Richard says that the fake can be easily identified because, unlike the pirate, he never signs as G2BZQ/QRP, only as G2BZQ; he only operates until 6am, whereas the imposter works after this period; and for many months Richard has only used 80m CW in connection with antenna research products.

Richard would like to suggest to the imposter, through the pages of this magazine, that he/she uses the vacant callsign G9ABF/QLF!

### In the Navy

The increasingly popular Royal Naval Amateur Radio Society Annual Mobile Rally will be held on the HMS

## RADIOGRAM

The square contains 16 well-known radio and electronic terms selected from recent articles published in this magazine. The words run across, diagonally, up, down and are occasionally spelt backwards. With two exceptions all terms are single words. When a term has been identified it should be circled. When all 16 terms have been circled the 'Radiogram' has been completed.

The first two correct entries out of the hat win a year's subscription to R&EW. Post yours to the address on the contents page. **Jack Burrows**

S	O	F	T	W	A	R	E	V	B	E	N	Q	D	C	G
X	F	S	R	E	T	U	P	M	O	C	W	A	N	H	R
R	C	G	A	E	U	T	A	P	E	L	O	O	P	S	D
O	E	A	N	H	Q	B	Z	S	D	F	T	D	R	N	A
S	C	Z	S	V	B	U	R	F	I	Q	O	A	D	J	H
S	L	K	I	T	C	X	E	D	V	L	F	U	G	M	W
E	V	A	S	S	M	C	H	N	A	O	D	F	U	E	B
C	K	N	T	B	E	E	G	U	C	N	H	R	O	F	R
O	D	R	O	L	D	H	P	H	S	Y	T	B	E	Z	O
R	F	K	R	O	U	B	T	C	S	C	O	E	P	L	A
P	Q	F	H	L	W	S	G	N	E	Y	D	A	N	K	D
O	F	T	S	D	L	R	V	P	Y	B	A	U	E	N	C
R	A	X	O	G	T	C	S	U	A	S	D	L	K	W	A
C	S	L	A	T	S	Y	R	C	U	F	Y	B	E	H	S
I	M	Q	U	A	X	C	K	N	R	V	D	O	Z	F	T
M	P	S	R	E	T	L	I	F	L	A	T	I	G	I	D

*Mercury*, near Petersfield, Hants, on 14th June.

Doors open at 10.00am and, as well as a wide variety of attractions for radio amateurs, many other kinds of goods will be on sale, including toys, jewellery and novelties. There will be rides and other amusements for children, crafts demonstrations, archery, vintage steam machines, and radio-controlled cars, boats and trains. Refreshments will be available throughout the day. Talk-in will be on 2m and 70cm.

For further details contact C G Harper G4UJR on (0703) 557469.

### Buzzing around

And now for something completely different... The South Bristol Amateur Radio Club is hosting a lecture, 'Apiculture explained' (bee-keeping), on 3rd June. On 17th June it's back to serious radio matters, though, with an HF activity evening.

The club meets every Wednesday evening at 7.30pm at the Whitchurch Folk House, East Dundry Road, Whitchurch, Bristol, Avon BS14 0LN. Further details are available from Len Baker on Whitchurch 834282.

### Light up

The Wimbledon and District Amateur Radio Society is hoping to come up with some bright ideas when Ray G4SQG presents a lecture, 'Making electric lightbulbs' on 26th June.

All meetings are held on the second and last Fridays of each month at 7.30pm in the St Andrew's Church Hall, Herbert Road, Wimbledon, London SW19.

For information on the society generally, contact George Cripps G3DWW on 01-540 2180.

### Getting historical

On Thursday 11th June the Southgate Amateur Radio Club will host a talk on the history of the Morse code by Tony Smith G4FAI. This will be followed on the 25th by an informal evening.

Meetings are held at 7.45pm at the Holy Trinity Church Hall (Upper), Green Lanes, Winchmore Hill, London N21. More details are available

from D Elson, G4YLL, 200 Churchgate Road, Cheshunt, Hertfordshire EN8 9EL.

### Sky high

The Burnham Beeches Radio Club's schedule for June takes off with a 'natter night' and film on airport radio on the 1st. This will be followed on June 15th by a visit to Gatwick Airport's Control Centre.

The BBRC meets at the Haymill Youth and Community Centre, Burnham Lane, Slough at 8.00pm on the first and third Mondays of each month.

The club contact is Eileen Chislett G6EIL who can be found on Maidenhead 25720.

### Get building!

Chelmsford Amateur Radio Society's constructors' competition will be held on 2nd June, so if you don't have anything brewing, get cracking!

It is reported in the society's newsletter that due to the popularity of its 2m net an earlier start time of 7.45pm has been agreed. This will enable stations to have at least two rounds and avoid over-running the start of the 10m net. The 2m net is on 145.225MHz and the 10m net is on 28.325MHz, the latter beginning at 8.30pm.

Further information is available from Roy G3PMX or Ela G6HKM on (0245) 360545.

### Denby Dale rally

The Denby Dale Radio Rally is due to be held on Sunday 21st June at Shelley High School, Huddersfield in Yorkshire (on the B6116 near Skelmanthorpe).

Talk-in will be on S22, SU22 and 10m FM.

For more details contact Gerald Edinburgh on Huddersfield 602905.

### Morse mastery

The Coventry Amateur Radio Society is continuing its Morse classes, with lessons on the 5th and 19th this month. There will also be a surplus equipment sale on the 26th, so it's not all hard slog.

The society usually meets every Friday at 8.00pm at Baden Powell House, 121 St Nicholas Street, Radford,

Coventry. Visitors are welcome.

For more information contact Bill Hahn G3UOL on (0203) 414684.

### Electric

The Felixstowe and District Amateur Radio Society has a visit to the Electricity Board Field Communications Centre in Ipswich planned for June 1st, followed on the 29th by a lecture entitled 'Air Traffic Control'.

All meetings are at the Scout Hut, Bath Road, Felixstowe. For confirmation of date, time, etc contact Paul Whiting G4YQC on (0473) 642595 (daytime).

### Much discussion

The Chesham and District ARS meets every Wednesday at 7.45pm at the Stable Loft, The Bury Farm, Pednor Road, Chesham.

This friendly club features two talks a month, and the opportunity for discussion, construction and operation on the other two Wednesdays with amateurs from Amersham, Chesham, Chorleywood and the surrounding villages.

Contact Liz G0ETU, QTHR, on (09278) 3911 for details.

### 1987 BARTG Rally

The Annual Rally of the British Amateur Radio Teleprinter Group (BARTG) will again take place at San-

down Park Racecourse on the Sunday of August Bank holiday weekend, 30th August 1987.

This rally is not to be missed by the RTTY enthusiast, and also has a limited number of regular rally stands to make this rally of interest to all radio amateurs.

This year BARTG is looking forward to an even better rally; the hall has just undergone modernisation, and there is now room for more exhibitors. Catering and bar facilities will this year be annexed from the main hall to provide a more comfortable environment.

Last year packet radio was well represented by the exhibitors, as well as RTTY and the other modes of data communication. Also, the car boot sale provided a popular alternative to a flea market and was an outstanding success.

Sandown Park Racecourse is located on Portsmouth Road, Esher, on the A307 just south of Kingston upon Thames, Surrey. With the M25 now complete access is easier.

The rally opens at 10.30 until 17.00 and talk-in will be on S22.

Further details are available from Peter Nicol G8VXY, BARTG Rally Manager, 38 Mitten Avenue, Rubery, Rednal, Birmingham B45 0JB. Tel: (021) 453 2676.

## Calling all club secretaries!

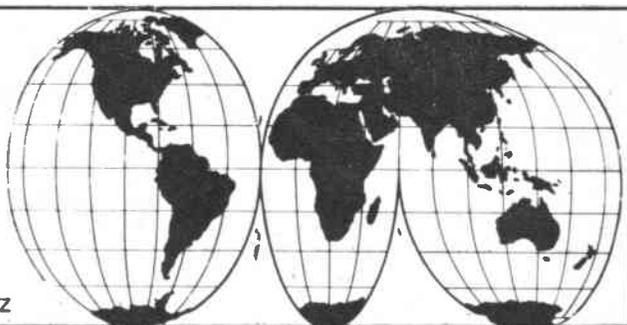
We are always pleased to receive news and details of interesting meetings from clubs and individuals. However, to help us to promote your organisation or event, please note the following:

- 1) Typed press releases on A4 paper are much more legible than scrawled notes on loo paper, and are less prone to misinterpretation.
- 2) Check that all the relevant information concerning an event is included, such as venue (with full address and directions if necessary), time and date.
- 3) A contact address, such as that of the club secretary, is essential. Please give a full postal address and phone number if possible.
- 4) Please bear in mind that we work two months in advance, so items for publication in a specific issue should be submitted at least three months before the event is due to take place.

# SHORT WAVE NEWS FOR DX LISTENERS

By Frank A Baldwin

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



Venezuelan stations are probably those most commonly reported by broadcast band SWLs operating on the 60 metre Tropical Band which begins on a frequency of **4750** and ends on **5050**.

The higher powered of these transmitters, ie 10kW or more, are fairly easy to receive, therefore representing an ideal project for those relatively new to the hobby. To set the scene, a few words about the country itself may be of interest prior to a Venezuelan logging session.

Venezuela is bounded in the north by the Caribbean in which its dependencies Margarita, Tortuga and some smaller islands are located. The capital and largest city is Caracas.

After Columbus had discovered the mouth of the Orinoco River in 1498, settlements were founded on the coast during the early sixteenth century. German adventurers then largely conquering the interior. Venezuela became part of Simon Bolivar's Greater Colombia after a war of independence with Spain. Antonia Paez later led a separatist movement which in 1830 resulted in an independent republic, largely dominated since by Caudillos (Leaders).

The country has four geographical areas, these being (1) the Orinoco Basin in the east, composed of vast plains (llanos) supporting large cattle herds, (2) coastal lowlands which are oil producing, more especially around Lake Maracaibo, (3) the Guiana Highlands to the south and east which are largely unexplored and (4) the highlands in the west which are a continuation of the

Andean range (Cordillera do Merida), where most of the population resides. Other main cities of Venezuela are Barquisimeto, Cumana, Puerto Cabello and Valencia.

## Making a start

At a convenient time after 2300 and before the sign-off time - see below - turn the tuning control to set the receiver on **4830**. Provided that propagation conditions for reception of the general area are at least moderate, the signals emanating from Radio Tachira in San Cristobal should be clearly audible. The programme language of Venezuelan stations is Spanish.

Why after 2300? Well, up to that sign-off time, Africa No: 1 in Moyabi-Moanda, Gabon dominates the channel with its 250kW transmitter. Clearly, then, signals from the lesser powered (10kW) Radio Tachira are effectively blotted out.

San Cristobal is a city in west Venezuela near the Colombian border, being set in a mining and agricultural area. This transmitter which serves the area from sign-on at 0900 (Sunday from 1000) to 0400 (Sunday until 0300) is heard and reported in the SWL press world-wide. Note, however, should be made of the fact that many Latin American transmitters often subject their respective schedules to variation. In the case of San Cristobal, it has been reported closing at 0700 and often working around the clock. Most certainly the writer has logged this one at weekends well after the scheduled sign-off time.

Tune next to **4970** on which channel one may hear the

signals from Radio Rumbos *La Emisora de Venezuela* in Caracas, the transmitter being located at nearby Villa de Cura. At 10kW, it entertains the local community from 0900 (Sunday from 1000) to 0600 (Sunday until 0400). Radio Rumbos is heard world-wide, little difficulty being encountered in the logging of this Venezuelan. It verifies by QSL card and the address is Apartado 2618, Caracas 1010A.

Also located in San Cristobal, Ecos del Torbes is on the air from 0900 (Sunday from 1000) to close at 0400 but sometimes works a 24-hour schedule. The power is 10kW, the frequency is **4980** and, like Radio Rumbos, Ecos del Torbes is frequently reported by listeners around the globe.

Scheduled from 0900 through to 0400, Radio Nacional is based in the capital Caracas. With a power of 30kW, it radiates from 1000 through to 0400. At present on **5025**, it has changed channel several times. It is not reported by Western European listeners as often as some of the lesser powered Venezuelans largely by reason of co-channel transmission interference.

For those who are interested in listening for the Venezuelan stations currently operating on the Tropical Bands, a list is included in the table.

## Nederlands Wereldomroep

Radio Nederland currently issues free to applicants a series of booklets designed to aid and provide advice on the short and medium wave listener fraternity.

The *Receiver Shopping List* (Edition 9) is a comprehensive survey of receivers currently available on the market, both new models and those recently discontinued. The contents of this publication include a most informative introduction and such chapter headings as 'Surplus Receivers', 'Vintage Wireless Societies', 'Circuit Diagram Sources', 'Current Receiver Survey', 'At a Glance Survey', 'Receivers Recently Discontinued' and, finally, 'Addresses For Further Information'.

Being a veritable mine of information, *Receiver Shopping List* is a worthwhile acquisition and may be obtained, like the booklet mentioned below, from Jonathan Marks, English Section, Radio Netherlands, PO Box 222, 1200 JG Hilversum, Holland.

*Infodutch* (Edition 3) is a 22-page production containing information of direct use to computer hobbyists. Divided into the following sections, it offers advice to those who use, or plan to use, a home computer in conjunction with a communications receiver, general hints, software for radio use, hardware, bulletin

3225 1kW R Occidente  
3255 1kW R La Voz del Tigre  
4770 1kW R Mundial Bolivar  
4780 1kW La Voz del Carabobo  
4830 10kW R Tachira  
4840 1kW R Valera

4850 1kW R Capital  
4970 10kW R Rumbos  
4980 10kW Ecos del Torbes  
5025 30kW R Nacional  
5040 1kW R Maturin



# SHORT WAVE NEWS

boards, radio related software and information/suppliers addresses.

## AROUND THE DIAL

The information provided below will assist our broadcast band enthusiast readers in logging some of the stations featured. Most certainly that is our aim.

## AFRICA

### Benin

Cotonou on **4870** at 1929, OM with announcements in French and xylophone type music in the fast rhythmic style typical of the locality. The Home Service schedule in French and vernaculars is from 0400 (Saturday from 0545, Sunday from 0600) to 0800 (Saturday until 1100, Sunday until 2300) and from 1300 to 2300. Cotonou sometimes features a newscast in English at 2000. The power is 30kW.

### Ivory Coast

Abidjan on **11920** at 2215, OMs with a discussion in the French programme for West Africa, timed from 1900 to 0100 daily.

### Liberia

LBS Monrovia on **3255** at 2245, recorded pops, OM with announcements in English. With a power of 50kW, this transmitter carries the Home Service in English, Liberian and many vernaculars from 0455 (Saturday from 0520, Sunday from 0558) to 0900 and from 1900 to 2400. There are English news bulletins at 0700, 1900, 2100 and 2300. A relay of the Voice of America newscast is broadcast at 2145 Monday to Friday inclusive.

### Morocco

Radio Méditerranée International, Tangiers on **9575** at 1216, OM with a talk in Arabic followed by an announcement and promos (promotions) in French. This one announces as Méditerranée 1 or Medi 1 and is on the air in French and Arabic from 0600 to 2400.

### Mozambique

Radio Mozambique, Maputo on **4866** at 1925, YLs with a local pop song in a vernacular then OM with some announcements in Portuguese. Lately widely

reported by DXers, the schedule is unknown at the time of writing but it has been heard signing off at 2210. The frequency may vary on occasions.

### Namibia

SWABC Windhoek on **3270** at 2209 with a Home Service programme of Abba pop songs. Also heard at 2317 featuring a Mario Lanza recording. The schedule is from 1630 to 0630 and the power is 100kW.

## CENTRAL AMERICA

### Belize

Radio Belize on **3285** at 0537, radiating a programme of pop songs and music followed by YL with announcements in English. Radio Belize operates in Spanish and English from 1100 (Sunday from 1200) to a variable closing time around 0600. The power is 1kW.

### Honduras

HRRI Sani Radio, Puerto Lempira on **4755** at 2331, OM with a talk in Spanish then OM with a folk song. At 10kW this one opens at 1200 and closes at 0200 daily. Programmes are in Spanish, Meskito and English.

### Nicaragua

The Voice of Nicaragua, Managua on **6015** at 0024, OM with a talk in Spanish with several mentions of Nicaragua. This particular Spanish transmission for Central America is timed from 2200 to 0100.

## SOUTH AMERICA

### Argentina

Radio Nacional, Buenos Aires on **15345** at 2150, YL with a talk about Argentinian wildlife, songs in Spanish, some guitar music then YL with the station identification, address for reports and off without the National Anthem at 2158. This was a transmission of the English Service directed to Europe and scheduled from 2100 to 2200.

### Brazil

Radio Nacional Amazonia, Brasilia on **11780** at 1940, OM and YL alternate with news items of both local and world events in the Portuguese programme for South Amer-

ica timed from 0800 through to 2145.

Radio Nacional Amazonia, Brasilia on **15200** at 1935, OM and YL with a discussion during the Portuguese transmission to Europe, timed from 1900 to 2130.

### Venezuela

Radio Nacional, Caracas on **11853** at 2212, OM and YL with news items during a bulletin in the Spanish programme for Central America, scheduled from 1700 through to 0400.

## ASIA

### India

AIR Delhi on **11810** at 1229, OM with a talk in the Chinese programme, this being followed by Indian style music and a song in Hindi during the Chinese presentation to Central Asia, scheduled from 1215 to 1315.

### Saudi Arabia

Riyadh on **15060** at 1504, recitations from the Holy Koran in the Arabic presentation to North Africa scheduled from 1100 to 1700.

### Turkey

Turkiye Polis Radosu (Turkish Police Radio) Ankara on **6340** at 1455, Turkish songs and music in a programme for home consumption timed daily from 0700 to 2000.

## SOUTH-EAST ASIA

### North Korea

Radio Pyongyang on **9977** at 1404, OM and YL with a talk during the Korean programme directed to South-East Asia from 1400 to 1450.

### Vietnam

Hanoi on **9840** at 1342, YL with the station identification and a talk in English about visiting Hanoi. The schedule and target area of this transmission is unknown at the time of writing.

## EUROPE

### Iceland

Radio Ríkisutvarpid, Reykjavik on **9985** at 1851, YL with a news bulletin in Icelandic in a transmission intended for Northern Europe. According to the schedule this should be timed from 1855 to 1945; an early start?

Radio Ríkisutvarpid has also been heard on **13758** at

1224 when radiating the Icelandic programme to Northern Europe scheduled from 1215 to 1300.

### Spain

Madrid (Emisor de Noblejas, Toledo) on **17845** at 1105, OM and YL with a news bulletin in the Spanish presentation to Central America, timed from 0930 to 1900 daily.

## PACIFIC

### Australia

Melbourne on **9655** at 0955, pop recordings followed by OM with the station identification in the English Service directed to the Pacific Islands and scheduled from 0700 to 1030.

Melbourne on **9770** at 1056, OM with an interview followed by the station identification, 'Waltzing Matilda', five pips and then the news in an English programme beamed to South-East Asia from 1000 to 1300.

## CLANDESTINE

Voice of the Crusader on **3920** at 2142, YL with a harangue in Farsi (Persian) and off abruptly at 2146. This was subjected to jamming, this sound being reminiscent of bubbling water. Voice of the Crusader, in Persian Inja Radio Seday-e Mojahed ast, is hostile to the present government of Iran. It is operated by the Mojahedin-e Khalq (Crusaders of the Masses) organisation and a couple of years ago was identifying as Voice of the Mojahedin-e Khalq.

Radio Iran Toilers on **6230** at 1530, martial music, OM with the station identification followed by a talk which included several mentions of Baghdad. This one is anti-Iranian government and pro-Tudeh (Communist) party. It programmes in Farsi and is thought to have some connection with R Afghanistan.

## NOW HEAR THIS

KCBS Shinuiju, North Korea on **3920** at 2156, OM with a talk in Korean followed by some martial music, four pips at 2200 and then OM and YL alternate with items presumably comprising a newscast. This 10kW transmitter is on the air from 2000 through to 1800.

# super alpha electronics

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West Sussex PO20 0TH



0243  
607108

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## TRANSISTORS

BC107	0.15
BC107A	0.15
BC107B	0.15
BC108	0.15
BC108A	0.18
BC108B	0.15
BC108C	0.15
BC109	0.18
BC108B	0.18
BC109C	0.18
BC182	0.12
BC182B	0.12
BC183	0.12
BC183B	0.12
BC184	0.12
BC212	0.12
BC212B	0.12
BC213	0.12
BC213B	0.12
BC214	0.12
BC327	0.16
BC337	0.16
BC548	0.12
BCY70	0.22
BCY71	0.22
BD131	0.60
BD132	0.60
BC135	0.34
BD136	0.35
BF258	0.60
BFX85	0.40
BFX88	0.40
BFY50	0.37
BFY51	0.37
BFY52	0.39
TIP31	0.42
TIP31A	0.48
TIP31B	0.56
TIP31C	0.54
TIP32A	0.42
TIP32C	0.42
TIP33A	1.00
TIP41A	0.63
TIP42A	0.55
TIP3055	0.76
TIP2955	0.76
ZTX300	0.17
ZTX500	0.17
2N3053	0.60
2N3054	1.60
2N3707	0.12
2N3703	0.12
2N3705	0.12
2N3771	1.40
2N3904	0.15
2N3906	0.15

## DIODES

IN4001	0.05
IN4002	0.05
IN4003	0.06
IN4004	0.06
IN4448	0.06

## OPTO ISOLATORS

TIL111 transistor o/p	1.10
TIL113 Darlington o/p	1.20
3021 Triac driver	1.50

## LEDS

T1¾ 5mm	
Red	0.18
Yellow	0.18
Green	0.18
Super bright	
T1¾ 5mm	
Red	0.35

## TRIACS

3 Amp 400V	0.75
8 Amp 400V	0.90

## ZENER DIODES

BZY88C 500m W	
4V7	0.10
10V	0.10
12V	0.10
BZX55C 500mW	
24V	0.10
BZX85C 1.3 Watt	
4V7	0.20
10V	0.20
12V	0.20
24V	0.20

## VOLTAGE REGULATORS

LM317T	
+1.2V to 37V	1.50
LM341P	
+5V	0.60
LM7905	
-5V	0.70

## BRIDGE RECTIFIERS

WOO4 1.5A	0.50
6005 6A	0.90

## CAPACITORS

<i>Electrolytic</i>		
47uF	25V	0.10
100uF	25V	0.12
470uF	25V	0.28
1000uF	25V	0.36

<i>Tantalum</i>		
0.1uF	35V	0.10
0.22uF	35V	0.10
0.47uF	35V	0.10
1uF	35V	0.10
2.2uF	35V	0.15
4.7uF	35V	0.20

<i>Ceramic</i>		
220pF	500V	0.06
470pF	500V	0.06
1000pF	100V	0.06
220pF	100V	0.06
4700pF	100V	0.06

## RESISTORS

Metal Film 5% ¼ Watt

2p each

100R 680R 1K 2K2 4K7 5K6  
6K8 10K 12K 15K 22K 27K  
33K 39K 47K 56K 68K 82K  
100K 120K 150K 180K 220K  
270K 330K 390K 470K 560K  
680K 820K 1M

## SKELETON PRESETS

Horizontal	0.19
Vertical	0.19

## LINEAR ICs

741	0.18	NE5534	0.80
555	0.30	ZN414	0.90
556	0.65	ZN416	1.60
LM301	0.28	LM308	0.70
NE5532	1.20	TL081	0.50

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BT Statesman with last number redial

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Brown	31.26
Maroon	31.26
Grey	31.26

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Ice Grey	26.04
Red	26.04
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■ Open frame power supply 24 volt output at 2.4 amps, form and fit UL certified £20. N Scragg, 11 Stourdale Road, Cradley Heath, Warley, West Midlands. Tel: (0384) 638263

■ Yaesu FP700 PSU, 6 months old still under guarantee £130. Himound Morse keys (2) £8 each ono. Hugh Cameron, Balloch, Blairgowrie PH11 8JN. Tel: (08283) 2829

■ 934MHz Delta 1 transceiver with all the gear, mobile antenna, plus very powerful 21 element home base beam with H100 coax. Have managed 150+ miles with this equipment. Rotator and all cables, plugs etc included. Would cost at least £500 to buy new, £250 ovno. Also TR9000 2 metre multimode, will swap for HF transceiver with cash adjustment. John. Tel: (0521) 72686

■ SWL Global ATU 1000, hardly used, boxed with data £20. Telescan scanning antenna 30-600MHz, suitable indoor/outdoor use £10. Carriage extra. Mr N Porter, 23 Calder Crt, Britannia Road, Surbiton, Surrey KT5 8TS. Tel: 01-390 2650

■ Koss personal stereo headphones, excellent sound, condition as new. Cost £18 will accept £10. Hitachi hi-fi speakers, excellent sound, 60 watts RMS per channel, soft dome tweeters, powerful woofers. Excellent condition, complete with cables and boxes. Less than four months old, cost over £90, will accept £50. Sanyo hi-fi amplifier and stereo tuner, matching pair. Dark grey finish, excellent sound and excellent condition, £60 the pair. Tel: Brentwood (0277) 219788

■ Antiference UF22 FM/UHF diplexer with line power by-pass for UHF amplifier. Unused and brand new in original box, complete with instructions for use. Cost over £7.50, only £6.50 including postage and packing. J Bridge, 21 Lilian Road, Burnham-on-Crouch, Essex CM0 8DS

■ Complete DX-TV set-up. Antiference MH311 interceptor VHF aerial combined Band 1/3 wideband; Triax BB quad grid 16 bay UHF aerial, very high gain; FU200 aerial rotor and control consol plus cable; 2 alignment bearings plus clamps; UHF wideband 40-860MHz, very high gain amplifier; Labgear CM7062 power unit; Antiference PU1240 power unit. Plus all the fittings and fixings: masts, chimney lashings and brackets, coaxial cable low loss etc. Hardly used. Cost £350 accept £200. D L Cox, 4 Fountains Road, Tuckswood, Norwich NR4 6LN. Tel: (0603) 503070

■ FT101E transceiver, good condition £100. Belcom liner 2 £40. Ex-computer PSU 40A £15. Steve Munday, Weston-Super-Mare. Tel: (0934) 22989 afternoons

■ Valves, class D wavemeter (less case), meters, capacitors, tools, car bits (new). 18p stamps list, send large sae. Williams, 25 Glenmore Road, Birkenhead, Cheshire L43. Tel: (051) 652 8799 evenings

■ AOR2001 scanner. As new, boxed, £200. Revcone antenna, £10. Heath HD-121P desk mike, £20. Aluminium parabolic dishes: 24in (Gramplan)/18in (PW), new, £10 each. Cirkit HF linear amp. Kit never opened; 1W in gives 15W out, £15. Fine HB RF speech processor (PW March '86) needs aligning, bargain, £10. New Woden UMO/DT1 modulation txfmrs, £2.50 each, inc spec sheets, all items, buyer pays carriage. Steve GM4GTU (QTHR). Tel: (0224) 743039 or (0903) 776570

■ Are you interested in medium wave and long wave radio? Yes! The *Medium Wave News* is for you. This informative and up to date newsletter, published by the only UK club dedicated to MW and LW radio, contains all the latest news, views, reception tips and feature articles. For a free sample copy and full subscription details please send a large SAE to MWC Secretary, 137A

Hampton Road, Southport, Merseyside PR8 5DY  
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■ 1939 quality radio 'feeder unit'; long, medium and two short wave bands. HF, FC, IF and audio stages, 'magic eye' tuning indicator; complete with power pack, loudspeaker and spare valves. Sundry radio components of the thirties also available, offers? F Cope, 50 Dennis Road, Gravesend, Kent DA11 7NW. Tel: (0474) 66051

■ Ayr teletext converter (model T1). Why not add Teletext to your existing TV, with remote control thrown in free? Cost £160, will accept £80. Good working order. Tel: (0242) 525357

■ TR2550 hand-held spkr mic, cash, £135. Yaesu FT290R, muTek, NiCads, charger, case, £195. 7/8 gutter mount aerial, £15. 5/8 mag mount aerial, £5. Tel: Ingatestone (0277) 354378 (Essex)

■ Found in attic, the following valves, vintage 1925 approx: SD2H, Mazda - EL2/HL2, Mullard CY1 - 2 volt types are made by Trio/Roh of Austria, which are YO2. UD2 plus some unmarked. Some do not have pins but 'side lags'. Also have bases for these. Also Mullard VP2; SP2H; SP13; some *Dumpee* silvered types (4 pin). These valves must be of use to someone. If interested tel: 01-505 6303 with offer. Also have some glass resistors

■ Pye Pocketphone 70 (PF2-FM) in good order. 158.25MHz with batteries, £30 ono, including postage or WHY. Tel: Kings Lynn (0553) 763428

■ Yaesu FT-301D 160-10m solid-state 100W HF transceiver. Matching PSU/speaker. SSB, CW, AM, FSK, digital VFO, readout. Variable AGC. Features include RF processor, noise blanker, clarifier and marker. Narrow CW and AM filters fitted. Internal/external VFO options. Provision for eleven crystal channels (any band), all 100% working and mint appearance. All boards plug in complete with manual, circuits, etc. £395 ovno. Carriage extra. Tel: (0282) 67481 after 5pm (Lancashire)

■ KW77 amateur bands receiver overhauled, nice condition with manual, £75. FRG7700 overhauled with aerial tuner and manual, £240. W Billinton, 16B Wyley Street, Honor-Oak-Park, London SE23 1DU. Tel: 01-699 4413 after 6pm

■ Grundig 3400 professional global receiver, little used, mint condition, instructions, bargain at £180. Tel: (0246) 410545 (evenings)

■ AR2001 scanner 25-550MHz, £190. Tandy VHF, UHF scanner antennas. £10. G8RHU QTHR. Tel: (0273) 516801

■ Teletype ASR33 110 baud printer complete with tape reader and punch. Plus stand and current loop interface. Good condition, £100 ono. Howard Finch, 31 Padway, Preston, Lancs. Tel: Preston (0772) 746475

■ Valves (tubes for our American friends): strange ones, wierd ones, neglected ones, collectable ones, most go need the room! Some dated 1936, most boxed, few ex equipment CV, CVX, VTS, even GPO types. WWII societies, preparing for summer season, want to get that old set working? Contact us. All half list (any list) price. Sid Shaw, 86A High Street, Poole, Dorset BH15 1DB. Tel: Poole 680500

■ *Wireless World* magazine April 1945 to Dec 48,

Sept 1949 to Dec 1971. Mostly complete, offers. *Practical Wireless*, 50s/60s, offers. Tel: Scunthorpe (0724) 857787

■ Yaesu FT7B, £275 no offers. Philips TV, UHF, VHF, 12in b/w, offers. Tel: (0283) 221870

■ Selena 8 band portable Rx, LW, MW, FM, 5 short wave bands, as new, £25. Tel: Bedford 720591

■ American wartime short wave receiver model BC-348-Q, complete with headphones and operation and maintenance manual, £35. Tel: (0992) 22517, evenings

■ I have 4 bags of new components to clear: contain 741, 555 ICs, 8+14 pin sockets, diodes, £5.25 a bag for quick sale. Also some hardware, wire, odd components, pot luck mix. Free. Please send £1 for post to D Martin, 6 Downland Garden, Epsom KT18 5SJ

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■ Valve radios, working and complete. Philco 4 W/B, Bush 3 W/B, Barker 3 W/B, Pilot 4 W/B, Bush VHF 3 W/B. Portables mains/batt. Roberts 3 W/B, Pye 2 W/B, Vidor 2 W/B. Also Pye 65A, requires 2V, 120V. Valve filaments, OK not tested. Earl, 1 Mayfield Drive, Daventry, Northants. Tel: Dav 702265

■ Sony ICF7600D compact portable short wave radio, 153kHz-30MHz AM/FM/SSB/CW, 10 memories, with all accessories, manuals etc, unwanted gift. Boxed, as new £99. Tel: (0254) 28969 (Blackburn, Lancs)

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■ Tandy Realistic PR2001 16 channel scanner 68-88 up 512MHz, cover all ham bands, VHF, UHF, ex condition, recently overhauled by Tandy, £125. RF strip covers 70MHz 500 milliwatt out, £6. Lined up by well-known ham. PC board for FM conversion for Pye Vanguard with instructions, £5. B24 coils in perfect condition, £5. Tel: (0792) 582941

■ 9 element Tonna antenna for 2m, unused, still boxed with 'N' type socket, with 'Bazooka' co-ax fitment, 50 ohm, £20.00. Buyer collects. ZX81 computer with manual, no PSU, £5.00. Mr N Porter, 23 Calder Court, Britannia Rd, Surbiton, Surrey KT5 8TS. Tel: 01-390 2650

■ HC1400 2m FM Tx/Rx, £100. J9R599CS, £100. Icom IC2E C/W case speaker/mic and base charger, £120. DX160, £80. Regency scanner, £80. All items ono. Going QRT so many other items. Phone for list. Tel: Phil (0742) 420550

■ 757GX plus YM38 scan/mic, £625 or exchange for older Tx/Rx for HF and/or older type communication Rx (Racal or sim). Anything considered. Must be good performance and condition. G4TSR. Tel: Hastings 813213

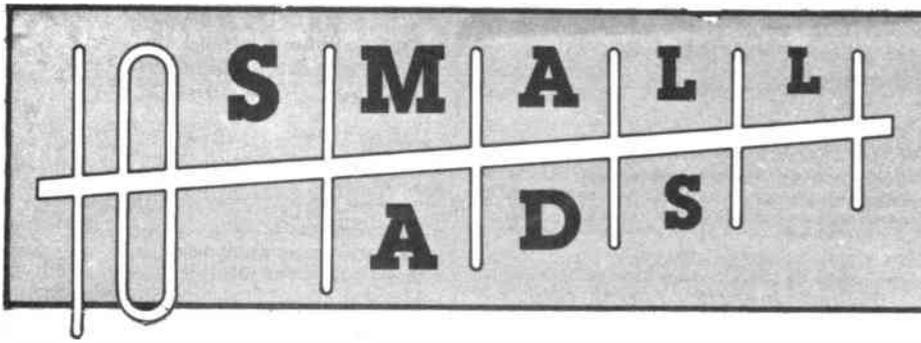
■ AMT-1 ICS Amtor RTTY terminal, complete manual, EPROM, G3WHO BBC B, £145. As new. CPM manuals, 7 discs incl Cobol for Acorn Z80 2nd processor, never used, £35 or exchange Brother HR5. MZ80K Sharp micro, £35 plus RTTY interface, custom built £20. Tel: Sam (0480) 53775

■ Yaesu FT480R 2 metre all mode transceiver, includes manual, mobile mount, ½ whip, mag mount, all cables and fixings, £300 ovno. Tel: Alan G6JOF, Coventry (0203) 616741, early evenings

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**PAYMENT ENCLOSED** £

Cheques should be made payable to Radio and Electronics World. Overseas payments by International Money Order

Conditions — Payment must be sent with order form. No copy changes allowed. Ads accepted subject to our standard conditions, available on request.

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C P I

# ADVERTISEMENT INDEX

Aerial Techniques .....	56	Number One Systems .....	11
Bi-Pak .....	16	Brian Reed .....	31
J Bull .....	67	Riscomp .....	17
Cirkit .....	56	Service Trading Co .....	53
P M Components .....	6,7	Sherwood Data .....	48
Display Elec .....	42,43	Smith Electronics .....	50
Grosvenor Software .....	53	Specialist Semi-Conductors .....	21
Harrison Electronics .....	11	Super Alpha Elec .....	61
ICOM .....	34,35	C R Supply .....	31
Keytronics .....	14	Telecoms .....	68
Marlow Marketing .....	11	Les Wallen Man .....	17
Menascope .....	50	Reg Ward .....	53
		West London Com .....	53
		R Withers .....	2

**Radio & Electronics**  
The communications and electronics magazine **World**

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Aug 87	11 Jun 87	17 Jun 87	19 Jun 87	9 Jul 87	
Sept 87	16 Jul 87	22 Jul 87	24 Jul 87	13 Aug 87	
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<p>Printed — web-offset <b>PAYMENT</b> Above rates exclude VAT All single insertion ads are accepted on a pre-payment basis only unless an account is held. Accounts will be opened for series rate advertisers subject to satisfactory credit references. Accounts are strictly net and must be settled by publication date.</p> <p><b>FOR FURTHER INFORMATION CONTACT</b> Radio &amp; Electronics World, Sovereign House, Brentwood, Essex CM14 4SE (0277) 219876</p>	<p>Overseas payments by International Money Order Commission to approved advertising agencies is 10%.</p> <p><b>CONDITIONS</b> 10% discount if advertising in both Radio &amp; Electronics World and Amateur Radio. A voucher copy will be sent to Display and Colour advertisers only. Ads accepted subject to our standard conditions, available on request.</p>



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- 3 - electrical switches, white flush mounting
- 7 4 - in flex line switches with neons
- 9 2 - mains transformers with 6V 1A secondaries
- 10 2 - mains transformers with 12V 1A secondaries
- 11 1 - extension speaker cabinet for 6" speaker
- 12 - glass reed switches
- 17 2 - ultrasonic transmitters and 2 receivers with circuit
- 19 2 - light dependent resistors
- 25 4 - water switches - 6p 2 way, 4p 3 way, 2p 6 way, 1p 12 way small one hold fixing and good length 1/2 spindle your choice
- 28 1 - 6 digit counter mains voltage
- 30 2 - Nicad battery chargers
- 31 1 - key switch with key
- 33 2 - aerosol cans of ICI Dry Lubricant
- 34 96 - 1 metre lengths colour-coded connecting wire
- 39 1 - long and medium wave tuner kit
- 41 8 - rocker switch 10 amp mains SPST
- 45 1 - 24 hour time switch mains operated (s h)
- 49 10 - neon valves - make good night lights
- 50 2 - 12V DC or 24V AC, 3 CO relays
- 51 1 - 12V 2 CO miniature relay very sensitive
- 52 1 - 12V 4 CO miniature relay
- 54 10 - rows of 32 gold plated IC sockets (total 320 sockets)
- 55 1 - locking mechanism with 2 keys
- 56 1 - miniature unselector with circuit for electric jigsaw puzzle
- 60 5 - ferrite rods 4" x 5/16" diameter aerials
- 61 4 - ferrite slab aerials with L & M wave coils
- 63 1 - Mullard thyristor trigger module
- 65 1 - magnetic brake - stops rotation instantly
- 67 1 - low pressure 3 level switch can be mouth operated
- 69 2 - 25 watt pots 8 ohm
- 70 2 - 25 watt pots 1000 ohm
- 71 4 - wire wound pots - 18, 33, 50 and 100 ohm your choice
- 77 1 - time reminder adjustable 1-60 mins clockwork
- 85 1 - mains shaded pole motor 1/2" stack - 1/2" shaft
- 89 1 - mains motor with gear box 1 rev per 24 hours
- 91 2 - mains motors with gear box 16 rpm
- 96 1 - thermostat for fridge
- 98 1 - motorised stud switch (s h)
- 101 1 - 2 1/2 hours delay switch
- 103 1 - mains power supply unit - 6V DC
- 104 1 - mains power supply unit - 4 1/2 V DC
- 107 1 - 5" speaker size radio cabinet with handle
- 112 1 - heating pad 200 watts mains
- 114 1 - 1W amplifier Mullard 1172
- 115 1 - wall mounting thermostat 24V
- 118 1 - teak effect extension 5" speaker cabinet
- 120 2 - p.c boards with 2 amp full wave and 17 other recs
- 121 4 - push push switches for table lamps etc
- 122 10 - mtrs twin screened flex white p.v.c outer
- 124 25 - clear plastic lenses 1 1/2 diameter
- 127 4 - pilot bulb lamp metal clip on type
- 128 10 - very fine drills for pcbs etc
- 129 4 - extra thin screw drivers for instruments
- 132 2 - plastic boxes with windows, ideal for interrupted beam switch
- 134 10 - model aircraft motor - require no on/off switch, just spin to start
- 137 1 - 6" x 4 ohm 10 watt speaker
- 142 10 - 4 BA spanners 1 end open, other end closed
- 145 2 - 4 reed relay kits 3V coil normally open or c/o of magnets added
- 146 20 - pilot bulbs 6.5V 3A Philips
- 155 1 - 12V drip proof relay - ideal for car jobs
- 156 3 - varicap push button tuners with knobs
- 169 4 - short wave air spaced trimmers 2-30M
- 172 10 - 12V 6W bulbs Philips m.e.s
- 178 3 - oblong amber indicators with kilguts 12V
- 180 6 - round amber indicators with neons 240V
- 181 100 - p.v.c grommets 1/2 hole size
- 182 1 - short wave tuning condenser 50 pf with 1/2" spindle
- 184 1 - three gang tuning condenser each section 500 pf with trimmers and good length 1/2" spindle
- 188 1 - plastic box sloping metal front, 16 x 95mm average depth 45mm
- 193 6 - 5 amp 3 pin flush sockets brown
- 195 5 - B.C. lampholders brown bakelite threaded entry
- 196 1 - in flex simmerstat for electric blanket soldering iron etc
- 197 2 - thermostats, spindle setting - adjustable range for ovens etc
- 199 1 - mains operated solenoid with plunger 1" travel
- 200 1 - 10 digit switch pad for telephones etc
- 201 8 - computer keyboard switches with knobs, pcb or vero mounting
- 206 20 - mtrs 80 ohm, standard type ca-ax off wire
- 211 1 - electric clock mains driven, always right time - not cased
- 216 1 - stereo pre-amp Mullard EP9001
- 232 2 - 12V solenoids, small with plunger
- 236 1 - mains transformer 9V 1 amp secondary C core construction
- 241 1 - car door speaker (very flat) 6 1/2" 15 ohm made for Radiomobile
- 242 2 - speakers 6" x 4" 4 ohm 5 watt made for Radiomobile
- 243 2 - speakers 6" x 4" 16 ohm 5 watt made for Radiomobile
- 244 1 - mains motor with gear-box very small, toothed output 1 rpm
- 245 4 - standard size pots, 1/2" mag with dp switch
- 249 1 - 13A switched socket on double plate with fused spur
- 266 2 - mains transformers 9V 1A secondary
- 267 1 - mains transformers 15V 1A secondary p.c.b. mounting
- 291 1 - ten turns 3 watt pot 1/2" spindle 100 ohm
- 296 3 - car cigar lighter socket plugs
- 298 2 - 15 amp round pin plugs brown bakelite
- 300 1 - mains solenoid with plunger compact type
- 301 10 - ceramic magnets Mullard 1" x 3/8 x 5/16
- 303 1 - 12 pole 3 way ceramic wave change switch
- 305 1 - tubular dynamic microphone with desk rest
- 308 1 - T.V. turret tuner (black & white TV)
- 310 2 - oven thermostats
- 313 5 - sub miniature micro switches
- 314 1 - 12" 8 watt mtr fluorescent tube white
- 315 1 - 6" 4 watt mtr fluorescent tube white
- 316 1 - round pin kettle plug with moulded on lead
- 453 2 - 2 1/2 in 80ohm loudspeakers
- 454 2 - 2 1/2 in Bohm loudspeakers

**FROZEN PIPES** Can be avoided by winding our heating cable around them. 15 mtrs connected to mains cost only about 10p per week to run. Hundreds of other uses as it is waterproof and very flexible. Resistance 60ohms/metre. Price 28p/metre or 15m for £3.95.

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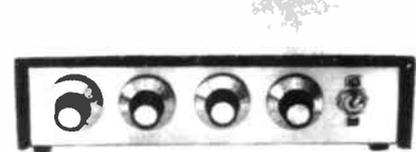


Ex-Electrify Board Guaranteed 12 months

### VENNER TIME SWITCH

Mains operated with 20 amp switch, one on and one off per 24 hrs repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only £2.95 without case, metal case - £2.95, adaptor kit to convert this into a normal 24hr time switch but with the added advantage of up to 12 on/off's per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30.

### SOUND TO LIGHT UNIT



Complete kit of parts of a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive tone metal case and has controls for each channel, and a master on/off. The audio input and output are by 1/2" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form.

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Made for use in cars, etc these are very powerful and easily reversible. Size 3 1/2" long by 3" dia. They have a good length of 1/2" spindle - 1/10 hp £3.45, 1/8 hp £5.75, 1/6 hp £7.50

### 25A ELECTRICAL PROGRAMMER

Learn in your sleep. Have radio playing and kettle boiling as you wake - switch on lights to ward off intruders - have a warm house to come home to. You can do all these and more. By a famous maker with 25 amp on/off switch. A beautiful unit at £2.50.

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**BENCH ISOLATION TRANSFORMER.** Toroidal wound 400 watt but very compact. Has a separate 10V winding which can be added or subtracted to give fine voltage control. Normally £40, our price £10 plus £2 post, ref 10P9.

### TANGENTIAL BLOWER HEATERS

We can supply 1.2KW - quite definitely the smallest tangential blow heater we have ever had, measuring approx 6" x 6" x 4". This could be just the thing for a small bedroom or to fit under desk or table if you suffer from cold legs. In addition to normal heating functions if put into a simple enclosure this could be a pipe warmer (much safer than a blow lamp) possibly even a paint stripper, hair dryer or hand dryer. Price is £5, plus £1 post, ref 5P23. 2.5KW - width approx 8" (plus meter), elements made up of two 1.2kw sections, so with switch supplied you can have 2kw, 1kw or cold blow. Over heat cut-out aluminium fins are not included. Fan blades are optional. Fan blades are metal. Price £5 plus £1.50 post, ref 5P62. 3KW - width approx 13" plus meter, element made up of 1kw and 2kw section, supplied with 4 section rocker switch, allowing 3kw, 2kw, 1kw and cold blow. Price £8.95 plus £2.00 post. If you want a really cheap tangential heater, this is your opportunity, made for 115v mains, to use in a 230v. Simply join elements in series, needs only simple on/off switch, as you will only have one heat level 2kw and no cold blow. Price £2 plus £1 post, ref 2P68. VERY LOW FLOWING COST - only a 300w element. So would cost only approx 1 1/2 p per hour to run. Should be enough for an airing cupboard or a hot line for food preservation. Might even be enough to keep a damp corner dry. Normal construction approx 4 1/2" plus meter wide. Price £5 plus £1 post, ref 5P78. 500W - 115V TRANSFORMER to isolate you or yours from mains to earth shock dangers. We are able to offer these transformers at less than the price of an auto transformer. Our price for the 500w mains to 115v isolation transformer is £10 plus £5 post, ref 10P5.

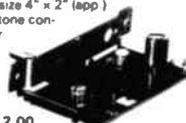
**RESIN CURED FILLER/BUILDER/STICKER** made by the famous Halls company, suitable for repairs, not only to car bodies but also to sinks and wash basins, water tanks, drain pipes and gutters, tiles, roofs, filling holes in walls and concrete, repairing cracks in gables, window frames, etc. etc. It is weather resistant and adheres well to metals, wood, concrete and some plastics. Special bargain price 2 large tubes for £1, ref 80464. **STEPPER MOTOR** By American Philips corporation. Step angle 7.5°. Coil resistance 21 ohms. Operating volts 10-14. Size approx 2 1/2" dia by 1 1/2" deep on a square mounting plate. This is in fact two bi-directional motors with P.M. rotors. Applying correct pulse causes a 7.5° step angle of rotation. Number of steps through which it rotates and a speed at which it rotates is determined by the applied impulses. Properly used this provides an ideal method of speed and position control. Brand new and unused price £5, ref 5P81.

**BIG GLASS FIBRE SHEETS** Virtually unbreakable, size 4" x 3" approx. Flat, approx 1/16" thick. Intended for pcb's but ideal for roof repairs, car part, greenhouse etc. £2 each, Minimum quantity we can dispatch is 10. Carriage cost £1.50 per 10. £8.50 for 15.

**IONISER KIT** Refresh your home, office, shop, work room, etc. with a negative ION generator. Makes you feel better and work harder - a complete mains operated kit, case included. £11.95 plus £2.00 post.

**TELEPHONE BITS** Master socket (has surge arrester - ringing condenser etc) and takes B.T. plug £3.95. Extension socket £2.95. Dual adaptors (2 from one socket) £2.95. Cord terminating with B.T. plug 3 metres £2.95. Kit for converting old entry terminal box to new B.T. master socket, complete with 4 core cable, cable clips and 2 BT extension sockets £11.50. 100 mtrs 4 core telephone cable £8.50.

**MINI MONO AMP** on p.c.b. size 4" x 2" (app.) Fitted volume control and a hole for a tone control should you require it. The amplifier has three transistors and we estimate the output to be 3W rms. More technical data will be included with the amp. Brand new, perfect condition, offered at the very low price of £1.15 each, or 13 for £12.00.



### J & N BULL ELECTRICAL

Dept RE, 250 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QT. MAIL ORDER TERMS: Cash, P.O. or cheque with order. Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted. Brighton 0273 734648. Bulk orders: write for quote.

### £2 POUNDERS\*

- 2P2 - Wall mounting thermostat, high precision with mercury switch and thermometer
- 2P3 - Variable and reversible 8-12v psu for model control
- 2P4 - 24 volt psu with separate channels for stereo made for Mullard UNILEX
- 2P6 - 100W mains to 115V auto-transformer with voltage tapings
- 2P8 - Mains motor with gear box and variable speed selector. Series wound so suitable for further speed control
- 2P9 - Time and set switch. Bored, glass fronted and with knobs. Controls up to 15 amps. Ideal to program electric heaters
- 2P10 - 12 volt 5 amp mains transformer
- 2P12 - Disk or Tape precision motor - has balanced rotor and is reversible 230v mains operated 1500 rpm
- 2P14 - Mug Stop kit - when thrown emits parking squeawk
- 2P15 - Interrupted beam kit for burglar alarms, cars, etc
- 2P17 - 2 rev per minute mains driven motor, ideal to operate mirror ball
- 2P18 - Liquid/gas shut off valve mains solenoid operated
- 2P19 - Discs switch-motor drives 8 or more 10 amp change over micro switches supplied ready for mains operation
- 2P20 - 20 metres extension lead, 2 c/o's - ideal most Black and Decker garden tools etc
- 2P21 - 10 watt amplifier, Mullard module reference 1173
- 2P22 - Motor driven switch 20 secs on or off after push
- 2P26 - Counter resettable mains operated 3 digit
- 2P27 - Goodmans Speaker 6 inch round Bohm 12 watt
- 2P28 - Drill Pump - always useful couples to any make portable drill
- 2P31 - 4 metres 96 way interconnectivity wire easy to strip
- 2P32 - Hot Wire amp motor - 4 1/2 round surface mounting 0-10A - old but working and definitely a bit of history
- 2P34 - Solenoid Air Valve mains operated
- 2P38 - 200 R.P.M. Geared Mains Motor 1" stack quite powerful, definitely large enough to drive a rotating aerial or a tumbler for polishing stones etc
- 2P43 - Small type blower or extractor fan, motor inset so very compact, 230V
- 2P46 - Our famous drill control kit complete and with prepared case
- 2P49 - Fire Alarm break glass switch in heavy cast case
- 2P51 - Stereo amplifier, 5w per channel
- 2P55 - Mains motor, extra powerful has 1 1/2" stack and good length of spindle
- 2P62 - 1 pair Goodmans 15 ohm speakers for Unilex
- 2P64 - 1 five bladed fan 6 1/2" with mains motor
- 2P66 - 1 2Kw tangential heater 115v easily convertible for 230V
- 2P67 - 1 12v-0-12v 2 amp mains transformer
- 2P68 - 1 15v-0-15v 2 amp mains transformer
- 2P69 - 1 250v-0-250v 60 mA & 86.3v 5A mains transformer + 50p post
- 2P70 - E.M.I. tape motor two speed and reversible
- 2P72 - 1 115v Muffin fan 4" x 4" approx (s h)
- 2P75 - 1 2 hour timer, plugs into 13A socket
- 2P82 - 3v-0-3v 2 amp mains transformer
- 2P84 - Modern board with press keys for telephone redialler
- 2P85 - 20v-0-20v 1/4 A Mains transformer
- 2P88 - Sangamo 24 hr time switch 20 amp (s h)
- 2P89 - 120 min time switch with knob
- 2P90 - 90 min. time switch with edgewise engraved controller
- 2P94 - Telephone handset for EE home telephone circuit
- 2P95 - 13A socket on satin chrome plate
- 2P97 - mains transformer 24V 2A upright mounting
- 2P98 - 20m 4 core telephone cable, white outer
- 2P99 - 500 hardened pin type staples for telephone cable
- 2P101 - 15V mains transformer 4A upright mounting
- 2P105 - capillary type thermostat for air temperature with c/o switch
- 2P108 - mains motor with gear box 110rpm
- 2P109 - 5" wide black adhesive PVC tape 33m, add £1 post if not collecting

### OVER 400 GIFTS YOU CAN CHOOSE FROM

There is a total of over 400 packs in our Baker's dozen range and you become entitled to a free gift with each dozen pounds you spend on these packs. A classified list of these packs and our latest "News Letter" will be enclosed with your goods, and you will automatically receive our next news letters.



### £5 POUNDERS\*

- 5P1 - 12 volt submersible pump complete with a tap and switch, an ideal caravan unit
- 5P2 - Sound to light kit complete in case suitable for up to 750 watts
- 5P3 - Silent sentinel ultra sonic transmitter and receive kit, complete
- 5P6 - 12V alarm bell with heavy 6" gong, suitable for outside if protected from direct rainfall. Ex GPO but in perfect order
- 5P12 - Equipment cooling fan - mini small type mains operated
- 5P13 - Ping pong ball blower - or for any job that requires a powerful stream of air - ex computer. Collect or add £2 post
- 5P15 - Unselector 4 pole, 25 very 50 volt coil
- 5P18 - motor driven water pump as fitted to many washing machines
- 5P20 - 2 kits, matchbox size, surveillance transmitter and FM receiver
- 5P23 - miniature (appr 2 1/2") tangential blow heater, 1-2kw
- 5P24 - 1/2 hp motor, ex computer, 230V, mains operation 1450rpm. If not collect add £3 post
- 5P25 - special effects lighting switch. Up to 6 channels of lamps can be on or off for varying time periods
- 5P27 - cartridge player 12V, has high quality stereo amplifier
- 5P28 - gear pump, mains motor driven with inlet and outlet pipe connectors
- 5P32 - large mains operated push or pull solenoid. Heavy so add £1.50 post
- 5P34 - 24V 5A toroidal mains transformer
- 5P35 - modern board from telephone auto dialler, complete with keypad and all ICs
- 5P37 - 74 hour time switch, 2 on/off's and clockwork reserve, ex Elec Board loading up to 50A. Add £1 post
- 5P41 - 5" extractor fan, very quiet runner (s h), grid 12 mths
- 5P46 - telephone extension bell in black case, ex GPO
- 5P51 - 200W auto transformer 230V to 115V toroidal
- 5P52 - mains transformer 20V 10A upright mounting, add £2 post
- 5P54 - mains motor with gear box, final speed 5rpm
- 5P58 - Amstrad stereo tuner FM and LM and S AM
- 5P60 - DC Muffin type fan 18 to 27v, only 3W
- 5P61 - drill pump mounted on frame, coupled to mains motor
- 5P62 - 2 1/2 kw tangential blow heater, add £1.50 post if not collecting
- 5P73C - high pressure mains operated gas or water valve with tube connection suitable soldering
- 5P74 - 6rpm 80W mains motor and gearbox with instant stop
- 5P79 - 30rpm 80 watt mains driven motor with gearbox
- 5P82 - 1 25rpm mains 80w motor with gearbox
- 5P84 - 1 delay time switch, adjust 0-20 seconds
- 7P1 - 1 instant heat solder gun - mains with renewable tip and job light
- 10P10 - 1 9" extractor fan 115V so supplied with adaptor

**LIGHT CHASER KIT** motor driven switch bank with connection diagram, used in connection with 4 sets of xmas lights makes a very eye catching display for home, shop or disco, only £5 ref 5P56.

## 934 MHz PERSONAL RADIO

### CYBERNET DELTA 1

This set is now used by over 75% of 934 MHz operators!



- Features
- Sensitive Receiver Front End
  - 16 Channels Memory
  - Auto or Manual Scan

**£365** + £5 DELIVERY  
H.P. AVAILABLE SUBJECT TO STATUS  
 £36 DEPOSIT A.P.R. 36%

### PA15 BASE ANTENNA

At just over 2 metres in length, this antenna has approximately 12 dBi Gain

**£79**

### MASTHEAD POWER & PRE-AMP

#### MODEL HL910R

Now you can have the full legal 8 watts at the masthead where you need it with this new unit. Combined with an ultra low noise Pre-amp we guarantee a startling improvement in performance.

Both Power Amp and Pre-amp are independently switchable.



**£199**

## SCANNING RECEIVERS

### C.T.E. DISCONE

#### Wideband Antenna

RECEIVE  
 TRANSMIT  
 MAX POWER  
 GAIN

70-700MHz  
 70-500 MHz  
 500W  
 3.5dB

**£26**

#### ALSO AVAILABLE

WIDEBAND DISCONE  
 RECEIVING ANTENNA  
 (3 Element) 70-500 MHz

£24.95



### UNIDEN Bearcat MODEL 100XL HAND HELD SCANNING RX

A super sensitive low cost hand held scanning receiver which covers public service, aircraft, marine, and amateur services.

- 16 Channels Memory Scan
- Priority Keyboard Lock
- Lighted Display
- 66 - 88 Mhz
- 118 - 174 Mhz
- 405 - 512 Mhz

**£229**



### UNIDEN Bearcat MODEL 175XL BASE SCANNING RX

With the same specifications as the popular handheld model, this set is designed for use at home and covers

- 66 - 88 Mhz, 118 - 174 Mhz,
- 405 - 512 Mhz

**£209**



SEND IN FOR OUR  
 NEW 1987  
**BUMPER CATALOGUE**  
 Packed full of CB, 934 Mhz  
 and Amateur Radio Equipment.  
**ONLY £2**  
 Includes a £2 Voucher

## NEVADA PRODUCTS

HIGH QUALITY BRITISH MADE  
 At last components that enable the construction of high powered A.T.U.'s at a price you can afford.

### HIGH POWER VARIABLES



MODEL TC500  
 26 - 500pF

**£28** (£2 p+p)

Both capacitors are suitable for ATU's or amplifiers up to 3KW.

MODEL TC250 **£19.95**  
 13 - 250 pF (£1 p+p)

### HIGH POWER "ROLLER COASTER" VARIABLE INDUCTOR MODEL TC21

An advanced design ensures super smooth action without arcing or contact bounce. Suitable for 1KW ATU.

**£24**

Frequency: 1-8 - 30 Mhz (£1 p+p)  
 Inductance: 30µH max  
 Size: 5 1/2 x 10 1/2 x 14 1/2 cm

### TURNS COUNTER MODEL TC4

Suitable for the above roller coaster. Counts 0 to 48 turns. May be used on other roller coasters, etc if required.

**£12.95**

## TEST EQUIPMENT

### ZETAGI DL150

#### RF DUMMY LOAD AND POWER METER

A very accurate unit for the service dept. or discerning enthusiast  
 FREQ: 0.5MHz-500MHz  
 POWER: 150 Watt Max in 3 ranges 0-3, 0-15, 0-150W

**£85.19**



### FD 1350 13MHz FREQUENCY COUNTER

FREQ: 10Hz-135MHz  
 SENSITIVITY: 43mV at 1GHz  
 DISPLAY: 8 Digit  
 SUPPLY: 9-12 Volt DC

**£139.53**



### 24 TO 12 VOLT DROPPER

Enables 12 Volt equipment up to 12 Amp max current to be run from a 24 Volt battery or DC supply.

**£19.79**



## 2 METRE EQUIPMENT

### CT 1600



### Super Sensitive 2 Metre Handheld (Similar to IC2E)

Manufactured for C.T.E. International one of Europe's largest distributors this handheld is fast gaining recognition in the UK at nearly £50 cheaper than its counterpart - its easy to understand why

- FREQUENCY
- REPEATER SHIFT
- BLOW PWR

**£169**

EXPIRES 31/10/87. Includes 2W rechargeable battery pack and hearing aid

### VHF MOBILE AMPLIFIER C.T.E. MODEL B110

A new high class mobile power amplifier and Gas/Fet pre-amplifier at a price you can afford.

**£169**  
 + £3.50 p+p



## MOBILE RF AMPLIFIERS



### C.T.E. MOD 757

FREQ: 3-30MHz  
 RF OUTPUT: 300W P.E.P.  
 100W Class AB  
 150W Class C  
 Remote Control Facility

**£116**

### ZETAGI MOD B300P

FREQ: 3-30MHz  
 RF OUTPUT: 300W P.E.P.  
 150W FM

RF INPUT: 5 to 10W

**£136**



### C.T.E. MOD 767

FREQ: 26-30MHz  
 RF OUTPUT: 76W FM  
 150W P.E.P.  
 RF INPUT: 5 to 10W  
 Remote Control Facility

**£49.90**

CTE MOD 737 50W FM/80W P.E.P. .... **£44.76**

## NEVADA PRODUCTS

HIGH QUALITY BRITISH MADE  
 29MHz FM PRODUCTS

### NEVADA TC35 DX

R.F. POWER AMP  
 WITH HARMONIC  
 FILTER

INPUT: 1-4 Watts  
 OUTPUT: 25 - 30 Watts  
 SUPPLY: 13.8V DC  
 FREQ: 26-30 MHz

Can be centred on 29.6 MHz or 28.5 MHz (state which) A new top quality amp which now features harmonic filter to reduce harmonic O/P



**£23.75**

### NEVADA TC27 RX

#### RECEIVER PRE-AMP FOR 26-30MHz

A superior low noise pre-amplifier for 29MHz FM operation  
 Variable gain - 6dB s to -18dB s suitable for use with transceivers up to 25 Watts output



**£22.34**

# TELECOMMS

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 HANTS, PO2 9AE,  
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