

## GEC MODEM

GEC Telecommunications has announced the release of the latest modem in its range of high performance professional data communications equipment.

Modem 9629 is designed to operate at up to 9600bit/s full duplex on 4-wire private circuits. Speeds of 7200 and 4800bit/s are also selectable from the front panel or via the modem's V24 serial data interface.

Modem 9629's advanced digital signal processing receiver includes adaptive

equalisation to dynamically match the modem to the line characteristics and provide the best possible performance on line.

Full V54 test facilities are provided to enable the complete data link to be tested and a comprehensive range of front panel indicators allow the modem and line conditions to be monitored at a glance.

GEC Telecommunications,  
PO Box 53,  
Coventry CV3 1HJ.  
Tel: (0203) 446331.

## MATHCAD OFFER

MathCAD, a new software package which understands mathematics, was introduced some months ago by MathSoft International.

Now mathematicians, engineers and scientists can try MathCAD for themselves, thanks to the introduction of a free 'mini MathCAD' system.

The mini MathCAD system is functionally the same as the full MathCAD system with restrictions only being placed on printing, storing and the size of documents. Like the full MathCAD system, mini MathCAD understands mathematics. The user can enter equations and see them displayed with all of the special symbols and notations as if written on a notepad. Solutions are calculated automatically and the results may be displayed in tables or graphs.

The 'mini MathCAD' system comprises a demonstration program to run through some of the MathCAD features, a tutorial to teach the basics and the MathCAD system. More than 50 built in functions are available, from simple arithmetic to fourier transforms and calculus.

MathCAD requires an IBM PC or compatible (512K RAM with CGA, EGA, Hercules or equivalent graphics). The full MathCAD system is available by mail order and costs £245 + VAT.

MathSoft International Ltd,  
Freepost,  
Tamworth,  
Staffs B79 7BR.  
Tel: (0827) 86239.

## PCB PROGRAM

CADsoft have introduced a new printed circuit board design program for the Amstrad range of computers.

The program will operate on all Amstrad CPC computers without the need for expansion RAM. Draft or final quality printouts can be produced at 2:1 scale, using the Amstrad DMP2000 or any Epson compatible dot matrix printer.

Single and double-sided boards up to 25 x 25 inches finished size can easily be accommodated, with up to 4000 structures (pads or tracks) on each board. Four track widths and four pad sizes are available and can be freely mixed.

The program costs £19.99 on tape and £21.99 on disc.

CADsoft,  
18 Ley Crescent,  
Astley,  
Tyldesley,  
Manchester M29 7BD.

## FUN AND GAMES

For the first time users of C compilers will be able to write their own games programs. Zorland, producers of Europe's best-selling C compiler, have launched a high quality, low priced Games Toolkit for £29.95.

It includes three ready to play games (Chess, Backgammon and the strategy game, Wari) and the full source code. There is also a 150-page manual, which explains how to write your own games of skill and strategy.

Zorland has also brought out a Graphics Toolkit, similarly priced.

The Graphics Toolbox includes a large collection of functions for drawing boxes, circles, ellipses, lines, graphic fonts, fills and patterns.

Zorland Ltd,  
65-66 Woodrow,  
London SE18 5DH.  
Tel: 01-854 1194.

## LASER PRINTER

Rapid Systems have just introduced PrintServer 40, a new breed of laser printer from Digital which utilises Ethernet to stretch the limits of laser printing.

The PrintServer 40 prints at 40 pages per minute and is ideal for use as a shared central printer in a large office environment. It offers a complete printing solution for VAX and MicroVAX users who typically print 30,000 to 100,000 pages per month and require high quality output and flexible graphics capabilities.

The PrintServer 40 utilises a MicroVax II subsystem as its data processor to achieve high performance. It contains the processors, memory and interfaces required to process images, graphics and text into a bit-map, and then into an output video signal using graphics accelerator

hardware. The controller also contains two 1.25 Megabyte full page bit-map memories which enable the PrintServer 40 to compose an entire page at once in full 300 by 300 dpi resolution.

PrintServer 40 employs the PostScript page description language, giving users complete flexibility in describing the appearance of a printed page. In addition, since PostScript is essentially device independent, it allows files created on the PrintServer 40 to be printed on high quality typesetting systems.

The PrintServer 40 is compatible with all DEC software and ReGIS based graphics applications. It is supplied complete with software and a VT220 which acts as a console device.

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

## DATACHAT MODEM

GEC's range of V23 modems has now been extended. A full facility auto-calling version, the Datachat 1223B, has been added, which has the high reliability and overall performance characteristic of the Datachat series.

The Datachat 1223B is a 1200/75 bit/s (CCITT V23) modem designed to operate on the public switched telephone network (PSTN) or a 2-wire private circuit (PC). In common with other modems in the range, the 1223B can be configured to transmit or receive at 1200 bit/s with a 75 bit/s backward channel and can operate at 1200/1200 bit/s in half duplex mode.

Datachat 1223B has an intelligent CCITT V25 bis auto-caller with battery-backed number store, auto-answering to CCITT V25 standards and an optional buffered 1200/1200 bit/s data interface for terminals unable to operate at split speeds. When operated from a 'dumb' terminal, the Datachat 1223B can be configured to return plain English messages instead of the V25 bis indications, allowing the user to monitor the progress of

automatically dialled calls.

Datachat 1223B is well suited to low cost data retrieval systems. Viewdata applications, electronic mail access, automatic remote alarm systems and other applications requiring V23 standards over dial-up or 2-wire leased lines. It is compatible with the other modems in the Datachat range, the line-powered manual dial, manual answer Datachat 1223 and the line-powered auto-answer version, Datachat 1223A. All Datachat modems are approved by the British Approvals Board for Telecommunications.

*GEC Telecommunications,  
PO Box 53,  
Coventry CV3 1HJ.  
Tel: (0203) 446331.*

## SPECIAL SERVICE

Leeway now offer a complete service for all those difficult to obtain spare parts, with a new 'Task-Force' world-wide procurement service.

Leeway claim to be able to obtain virtually any spare part for any piece of computer equipment, including out of production models, ensuring that equipment does not become redundant due to lack of spares. With a network of contacts and specialist companies throughout the world's manufacturing centres, Leeway can locate replacement parts for disc and tape drives, printers, plotters and other computer products.

Leeway can give a same-day service for the majority of its customers' requirements. The range of products now available includes replacement magnetic tape, floppy and hard disc recording heads, absolute and pre-filters, magnetic media, tape heads, stepper motors, fans and magnetic sensors. There is also a head refurbishment service.

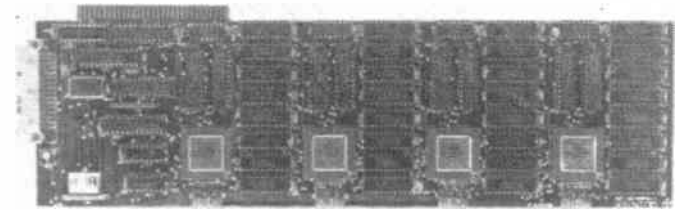
*Leeway Data Products,  
Headway House,  
Christy Estate,  
Ivy Road,  
Aldershot,  
Hants GU12 4TX.  
Tel: (0252) 333575.*

## IBM BOOSTER

Quintek Ltd has designed and produced a one-board transputer workstation suitable for stand alone applications or as a component in larger transputer networks which, for example, will increase the speed of the IBM PC from less than 1 MIPS to 40 MIPS at a cost-effective price.

Fast 4 is the first of a family of products to be launched by Quintek, all using the power of the Inmos transputer for applications covering scientific and mathematical modelling, high speed multiprocessor systems, digital signal processing, image processing, workstation clusters and similar leading edge technologies.

Using one expansion slot on an IBM PC or compatible system, Fast4 adheres to all applicable INMOS standards, will run all INMOS software without modification and will support both the 32-bit T414 INMOS transputer and the new T800-20 floating-point transputers which provide a



total processing power of 40 MIPS or 6 MFlop/sec.

It has four transputers, each supplied with one megabyte of RAM, the first being capable of driving its own separate subsystem or switched to control the remaining three transputers on the board. This technique enables software such as the TDS (INMOS Transputer Development System) to be run on one transputer while controlling the other three as a subordinate network, loading their code and supervising error recovery. Fast4 will also support Fortran, Pascal and C, allowing programs to be compiled as independent processes and then loaded onto the network using a supplied harness.

Fast4 boards have been designed to be linked together, if required, to create larger networks and can therefore run any program written for general purpose transputer arrays, suitably configured for the chosen network. Links between processors are easy to use, with two from each transputer accessible from the rear connector and the remainder pre-wired into a square. This method opens up a whole range of network topologies, including rings, grids and hypercubes.

*Quintek Ltd,  
Southfield House,  
2 Southfield Road,  
Westbury-on-Trym,  
Bristol BS9 3BH.*

## SERVICING KIT

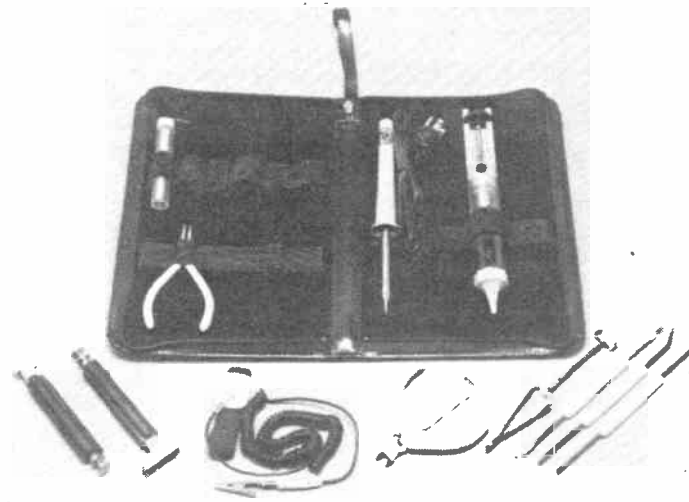
Global Specialties has introduced a new electronic service kit, the CSK-16, which contains a variety of aids for the servicing of integrated circuit based electronic equipment.

Tools included in the CSK-16 kit include IC insertion and extraction tools, soldering and desoldering tools, static-protection aids, nippers and shears for trimming component leads and a number of

aids to soldering such as knife/brush, scraper/hook and fork/spike combinations.

The CSK-16 is supplied in a zipped vinyl case measuring 11½ x 7½ x 1½ inches and costs £49.50.

*Global Specialties,  
Shire Hill Industrial  
Estate,  
Saffron Walden,  
Essex  
CB11 3AQ.  
Tel: (0799) 21682.*



## SWITCHED MODE PSU

The latest SGS GS-R family of switched mode power supply modules now available from VSI Electronics is designed to meet both development and production requirements.

The modules are engineered to simplify the design of all levels of electronic equipment, from laboratory bench to OEM production. Requiring only a minimum of external components, the modules employ switched mode technology to provide high input/output isolation and single or multiple outputs.

Typical of the family, the GS-R 400 series offers a choice of single outputs of 5.1, 12, 15 and 24 volts at 4 amps. Both analogue and digital circuits can be powered by the GS-R 51212, which provides 5 volts at 3.5 amps and two independent 12 volt 150mA outputs.

*VSI Electronics Ltd,  
Roydonbury Industrial Park,  
Harlow,  
Essex CM19 5BY.  
Tel: (0279) 29666.*



NOVEMBER 1987 £1.40

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# Radio & Electronics

The communications and electronics magazine

# World

**POWER SUPPLIES:  
WHY WORRY  
ABOUT THEM?**

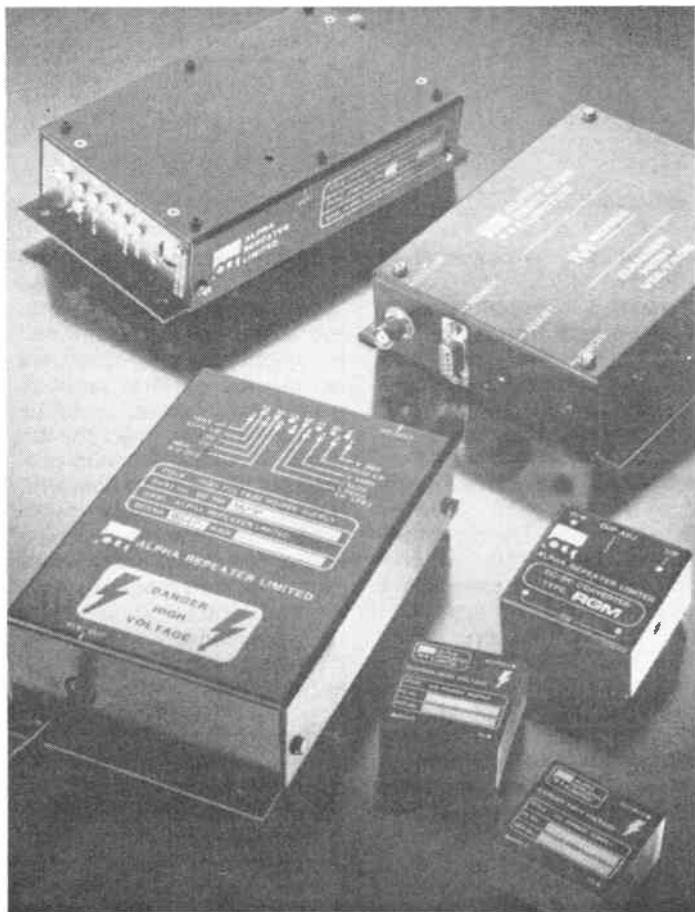
**THE SIXTIES:  
TWO RECEIVER  
DESIGNS UPDATED**

**UP IN SPACE:  
DATA RELAY  
SATELLITES**

**LOOPSTICKS:  
FERRITE RODS  
EXPLAINED**



**AUDIO SIGNAL  
GENERATOR**



## MORE POWER

Rendar now stocks a range of low cost high performance power supply units manufactured by Alpha-Repeater Limited.

High efficiency PCB-mounting converters offer low rip-

ple outputs and full encapsulation for safety and reliability. The compact modules have intermittent short circuit protection and RFI screening. A mains PSU features full regulation, low ripple output and remote or on-

board output control. Flashover and short-circuit protection are provided on a dc-powered unit which also has voltage and current monitor outputs, an HV-off connection and a reference voltage output.

Areas of use include general purpose high-voltage dc-dc conversion, photomultiplier, photodiode, CRT and plasma-display driving applications. Low cost laboratory and bench power supplies are easily configured using the M and DCPM series modules.

Stock items in the new range are miniature high voltage dc-dc converters (GM series), regulated dc-dc converters (RGM series), a mains powered photomultiplier power supply (M series) and a versatile high performance dc-powered module (DCPM series).

Dc-dc converters feature 1.5 and 3kV positive or negative output versions. The 15kV/0.7mA dc-powered module has a 10.24V reference output and operates from a 24V dc supply. Mains powered, the fully regulated photomultiplier power supply has a low ripple 3kV output.

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

## ROLL KIT

Cooper Tools has introduced a versatile twenty-three piece set of quality hand tools, conveniently contained in a durable roll-up plastic coated canvas case. The kit provides a variety of quick change tool combinations to assist the service engineer.

Included in the roll kit are 1 pair of 152mm long nose cushion grip pliers, 1 pair of 127mm diagonal cut cushion grip pliers, 1 x 152mm thin pattern cushion grip adjustable wrench, 1 regular and 1 stubby handle, ranges of regular and stubby nutdrivers, ranges of Philips and slotted screwdrivers, 1 reamer and 1 extension.

*Cooper Tools Ltd,*

*Sedling Road,  
Wear,  
Washington,  
Tyne and Wear NE38 9BZ.  
Tel: (091) 416 6062.*

## POCKET-SIZED TV

In August Ferguson launched a new pocket-sized LCD colour television, the Ferguson PTV01.

The Ferguson PTV01, priced at around £250, is aimed at an upmarket audience with a high disposable income and its launch is timed to benefit from the Christmas gift market. In addition to its use as a watch-anywhere television, it can also be used as a colour monitor for Ferguson Videostar camera cassette recorders with playback capability.

The comprehensive range of accessories comprise a rechargeable battery pack, TA181 (approximately £19.99), a car adaptor, TA183 (approximately £15.99), an external aerial adaptor, TA180 (approximately £4.99) and an adaptor/charger, TA182 (approximately £15.99).

The PTV01 is compact (85mm x 145mm x 35.3mm) and lightweight (330g), with a 6.6cm (2.6in) diagonal screen which uses the new TN liquid crystal.

There is automatic channel selection by press button electronic sweep tuning; on-screen indication of channel tuning; press button adjustment of volume, with earphone socket for private listening (earphone supplied); built-in telescopic rod

aerial with socket for connecting external aerials in difficult reception situations; a socket for connecting a mains adaptor or 12 volt battery adaptor (optional accessories); a socket for audio-visual input from Ferguson Videostar camera cassette recorders.

*Ferguson,  
Cambridge House,  
Great Cambridge Road,  
Enfield,  
Middlesex EN1 1UL.  
Tel: 01-363 5353.*

## DESIGNER TVs?

Ferguson has also launched a new premium range of FST colour televisions, called Interiors.

The Ferguson Interiors range incorporates really modern television design. A pair of slimline convex two-way speakers provides an attractive symmetrical balance and enhanced 'super-sound' with bass band audio input.

A 55 function remote control handset includes audio tone controls. The on/off switch is set beneath the right-hand speaker grill and LED displays, including audio and spot-on tuning, are located in the panel which runs beneath the screen. Occasional controls are positioned above the screen on the top right-hand side beneath a neatly concealed panel which continues the line of the fascia detail.

There is automatic switch off, 33 channel frequency synthesis tuning, headphone sockets and Peritel sockets on the two larger screen sizes, 59cm and 66cm.

These models are finished in black ash effect with matching gloss black fascia and each is supplied with its own stand with video shelf.

The first Interiors range, 51H4, 59H4 and 66H4 will be priced at around £479.99, £619.99 and £649.99 respectively.

*Ferguson,  
Cambridge House,  
Great Cambridge Road,  
Enfield,  
Middlesex  
EN1 1UL.  
Tel: 01-363 5353.*



# For Tomorrow's Radio Technology TODAY

## BASE STATIONS

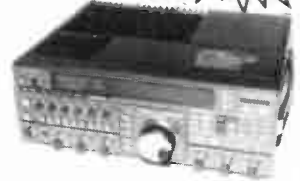


ICOM IC735

### IMPROVED YAESU FT767 RWC/MK2 HF-UHF BASE STATION

We are pleased to announce that our improved HF-UHF base station (see review) leading to better dynamic range in the 160-30MHz range can be further improved in a number of ways! This new feature is only available from February onwards! GET it at the best price possible by ordering it early! Existing stock is £599.00 - return postage FREE. COMPLETE TOP CLASS BASE STATION (EX. HF+UHF) £1499.00  
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FT767GX MK2/RWC



NEW

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## SCANNERS

### YAESU FRG9600/RWC



FRG 9600

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 REGENCY MX7000. SAME COVERAGE SAME MAKE AS AOR2002 £399.00  
 FDK AIR BAND HANDHELD THUMBWHEEL MINI C/W NCDS PSU £139.00  
 FDK AS ABOVE COVERAGE 140-173.00MHZ FM BANDS £139.00  
 MANY MORE MAKES AND MODELS IN STOCK PLEASE CALL FOR DETAILS  
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 YAESU FRG8000 FRV8800 AS ABOVE WITH VHF CONVERTER £669.00  
 ICOM ICR71 100KHZ 30MHZ A TOP CLASS RECEIVER £738.00

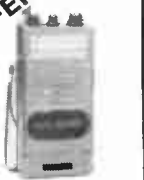
## NEW PRODUCTS

### INTERNATIONAL MODEL 877R AIR-BAND RECEIVERS

This new tuneable receiver covers 52-174 Mhz as well as CB in three bands and is a cost-effective alternative to handheld scanners. The receiver is fitted with a Helical antenna and has good performance for a radio with this coverage. It is ideal for monitoring Air Band, the two metre and PMR/Marine bands as well as Band 2 FM Broadcast. A squelch control is also provided. Two versions are currently available.

Model 877R for use with Dry Cells £39.50  
 Model 877R c/w nicads and charger £49.50

DEALERS CALL FOR TRADE PRICES P&P £2.50



INTRODUCTORY OFFER

NEW

## RAYCOM PRODUCTS

### NEW ICOM TYPE COMPATIBLE NICAD PACKS, EMPTY CELL CASES AND DESK TOP CHARGER

A new range of professional Heavy Duty long life nicad packs imported from the USA, available exclusively at RWC  
**10AH 10V 800 MAH LONG LIFE, ICOM EQUIV BP5/8** £55.00  
**12AH 12V 600 MAH LONG LIFE, ICOM EQUIVALENT BP7** £52.50  
 (Both active units for use in ICOM BC30/60 OR RAYCOM NC580)  
**MT1 EMPTY Cell case for self assembly of up to 10x Nicads for a cost effective replacement for packs with an RPT etc. There is ample room for a DC jack c/w instructions** £8.50  
**AA NICADS** lauded 1.2V 500mA Nicad cells for above £1.60  
**NC580** Dual band charger for all Icom type Nicads above 400mA two charging positions 50mA & 40mA 14hr charge £39.50  
 Trade and Dealer enquiries welcome. Call for more details  
 P&P £2.50 per order



NEW

## ANTENNAS & ACCESSORIES

ICOM AH7000 SUPER DISCONE 25-1300MHZ INC POST £79.00  
 NEW RAYCOM AIR BAND DISCONE 118-170 MHZ 6 ELEMENTS £12.50  
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 Hundreds of other types of base and mobile antennas in stock  
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## MOD KITS

**RWC MOD KITS, ANNOUNCEMENT**  
 We apologize to customers waiting for various mod kits, supplies of crystals and components are inconsistent and demand for kits varies so there is occasionally a delay before we can send your kit of parts, please be patient. Rome was NOT built in a DAY! Kits still available  
 SANYO LC7137 SYNTHESIZER CB 10MTRS. LCL/DNT CB-10MTRS. FT757GX MK1 FAST TUNING MOD, STORNO COM713 PMR-2MTR KIT, PYE A200 E-BAND 50MHZ KIT call for technical details, prices and delivery

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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.

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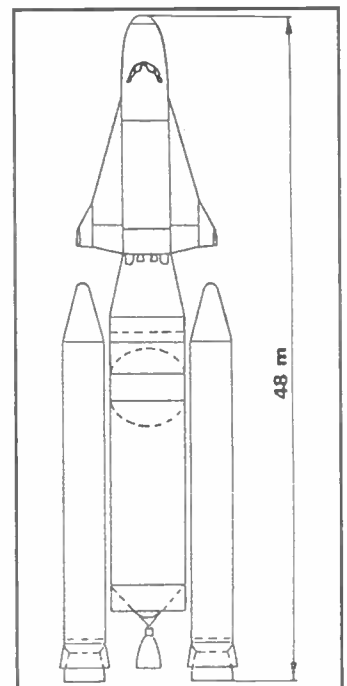
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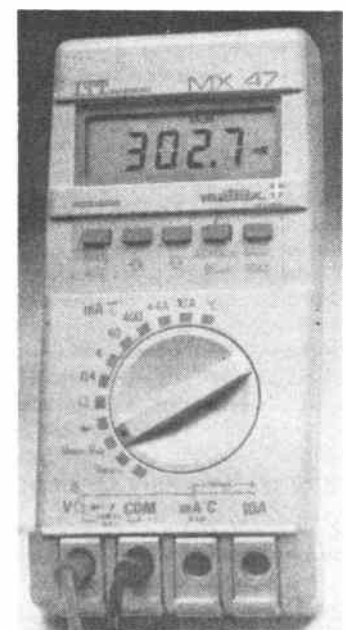
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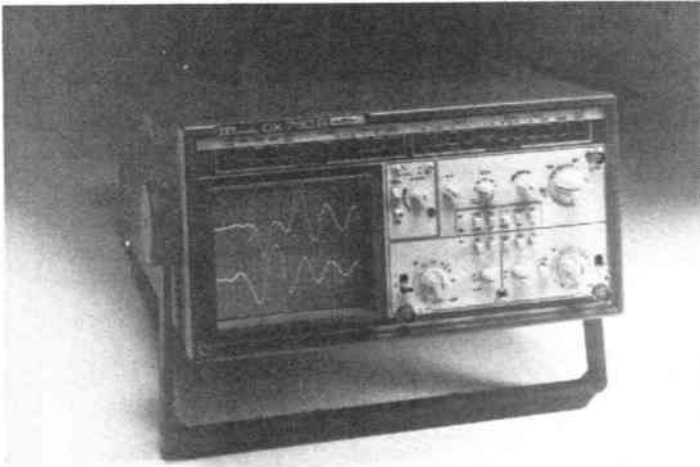
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# PRODUCT NEWS

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



## LOW COST DSO

New from ITT Instruments is the OX750B, a low cost, compact digital storage oscilloscope which offers a digital performance based on two 8-bit 2MHz A/D converters and an analogue performance of a 20MHz dual-trace oscilloscope.

Ideally suited to industrial applications or field service, the OX750B is housed in a rugged case weighing only 10kg and measuring 450 x 310 x 160mm. The instrument is suitable for users with little oscilloscope experience; it

has an ergonomically designed front panel and controls with analogue and digital sections, as well as signal acquisition and analysis functions clearly segregated.

A major feature of the OX750B is its comprehensive range of built-in signal analysis facilities. The memory can hold up to 2048 samples per channel, 2000 of which may be displayed on the screen, while the remaining 48 are used for the reference position. To facilitate analysis, the OX750B incorporates a hori-

zontal digital expansion of up to x32 (in six steps) and an interactive cursor which allows the user to select that part of the stored signal required for analysis. Luminous intensity of the trace is constant and remains independent of the expansion factor.

Also provided are vertical digital trace shift and digital expansion capabilities. The OX750B can capture one or two signals individually or simultaneously across the entire dynamic range of each converter and superimpose them for comparison. In addition, an incoming signal can be compared with a stored reference signal.

The OX750B is an essential working aid in industrial electronics laboratories and is ideal for studying physical phenomena such as shock, vibration, mechanical fractures and deformation, drop-outs and switching spikes.

The OX750B is priced at £1250 plus VAT.

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

suited to industrial field service and military maintenance applications. Prices start from £89.

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

## MORE SCOPE

The new Kenwood CS-2110, available ex-stock from Thurlby Electronics, is a low cost 100MHz oscilloscope with four input channels.

Each channel has its own vertical position control, and accurate timing measurements are assured by guaranteed time difference figures of less than 0.5 nanoseconds (ns) for CH1/CH2 and less than 1ns for channels 1/2 to channels 3/4.

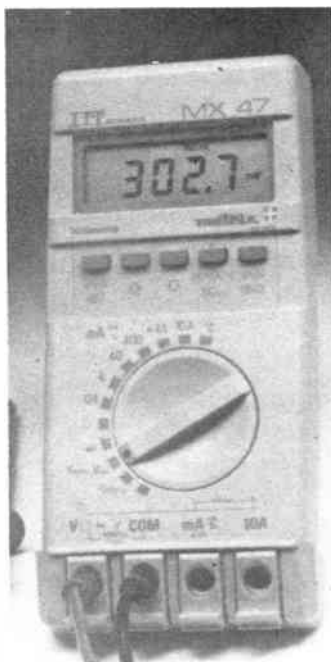
The CS-2110 has a maximum sensitivity of 1mV/div and a maximum sweep speed of 2ns/div. Full dual timebases with separate and comprehensive controls for the B trigger signal are provided. Alternate sweep operation (with optional B ends A) provides a convenient method of viewing both the expanded and non-expanded waveforms simultaneously.

A 20kV acceleration potential is used for the display. This provides a sharp, high intensity trace even in bright lighting conditions and with low duty cycle waveforms. The rear panel sockets include an intensity input (Z modulation), a CH1 output socket for driving a frequency counter, and gate signals for the A and B timebases. A calibration loop is also provided for use with the current probes.

The CS-2110 is lightweight and compact, weighing only 7.4kg and measuring only 284 x 138 x 400mm (11.2 x 5.4 x 15.7in).

It costs £1,395 + VAT.

*Thurlby Electronics Ltd,  
New Road,  
St Ives,  
Huntingdon PE17 4BG.  
Tel: (0480) 63570.*



## HARSH CONDITIONS?

New from ITT Instruments is the MX40 series of professional autoranging multimeters, offering a rugged design to withstand harsh conditions and a range of advanced measuring features.

The five models in the series are designed for heavy duty use. Three models (the MX43, MX45 and MX47) feature sealed waterproof cases and all models are constructed to withstand high levels of shock and vibration.

A major feature is an extended dynamic measuring range of 4000 counts, which allows, for example, direct measurement up to 400V with a resolution of 0.1V. Autoranging or manual ranging modes for Vdc, Vac, and ohms functions are provided. In the

automatic mode the instrument selects the optimum range from 400mV dc or ac upwards, unlike most other hand-held DMMs which only start from a range of several volts. The large liquid crystal display includes annunciators to show the selected operating mode, as well as captions to display the selected range.

All models in the 40 series are designed in accordance with IEC348 Class 2 safety standards and incorporate a high level of protection against accidental overloads. A unique safety feature is SECUR'X, patented by ITT Instruments, which locks the input leads into the terminals, thereby preventing possible accidental disconnection of the multimeter.

The MX40 series is ideally

### FREQUENCY COUNTER

The GFC-8100G is a new microprocessor controlled, high resolution frequency counter. Made in Taiwan by GW Instrumentation, the counter is available from Flight Electronics.

The new counter has two channels in order to cover a wide range of frequencies from dc to 1GHz. Despite this wide coverage, the counter costs 15-20% less than competitive products with smaller ranges. It is accurate to typically <0.01% at 23°C and

sensitive down to pulses of 10mV.

Resolution remains high at both high and low frequencies. At least seven digits are displayed for a one second gate time, and five digits for a 60ms gate time. The gate time is variable from 60ms to 10s or ten periods of input, whichever is the longer.

The counter will be of use to those involved in test and measurement, such as in educational establishments and in design and development for manufacturers. It is

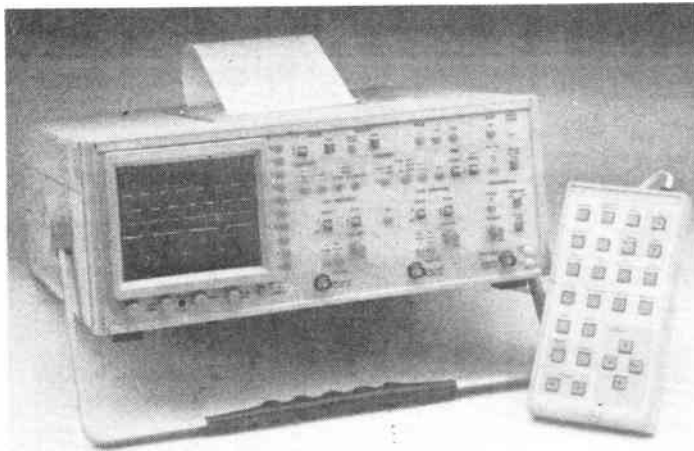


useful for measuring and verifying signal frequencies, for pulse counting and as a tachometer or a timer.

The cost of the instrument is £299, including all the connecting cables, a hand-

book and guarantee.

*Flight Electronics Ltd,  
Flight House,  
Ascupart Street,  
Southampton SO1 1LU.  
Tel: (0703) 227721.*



### TWIN-CHANNEL DSO

Gould has introduced a new twin channel digital storage oscilloscope, the 1602, which is ideally suited for transducer and low frequency electronics measurements.

The new instrument from Gould's 1600 DSO series, which also includes the 4-channel 1604, combines a 20MHz real time bandwidth

with a 20 megasamples-per-second sample rate in single-channel mode and 10 megasamples per second in dual-channel mode.

A prime feature of the 1602 is its large memory capacity, with a 10K word acquisition memory available on each channel. This allows users to capture traces at very high resolution, in conjunction

with pre-trigger and trigger delay.

The 1602 incorporates automatic cursor-based measurement facilities, with on-screen alphanumeric providing direct readout of measured values. With the addition of a hand-held waveform processor keypad, the instrument is transformed into a powerful automatic measurement and analysis tool.

Other features include an integral digital colour plotter for hard copy output of screen data, and a plug-in battery backed non-volatile memory module allowing the storage of reference traces for comparison and analysis purposes.

The 1602 is a portable, lightweight unit, measuring only 425 x 401 x 155mm and weighing 8kg.

*Gould Electronics Ltd,  
Instrument Systems,  
Roebuck Road,  
Hainault, Ilford,  
Essex IG6 3UE.*

storage technology. These fully programmable instruments will enable wideband waveform capture and storage using a standard oscilloscope. They feature storage of repetitive waveforms up to 40MHz, a large acquisition memory of 4,000 words per channel and on-screen cursors and annotation.

Also highlighted on the stand will be a wide range of Kenwood products including test and measuring instruments, power supplies and compact disc and digital audio tape (DAT) test equipment. A feature of this range is the PD series of regulated dc power supplies which are offered with output voltages up to 110V and current outputs up to 30A.

The company's exhibit will be completed by a comprehensive range of oscilloscopes as well as the well-established Thurlby ranges of logic analysers, multimeters, multiplexers and power supplies.

*Thurlby Electronics Ltd,  
New Road,  
St Ives,  
Huntingdon,  
Cambs EE17 4BG.  
Tel: (0480) 63570.*

### COUNTER/TIMERS

STC Instrument Services has introduced the Thandar TF1000 and TF1100 universal counter/timers.

The TF1000 is designed to provide frequency, period, period average, time interval, time interval average and frequency ratio measurements.

Inputs A and B both have a dc to 100MHz bandwidth; ac or dc coupling; slope selection; a 1/x10 attenuator and trigger level controls with 3-state trigger indicators. In addition, channel A also features an HF filter.

For time interval measurements, a trigger hold-off control is provided whilst a display timer control permits display times of between 100ms to infinity (hold facility). An 8-digit red LED display features additional annunciators for external standard, gate, overflow MHz/ $\mu$ s, kHz/ms and seconds.

An internal/external clock switch and socket, low frequency monitors for probe calibration via A and B, plus two-channel dc trigger level outputs are mounted on the rear panel. The TF1100 features, in addition, an extra

input (C) to allow frequency measurements up to 1GHz.

*STC Instrument Services,  
Dewar House,  
Central Road,  
Harlow,  
Essex CM20 2TA.  
Tel: (0279) 29522.*

### DIGITAL STORAGE

At Testmex, to be held from 20th-22nd October at the Business Design Centre in Islington, London, Thurlby Electronics will be featuring what they describe as a major new development in digital

Don't miss all the latest information on new products each month in these columns – take out a subscription using the form on page 15.











## BUDGET TOROIDS



New production methods and materials have enabled Cotswold Electronics to supply their budget range of toroidal transformers with an alternative double insulation which meets BS5850 requirements and BS415 Class 2 for insulation. When a thermal cut out is fitted the transformers in the budget range meet all the other aspects of BS415.

Those already using the D1000 to D1067 transformers will find that the D2000 series are exact equivalents with the exception of the double insulation capability, which is now available at no extra cost. The VA ratings remain the same at 30, 60, 100, 160, 230, 330 and 530VA. The standard stock primary voltage is 120 + 120V but single primary 240V and 110V and 220V are also available. The working frequency is 50 to 60Hz and the operating range is 47 to 400Hz. An interwinding metal screen can be supplied where the transformer is intended to provide protection against the primary voltage being applied to the secondary in the case of an insulation fault.

The secondary windings are generally dual voltage types ranging from 6 + 6V to 50 + 50V with 9, 12, 15, 18, 22, 25, 30, 35, 40, 45V in between. Toroids with single secondaries of 110, 220 and 240V are also available. The double insulated budget range are terminated in PVC insulated leads 150mm long (special terminations can be supplied on request, subject to extra charges).

## COAXIAL SWITCHES

A new range of 5-way coaxial switches is now available in the UK. Hofi professional switches are engineered to the highest electrical and mechanical standards. Manually operated or remotely controlled switches are available with either SO239 or 'N' type sockets fitted.

Hofi switches offer a new standard of guaranteed performance to the professional and amateur user. Every unit is supplied with an individual certificate of performance, giving factory guaranteed figures for insertion loss and isolation.

High operational reliability is guaranteed by the use of a unique double contact system giving high power transfer and excellent performance to UHF frequencies. Rugged construction and the use of corrosion resistant materials ensure long life for Hofi switches.

The remotely controlled system is available with

weather protecting cover for the switch unit, easy to operate control box and, as an option, a remotely controlled switch box to enable a rotator to be controlled via the same 8-way control cable, thus effecting considerable savings in the use of multi-way cable.

Technical specification includes power handling up

to 3kW, insertion loss at a low 0.04dB and an SWR better than 1.06 at 50 ohms. Hofi switches are available from £54.00.

*Winchester Communications,  
Trinder House,  
Free Street,  
Bishops Waltham,  
Hants SO3 1EE.  
Tel: (04893) 3404.*

## TRANSFORMERS

Avel toroidal transformers can be supplied to comply with the British Standards for measuring equipment (BS4743 and BS348). The specifications require that the construction of the transformers provides reasonable protection to the user from accidental electric shock, which would necessitate the use of double insulation and a copper screen.

The toroids can be supplied with dual 50/60Hz primary windings for operation from either 240V or 120V ac mains. The Avel toroids can be supplied with twin centre-tapped or single wound secondary windings if required. The equipment designer can select from a menu of options including: variable height to diameter geometry; extra low radiated and audible noise characteristics; integral overload protection; metal cans, mu-metal cans, thermoplastic pots, Melinex tape, impregnated cotton tape finishes; centre hole fixing; flying leads, direct PCB mounting and flow soldering, surface mount connections; temperature maintained at 40°C above

ambient without artificial cooling due to a toroid's inherent high efficiency.

*Avel-Lindberg Ltd,  
South Ockendon,  
Essex RM15 5TD.  
Tel: (0708) 853444.*

## BATTERY BOOST

Power-Sonic Europe has increased the capacity of four of its sealed rechargeable lead acid batteries. The price and case size remain the same.

The improved models are: PS618 (6V), 1.8AH is now 2AH; PS626 (6V), 2.6AH is now 3AH; PS630 (6V), 3AH is now 3.2AH; PS1226 (12V), is now 3.2AH.

All Power-Sonic batteries offer leakproof cases, suspended electrolyte, overcharge protection, cycle or float operation, high discharge rate, rugged compact construction and extended shelf life. Charging requirements for the improved models remain the same.

*Power-Sonic Europe Ltd,  
Cornwallis House,  
Howards Chase,  
Pipps Hill Industrial Estate,  
Basildon,  
Essex.  
Tel: (0268) 293353.*

## IT FITS!

Telecomms now offer a Greenpar 'N' type silver plated connector to fit the popular Pope H100 cable.

Greenpar have specially manufactured this item and Telecomms are holding large stocks for both trade and retail users. In recent years, Pope H100 has become very popular with both radio amateurs and commercial users, since it offers extremely low loss at an economical price.

The outer diameter of 9.1mm for this cable means that many other connectors will not fit correctly.

The new Greenpar 'N' type sells at £3.36.

*Telecomms,  
189 London Road,  
North End, Portsmouth,  
Hants PO2 9AE.  
Tel: (0705) 698113.*

# NEWS DESK

## SPECTRA calling

The world's first fully integrated paging, voice mail and telephone answering terminal, SPECTRA, has been introduced by SCE of Hicksville, New York, from August this year.

The unit is equipped to provide a full menu of subscriber services designed to increase revenues and expand a service provider's system without the need for multiple investments or multiple manufacturers' equipment.

Its modular design and software intensiveness support the most advanced features

in each of the three technologies it combines. These include: networking, full statistical system management, user-selected greetings, user-activated intercept of paging calls, solid state switching, on-line configuration control and full redundancy.

The unit will be shown at Telecom '87 in Geneva at USA Pavilion Booth 1.360.

## Ariane for Aerospace

British Aerospace Space and Communications Division has been awarded a contract worth over £20 million to supply Arianespace

new antenna lies in the reduction of its radius of rotation, which is about half that of its predecessor, AK751.

The AK451 antenna can be used in embassy radio networks or for high-sensitivity radiomonitoring.

## R & S antenna

The rotatable log-periodic HF antenna AK451, from Rohde & Schwarz, for transmitter powers up to 1kW, has been developed for the frequency range 5 to 30MHz. The essential improvement of this

with twenty 'SPELDA' payload bay structures for Europe's Ariane 4 rocket.

SPELDA is an integrated payload bay structure which will enable Ariane 4 to launch independently two or more spacecraft during the same mission.

The bay is a large cylindrical structure, 3.97m in diameter, below a truncated conical section. One satellite is carried on a mounting ring fitted to the top of the conical section, and the second satellite is enclosed within the cylindrical portion.

Early in the flight, Ariane's nose fairing is jettisoned, clearing the way for the upper satellite to be released in orbit. After launch of the first satellite, a pyrotechnic charge separates the upper and lower sections of SPELDA before the upper section is propelled away by a precompressed spring system, leaving the second satellite free for release into transfer orbit.

The first flight model will be employed on the maiden flight of Ariane 4 (flight V21). This latest launcher will provide Europe with the capability of placing into geotransfer orbit the largest satellites now being built. The maiden flight will take place from Kourou, French Guiana, in 1988.

## Skylark launch

On August 25th 1987 British Aerospace Space and Communications Division celebrated the latest launch and 30th anniversary of the Skylark Sounding Rocket.

The launch, which took place at 2.00am local time, from the re-opened Woomera rocket range in South Australia, provided astronomers and scientists with the opportunity to observe from space the recently discovered supernova situated 155,000 light years distant in the Large Magellanic Cloud (LMC). The LMC, which is a satellite galaxy to our own, is only visible from the southern hemisphere.

The customer for the launch was the German Aerospace Research Establishment, DFVLR, who were responsible for procurement of the rocket and co-ordina-

tion of the launch. The German Max Planck-Institut were responsible for procurement and management of the payload experiment. Funding for the project was provided by the German Ministry of Research (BMFT).

The rocket's payload consisted of an X-ray telescope and camera which will provide astronomers with a colour X-ray image of the supernova. The results should provide astronomers with valuable information about the matter expelled during the explosion and increase understanding of the supernova remnant. After providing approximately five minutes of observation time the payload will be parachuted back to Earth for recovery by helicopter.

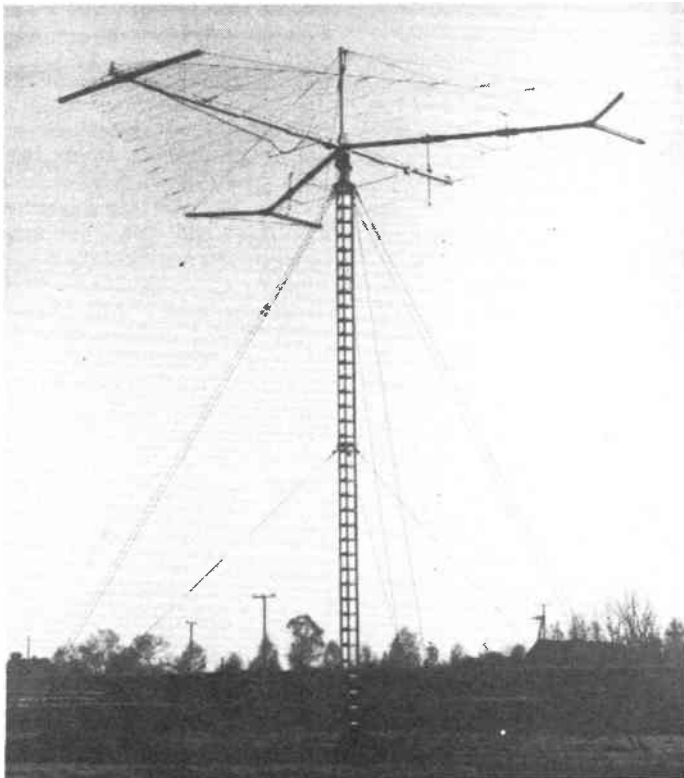
The first Skylark was launched from Woomera in support of the 1957 International Geophysical Year, and since 1964 British Aerospace has supplied an entire family of Skylark rockets.

## GRP approved

The Department of Trade and Industry announced on 8th September the completion of work on the preparation of several performance specifications for the type approval of low power radio devices.

Radio devices coming on to the UK market must be type approved and the specifications have been necessary in order to prepare the way for a Statutory Instrument to exempt from individual licensing a whole range of low power radio devices. Type approval remains necessary in a licence-free regime to ensure that products meet the necessary standard to minimise interference and provide users with a good quality of service.

The new specifications generally update existing outline specifications for induction systems, telemetry and telecommand devices, wireless microphones and hearing aids, Doppler and field disturbance devices and emergency alarms for the elderly and infirm. New specifications have been introduced for some types of radio alarms, for general purpose low power devices





operating at 49MHz and for low power devices operating in the microwave bands.

Since the beginning of the year the department has been issuing free licences for the devices to be exempted under the forthcoming Statutory Instrument. The eventual aim of the more liberal regime is that users will no longer have to pay fees or complete licence application forms and manufacturers and distributors can market products in a less regulated environment. The new specifications for radio alarms and general purpose low power devices release new frequencies and thus provide new opportunities for manufacturers.

### Space funding

The Space and Communications Division of British Aerospace has welcomed the decision by the Government to review its position on the funding of UK space activities. The division has also been informed of the provision of interim funding for the continuation of the British involvement in the current preparatory work being undertaken on the Columbus and Ariane 5 programmes.

British Aerospace has also acknowledged the need expressed by the Prime Minister for industrial support and is to contribute funds for continued work on HOTOL and Radarsat, both important national space programmes.

Space research, British Aerospace believe, acts as a pathfinder in education, science and technological development generally, and in the United Kingdom and Europe space research has been almost entirely aimed at practical benefits to mankind. The programmes covered by these arrangements are consistent with these aims, and the funding will enable British Aerospace and other companies concerned to complete by November this year the tasks for which they have been under contract to the European Space Agency, and to progress significantly the national programmes.

### Speedy repairs in the city?

London's four million telephone customers will

benefit from a greatly improved fault repair service from the end of the year, following British Telecom's purchase of automatic line test gear worth more than £15 million.

The installation of the equipment began in October in the City, in London's 87 repair service controls.

The equipment will automatically test customers' lines and equipment to pinpoint degradation before it develops into faults which could affect the telephone service.

### Nigerians end piracy

A Nigerian court has ordered the destruction of 200,000 pirate music cassettes containing works by over 300 classical, jazz and pop artists. This is the latest in a series of legal moves by the local music industry against importers and manufacturers of illicit tapes and follows a recent pledge by a senior government minister that measures to eradicate piracy will be introduced by the end of 1987.

Nigeria is the largest market for recorded music in Africa, with annual sales of some 23 million records and cassettes. Of these, however, some 70% are pirated, with a retail value of 96 million naira (\$30 million). Although hampered by the inadequate state of the current law, the IFPI's (International Federation of Phonogram and Videogram Producers) Nigerian group has won four major anti-piracy actions in the Lagos courts in the last twelve months. The cases brought against manufacturers, importers and printers involved in piracy have resulted in the imposition of damages totalling over 120,000 naira.

### A year after Big Bang

The fifth Computers in the City event, organised by Online International, will take place at the Barbican Centre from 17-19th November. With the City a year wiser after Big Bang, visitors to this year's exhibition will be viewing the latest developments in computer-based financial systems from over 100 exhibitors with the experience of sea-

soned campaigners.

As in previous years, Computers in the City has drawn the support of leading manufacturers and suppliers of equipment, software and services. Demand for space at this event has been such that the 1987 exhibition will be using all four of the Barbican halls.

Further details are available from Pam Howard on 01-868 4466.

### Eutelsat development

Marconi Space Systems Ltd has received from Aerospatiale of France an £8 million contract to proceed with the manufacture of a communications repeater for a fourth Eutelsat II satellite.

Repeaters for the first three satellites were ordered in May 1986 and were the first ever commercially produced for the European telecommunication and television distribution market. Long-lead items for the fourth were ordered in June 1986 in a contract valued at £1 million.

Each satellite can carry some 16,000 simultaneous telephone conversations, provide high-speed computer datalinks, carry high quality television programmes within the Eurovision network, and

permit direct broadcasting by satellite (DBS), as well as video conferencing facilities.

The first three satellites are expected to be launched in 1990 and delivery of the fourth repeater to Aerospatiale in Cannes is scheduled for February 1990, with launch in 1991.

### New Atlantic link

Work in Britain on laying the world's first transatlantic optical fibre cable - code-named TAT 8 - was due to start on September 5th.

At Widemouth Bay in Cornwall, the UK shore end of this £220 million undersea system is being installed by staff from BTI.

When TAT 8 comes into service, it will have the capacity to carry the equivalent of 40,000 simultaneous phone calls, or their equivalent in data, text, facsimile, graphics or TV pictures.

At the UK end, TAT 8 calls will go over British Telecom's inland digital network to an international switching centre in London.

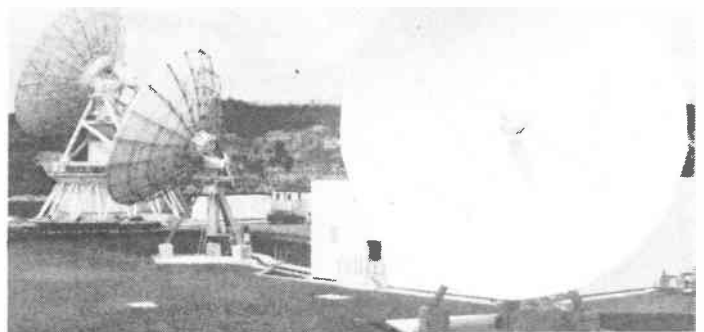
The new cable will carry both public and private communications. BTI has already taken advance orders worth over £14 million for private leased circuits on TAT 8.

### Mercury buys Marconi

Marconi Communication Systems has recently been awarded a contract for the supply of two Intelsat Standard A terminals to be installed at the Mercury Communications Satellite Earth Station at Whitehill, Oxfordshire. The contract, won in the face of strong international competition, is

valued at £3.7 million to Marconi.

The terminals are to be installed and ready for service early in 1988 and will extend the services already being provided by mercury from this site. They will be used to communicate with the Far East and the USA via the Indian Ocean and Atlantic Ocean satellites.



# AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

**T**he Falklands, which before the 'war' were hardly ever heard of, nowadays seem to be continuously in the public eye. They get their fair share of attention even in the amateur radio press, through the activities of its few, but active, radio amateurs.

Your scribe recently came across an unexpected story of an unusual nature, which had a strong radio interest. Besides amateur radio, I have an interest in narrow gauge railways and miniature locomotives. Whilst browsing through a catalogue relating to the latter, I came across a loco kit based on an industrial railway locomotive which was said to have seen service in the Falkland Islands, where it had assisted 'in the construction of a powerful transmitter'. Just what sort of 'transmitter' it was and when it was built was not mentioned, but a reference was given as to where further information was to be found. A most interesting story was unravelled from these references.

At the beginning of the First World War, the German battleship Admiral Graf von Spee sank two British cruisers off Coronel, Chile. Two British battle cruisers, the Invincible and the Inflexible were despatched to take countermeasures. They called in at the Falklands to take on coal and, while they were there, four German ships approached the Falklands. They were engaged by the British ships and were sunk.

This incident demonstrated beyond all doubt the need for better communications between the Northern and Southern Hemispheres, and the Admiralty decided to build a powerful spark wireless transmitter on the islands. This early wireless transmitter required very large power supplies; so two Babcock and Wilcox boilers provided steam for three electric generators. The boilers required huge quantities of coal to fire them and hence a light narrow gauge railway was built to carry the coal from the Navy jetty to the site of the wireless station at Moody Brook, a distance of some three or four miles. The wireless station was built by the Marconi Company. Two 2-foot gauge locomotives, built by Kerr Stuart & Co of Stoke on Trent, provided the motive power for the coal trains.

First trials of the transmitter were

made in April 1915, during which too much power was applied to it, resulting in many miles of wiring being burnt out! After modifications all was well, and so powerful were the radio signals from the station that they were audible in the North Sea! Good DX for those days!

The remains of these two locomotives were discovered during the recent Falklands conflict! Readers interested in philately may like to know that these locomotives are illustrated on the old 27p Falkland Islands stamp and on the new 7p Falkland Islands stamp, issued in February 1985.

## Expeditions fund

The RSGB's HF Committee has launched a fund to assist intending HF DX expeditions, both in the UK and worldwide. Its objectives are to help in acquiring suitable equipment for DXpeditions, to assist with the costs of chartered transportation, such as boats, to uninhabited islands and also to help with the cost of good quality pictorial QSL cards. The latter in particular seems a very good idea.

This scheme should certainly appeal to those interested in DX activities and should help prevent those 'shoe-string' expeditions which, through inexperience and lack of funds, often end in chaos!

When making recommendations on sponsoring a particular proposal, the HF Committee will take into account such factors as the likely interest of RSGB members in the proposed expedition and the degree of involvement of society members, the relevance of the expedition to society awards, the range of activities proposed and the quality of the leadership.

This scheme would seem to be an excellent one and will certainly help to encourage such expeditions and put them on a sound basis; reading the accounts of some such projects which have been attempted in the past, I believe this needs doing.

The first priority will be to build up a fund and payments will at first be infrequent, depending on how the fund builds up. Donations and bequests will be very welcome and should be sent to Martin Atherton G3ZAY, PO Box 146, Cambridge, from whom details of the

fund's terms of reference can be had.

## The origin of '73'

We have mentioned the activities of the 'Old-Timers Association' once or twice previously in this column. It will be recalled that this organisation was at one time a very active group, but has declined in recent years. Steps were taken recently to revive it and, to judge from its quarterly magazine, *OT News*, this revival is proceeding very satisfactorily.

One can judge quite accurately the liveliness of an organisation from its journal or newsletter. The July issue, just to hand, contains a lot of very interesting material. One article which particularly caught your scribe's attention was on the origin of the code CW group '73', sent as the final greeting at the end of a QSO.

These code groups, such as '73', '88' and 'VE'—which are now being discussed in some of the amateur radio media—seem to have become part of the radio amateur CW jargon for no apparent reason. So it is of interest when someone comes up with a tenable explanation. This one is by Louise Ramsey Moreau W3WRE, who, besides being a great archivist, has one of the finest collections of Morse keys in the world—over 300!

He says that the first authentic use of '73' is in a publication called *The National Telegraphic Review and Operator's Guide*, which was first published in April 1857. At that time it meant 'My love to you!' Succeeding issues of this publication continued to use this definition. However, within a short time, the use of '73' began to change, from this Valentine-type sentiment to one of fraternalism. '73' became a greeting, a friendly word between operators, and it was so used on all telegraphic systems.

In 1859, the Western Union Company introduced a standard list of codes known as the '92 code'. This was a list of numerals from 1 to 92, indicating a series of phrases for use by telegraphic operators. In this list, '73' was changed from the previous interpretation to one of 'Accept my compliments'. Over the years from 1859 to 1900 various telegraphic manuals showed variations of this meaning. The *Telegraphic Instructor* gives it as simply 'Compli-



ments'. The *20th Century Manual of Railway and Commercial Telegraphy* defined it in two ways, viz, 'My compliments to you' and merely 'Compliments'. Edison's *Telegraphy Self-Taught* shows it as 'Accept my compliments'. By 1908, the latest edition of *The Telegraph Instructor* defined it as 'Best Regards' and that is more or less its meaning nowadays.

### 50MHz transequatorial tests

As we reported last month, sporadic-E propagation has produced some very good DX openings during the past summer months. The general release of 50MHz has shown that this type of propagation is much more frequent than had been expected on that band. VHF transequatorial (TEP) propagation has been a subject of considerable interest for several years, and it is expected that with the good sporadic-E conditions existing recently there may well be some good DX possibilities on 50MHz over N-S paths.

From the *VHF/UHF Newsletter* for September 1987 we learn that special tests have been organised over European-African paths from 26th September to 8th November.

The RSGB VHF Committee is to keep

records for the 50MHz band in the same way as they do for other VHF/UHF bands. The following records will be recognised for the 50MHz band:

1) Maximum distance. Any mode, worked from Britain direct, ie, not via satellite or repeater, the distance to be measured by the shortest great circle distance between the stations claiming the record.

2) Maximum distance worked at sunspot minimum. Conditions same as 1) with the provision that the QSO must have taken place during the period of 10 months either side of the month of official sunspot minimum once this has been established.

3) Maximum distance within the British Isles. Expeditions are to be encouraged and will be recognised for this record.

4) Maximum distance via aurora.

5) Maximum distance by meteor scatter.

The *VHF/UHF Newsletter* has just come out in a new format, which is a great improvement on its previous one. It is a monthly publication for VHF enthusiasts, produced by the RSGB, edited by David Butler G4ASR. It is a valuable source of information on what has been happening in this field month by month. It is available to non-members of the RSGB at £9.35 per yearly subscription.

### Wireless Telegraphy Act, prosecutions

The DTI reports that during the period from April to June this year, there were 78 prosecutions for offences under this act.

### Joint polar expedition

Preparations for a joint Russian-Canadian polar expedition are going ahead well and it is expected to be leaving for the North Pole next February. Leonid Labutin UA3CR, the well-known polar explorer and Radio Sputnik exponent, will be taking part in the expedition.

He has already visited Canada to make arrangements for radio communication. It is believed that it was for this reason that he was not able to take part in the AMSAT-UK/UoSAT Colloquium held on July 17th-19th.

Satellites will be part of the radio communication system, a new hand-held satellite communications transceiver being included in the equipment. Discussions have been held between Dr Martin Sweeting G3YJO, Director of the University of Surrey Spacecraft Centre, and Leonid Labutin on the possibility of carrying a UoSAT DCE station for use with one of the UoSAT satellites on the expedition. REW



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# SPECTRUM WATCH

by John Andrews

A little while back we mentioned the possibility of MDS-TV in Great Britain and Ireland. This would be an alternative to cable for distributing extra TV channels, using microwaves in the 2GHz band, and would be readily receivable by viewers with apparatus supplied by the cable companies—and by gifted hobbyists.

Nearly all the American hobby electronics and ham radio magazines carry advertisements for easy-to-build 2GHz aerials and converters. Don't bother to send off for these though, as the DTI has turned down the request of Croydon Cable Television to use these frequencies to send programmes between cable head-ends.

The company had hoped that, by exchanging programmes, the London operators could create a local London news channel. They also wanted to use microwave for distributing the Bravo film channel and Westminster's House of Lords channel, but the DTI says these channels are the preserve of the broadcasters, BT and Mercury, and will remain so.

## OTH-B again

OTH-B (over the horizon backscatter radar) was featured in the last *Spectrum Watch*, in August. Since then, the American General Electric Company of Syracuse, NY has received a \$145 million contract for the construction and integration of the West Coast OTH-B system. Total construction of the project will amount to \$313 million.

GE's contribution to the project will be to build three western OTH-B sectors,

each providing 60 degrees of coverage (for a total of 180 degrees). This will extend from Alaska to the Baja California peninsula and the range of the radar will be from 500 to 1,800 nautical miles.

The contract value may sound like telephone numbers, but it indicates the importance the US Government places on defence (it spends 10 times as much on defence services and supplies as Britain, some \$100,000 million a year).

It is contracts like these which keep the US electronics industry going—and keep down the cost of piece parts to hobbyists and amateurs. Long may they continue! Incidentally, GE of America has no connection with the UK General Electric Company, which was established earlier and has always been a British organisation.

## Marconi's satellite success

Over the next few years the world's major satellite earth stations will engage upon an updating programme to convert to the IDR (intermediate data rate) system of operation. This requires the use of special modems to carry the digitised traffic.

British Telecom International is the first organisation in the world to start the conversion, by using new Marconi modems. Initially, they will be used for experimental transmissions with COMSAT in the United States.

The modems were designed by Marconi Communications Systems, and are an extension of the company's range of digital modems already used by organisations world-wide in conjunction with Intelsat and Eutelsat. BTI's modems

have been delivered and will be in operation shortly. They work at 2.048Mbit/sec (I understand that) and are equipped with a self-contained 3/4 rate VITERBI FEC CODEC (I'm not so sure about this!).

## Millimetric mobile radio

Mobile cellular radio systems are starting to bulge at the seams in metropolitan areas, and the provision of extra base stations with smaller cells is an expensive operation. User numbers show no sign of tailing off, from 350,000 today to perhaps 2.5 million in the year 2000, so an alternative solution may be necessary. Attention is therefore turning now to millimetric wavelengths to find new channels.

Scientists at University College, London have been occupied with studying results of tests at 55GHz. In a heavily built-up mobile radio environment the use of these unbelievably high frequencies is found to have definite merit, though propagation is better in built-up areas than in open country, where there are fewer objects to reflect the signals.

The study, which was conducted under a SERC grant, indicated that these frequencies were usable in an urban environment, though there are still obstacles to overcome.

One is the prohibitively high cost of millimetric wavelength components and another is the need for a total research programme to determine all the propagation characteristics of mm-wave cellular radio.

## USAF gets MUTES

Collectors of acronyms should carefully note MUTES, short for multiple threat emitter system. The project is deadly serious and involves a \$54 million contract to the Aydin Corporation from the US Air Force. MUTES is a ground-based emitter simulator which is used to evaluate airborne radar warning and ECM (electronic counter measures) systems. It is also used to train pilots.

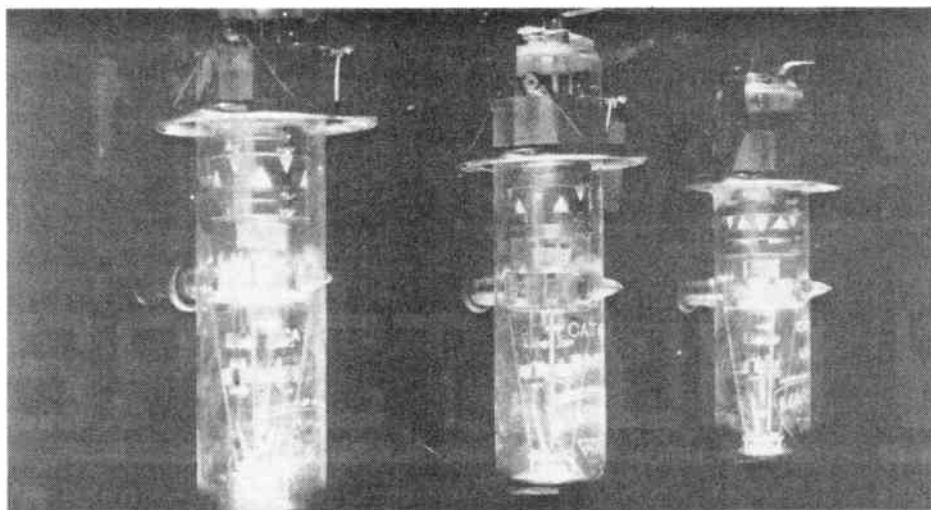
## US Navy wants Blimps

Blimps: just think of airships and barrage balloons. Proponents of blimps claim that they provide 10 times the radar coverage of conventional air-borne systems at one tenth of the cost. Furthermore, they say, blimp-mounted radar can spot smaller targets than can, say, AWACS.

The threat is from the new breed of cruise missiles, which are almost impossible to detect using ship-based radar (as demonstrated by the Exocet attack on HMS Sheffield during the Falklands conflict). By putting the radar a mile in the sky on an airship platform, it could operate in over-the-horizon mode, spotting cruise missiles up to 200 miles

*The welcome glow of valves... but these are no ordinary radio valves. In fact, they are transmitting valves used at the BBC's Moorside Edge station, first installed by Marconi's Wireless Telegraph Company in 1931 and still operational 52 years later.*

*The original transmitter was still used one day a week as operational standby until the old station was closed down at the end of 1983. Like its predecessor, it was replaced with the latest Marconi technology as part of the BBC's re-equipment programme for its high-power medium frequency transmitting stations*







# ATV ON THE AIR

## Andy Emmerson G8PTH puts you in the picture

It's quite a while since I had a new book on video to review, so it gives me pleasure to have something substantial to get my teeth into. The book in question is the second edition of Ru van Wezel's *Video Handbook* just out from William Heinemann.

Priced at £30, the book presents in one volume all the serious amateur needs to know about video. By amateur I mean anyone who is involved in video but who has not had the benefit of professional training.

Picking up the information on subjects as diverse as TV standards, colour cameras and studio lighting is not easy, the more so if you are hoping to find practical circuits with which to build working video equipment at home.

So, if you are a serious enthusiast, TV amateur or are involved in student TV, amateur dramatics or a small professional studio this book is for you, and all I have to do is convince you that £30 is not an unreasonable price to pay for so much information in one book.

The first edition appeared in 1982 and contained 400 pages; the new edition has been expanded by 50 more. The coverage is largely unaltered – a little bit of history, a fair bit of theory and lots of practice, with as little mathematics as necessary.

Since the first edition was published, however, all the cameras and video recorders mentioned have been succeeded by at least one generation, and the contents of the book have been revised to take account of this. Thus formats up to 8mm are included, though VHS-C seems to have passed Mr Wezel by and the RCA Hawkeye's demise has similarly escaped him – this makes me suspect that the revision was done several years ago. Confirmation comes on the footnote of page 180, where the author thinks that the old 405-line VHF channels in Britain may be re-engineered for 625 line transmissions – tut tut!

### Practical bias

Despite the healthy doses of theory, this book contains more information on practical video techniques than I have ever seen before and this is why I think it is worth its price. It has shortcomings, but these can be corrected. Virtually all of the 450 pages include a photo or diagram and the comprehensive descriptions of how the apparatus works are most instructive.

Subjects covered in great detail include processing amplifiers, sync pulse generators and special effects generators. Connectors are covered and the audio side is given full emphasis, as

are staging and studio lighting. The author also discusses cameras, mono and colour, and just as important, he goes into the subject of optics and colour temperature.

### Wide appeal

Although concentrating on small systems, van Wezel does not neglect broadcast video. He explains how TV works, gives examples of test cards and tells how they are interpreted.

All this is done in language any enthusiast can follow and in a way that avoids boredom and technical details for their own sake. The book is international in outlook – it is written by a Dutchman and has already appeared in Dutch and German editions. Makes of equipment mentioned include Sony (Japanese), Philips (Dutch), Grundig (German), Ferranti (UK) and Texas (USA), so there is no bias.

### DIY projects

One of the attractions of the first edition of this book was the inclusion of practical circuits and PCB layouts for home-brewing a complete range of home studio apparatus – video and audio mixer, effects generator, sync separator and so on. These are reproduced again, but have now lost their sparkle. The designs, which date back to 1977 and 1978, were innovative in 1982, when information of this kind was difficult to find. Seen again today, those designs look desperately simplistic alongside the sophistication of today's cameras and recorders.

The circuits themselves are bulky and clumsy, making no use of all the clever integrated circuit packages which have come out in the past few years. They have no relevance to today's constructor and sit uneasily beside the rest of the text, which is very professional. On the other hand, the first edition of the *Video Handbook* reproduced circuit diagrams of typical commercial units and these have been dropped in the current edition. It should have been the other way round!

### Avoidable errors

Although publishers spend a lot of money sending out review copies, it appears that they do not read the reviews which ensue. Well not in the case of the *Video Handbook*, anyway, because several of the errors I pointed out in the first edition have been carried over.

People buying an expensive book such as this expect it to get its terminology right, and it is no good having the translator give literal translations of the original Dutch.

Sillies such as *picture pulse* (for field drive) and *MF* (meaning IF or intermediate frequency, *not* medium frequency) have crept through on diagrams from the previous edition (they have been corrected in the text). Similarly, for *line pulse* read *line drive*, for *IF* (low frequency in Dutch) read *AF* (audio frequency in English). What the publisher thinks we call *total syncs* are in fact mixed syncs.

### More drop-outs

Pages 216-8 give a useful survey of connectors used in video but contain some remarkable omissions. The author doesn't mention that the EIAJ 8-pin connector is generally known as a U-Matic or Honda plug, or that the Hirose 10-pin is more commonly known as the EIAJ 'J' type.

The Sony 'K' type, used on all domestic Sony equipment is not shown at all, nor is the similar multi-pin connector used on their professional range. The SCART plug is also known as Peritel and Euroconnector, and there are other pin conventions on Japanese equipment using this connector.

### Still worth buying?

The criticisms above reflect on the publisher, not the author, and are a minor facet of what is a most comprehensive book. It must have been a labour of love, and the author's enthusiasm shows through clearly.

The book is a valuable source of reference and instruction and, despite its price, is well worth having. In fact, if you can afford video you can afford this book – you cannot afford not to have it! (Incidentally, when it first came out in late 1981 it cost the same as two E-180 tapes, £20. Now it costs £30, and you can get ten three-hour tapes for the same amount if you shop around!)

### Video titling

Another program to add to the repertoire set out last month is for a Commodore 64 with disc drive. It's called *Video Title Shop*. The title indicates that it may have come from the USA and the distributor is certainly US Gold (Units 2-3, Holford Way, Birmingham B6 7AY). The price is £14.99 and the program has had mixed reviews so far.

I haven't seen it myself, but am impressed by the claimed ability for one page to push another off the screen or fizzle (fade pixel by pixel from one page to another). The results are considered quite reasonable, producing caption screens and simple illustrations, so if you have a Commodore, why not check this one out?





# NETWORK

## 934

Andy Emmerson G9BUP

**A** mail-out by the 934MHz Club UK recently included a detailed statement on future technical specifications for the band, a revised members list, together with log sheets and regulations for the annual 934MHz contest and field day.

The members list is an interesting document and is the closest thing we have to a callbook for 934MHz. Amateur radio callbooks list users in call sign order for easy reference, but a similar system is unfortunately not possible on 934MHz, since there is no consistent form of call sign.

Apart from the G9 plus three letter calls issued by the DTI, all other call signs are adopted by the users themselves. Quite a few people now use their club number prefixed UK, but others seem to use their initials or a club identifier plus two digits. Ah well... in any case, the booklet lists something like 1200 numbers, which I guess represents around a third of the total number of users now. I wonder how many are active? Probably most, given that they have chosen to join the club. There are many advantages to joining and you can find out what they are by sending a stamped addressed envelope to PO Box 424, Althorne, Chelmsford, Essex CM3 6UP.

### Technical topics

The other papers relate to a DTI meeting held in July to discuss new technical specifications for the 934MHz band. Given the intention to establish a common European specification for 933-935MHz personal radio apparatus, Mr Maxwell of the DTI explained that the choice lay between an analogue Swiss-style system or a brand new digital one. The existing specification, MPT1321, has come to the end of its useful life and will be withdrawn, probably in 1989, before the new norms are introduced (this is expected to take place in 1990).

Existing equipment and frequencies will remain in use until at least 1990, when the radio spectrum will be reviewed, and every effort will be made to ensure that the new specs will take account of existing users and avoid interference.

### Stateside success

Our American colleagues have had the use of 902-928MHz for the last two years. It's an amateur band over there, and not unexpectedly they have been going great guns to get the best out of the band. A lengthy report in *Ham Radio* (April 1987) gave the latest news, and an encapsulation of it follows.

Activity has started in several areas of the USA and Canada, and there are a number of FM repeaters in use now. In California and Massachusetts the wider band is also used for amateur television repeaters. Portable activity is popular, typically with 10 watts power and 12 foot long loop yagi antennas. A hundred miles

is considered easy going with SSB and the best DX reported yet is 377 miles (606km), so we have some catching up to do! Several users have noted the signs of aircraft flutter on their DX contacts – the sudden appearance of a distant station, some flutter and then fading to nothing – and perhaps we should make more use of this method of propagation.

### Big beams

The article gives constructional details for a 45 element loop yagi antenna – this measures a massive 17 feet 6 inches long! The gain is estimated at 20.5dBi, with 15 degree beamwidth. Also discussed are 'black brick' RF power modules from Japan, which provide an easy method of putting together a decent transmitter and power output stage.

In addition, mention is made of the German SSB Electronics LT33S transverter, which uses a normal two metre transceiver to put out 6 to 10 watts of power on 903MHz and has a low noise GaAsFET receiver. It should be possible to obtain these from Piper Communications (Didcot) in this country and change the crystal to achieve output on 934MHz, but whether this would work out cheaper – or better – than a Delta One is another matter!

W1RIL and others have modified the 70cm 2C39 amplifier described in *The UHF Compendium* (from the RSGB) to work at 33cm – they report obtaining 50 to 100 watts output, while other designs mentioned produce 300 to 500 watts! Filters and preamplifiers are also discussed, as is the possible use of Japanese FM transceivers in America. Let me know if you want more info; I can try and get you a copy of this fascinating article.

### More threats

Many users of the 900MHz bands – not just us 934 folk but cellular radio subscribers as well – are unaware that they share the bands with other radio users. The fact that we never hear military users shows how well in fact we co-exist, and the old complaints of breakthrough from cellular base stations seem to have dried up.

On the other hand, cellphone users around Sutton Coldfield in the West Midlands were finding their transmissions wiped out by a mystery 'noise'. The source was tracked down to a factory near the cell transmitter site which used high power radio frequency for vulcanising rubber. The equipment was operating on 896MHz and perfectly legally – it

was installed in 1977 and was licensed to use the so-called ISM (industrial, scientific and medical) band, established in 1971 on 886-906MHz.

How does this affect us 934MHz users? Simple – 'they' want to move their interference to 934MHz! Industrial uses for RF, known as electroheat, are growing. Using radio frequency is an efficient method for processes such as plastic welding, material drying and surface hardening of metals. It saves energy and time and is environmentally 'clean', which means that it is popular for applications such as food processing and rubber curing.

The only snag is that it causes radio interference. Most of this can be avoided by means of special shielding, but experience at Sutton Coldfield would appear to indicate that this is not 100 per cent effective. The British National Committee for Electroheat (BNCE) represents the interests of manufacturers and considers that the only solution to the cellular interference problem is to shift electroheat to another frequency. And the frequency they have chosen is 934MHz!

Quoted in *The Engineer*, the BNCE's Mike Thelwell says that the attraction of this frequency is that it is close enough to 896MHz to require only minimal changes to the design of electroheat apparatus. 'It wouldn't present us with any technical hassle, just expenses', he said. Luckily, they will only move to 934MHz if it is agreed internationally and they accept that persuading the European Commission could be a long bureaucratic process. Let's hope it is!

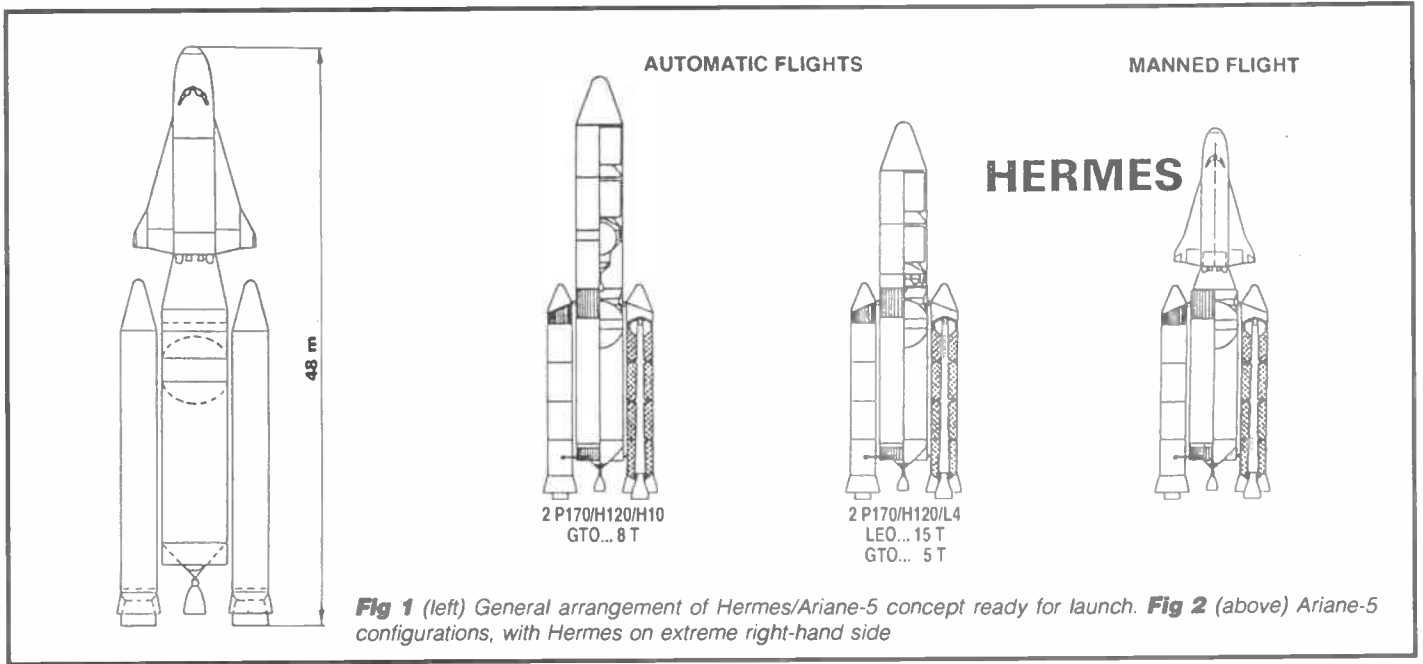
### New neighbours

Last time I mentioned that the rumour machine indicated that the Dutch had decided to postpone the introduction of their personal radio system and wait for the pan-European digital disaster. Info from the DTI indicates that this has not happened and the Dutch analogue system does indeed start in October. As soon as I have definite information you will have it too.

On the face of it, this does seem to be the opportunity for legal international DX: I can see nothing in the licence regulations which prohibits contacts with foreign stations. So far, the only contacts with stations abroad have been to mobile stations in France, where 934MHz is not legal – there has not yet been a tropospheric opening sufficient to support contacts with Switzerland, the only other place with a legal 934MHz service. On the other hand, it will take only a slight lift in conditions to make contacts possible between stations on the Kent, Essex and Suffolk coasts and those in Holland.

Who will be the first to make an authentic QSO, with QSLs to prove it? Stake your claims here!

REW



# COMMUNICATIONS LINKS FOR DATA RELAY SATELLITES

To determine the requirement for a European data relay satellite the European Space Agency (ESA) conducted surveys of telecommunications traffic currently, plus its forecast growth into the 21st century.

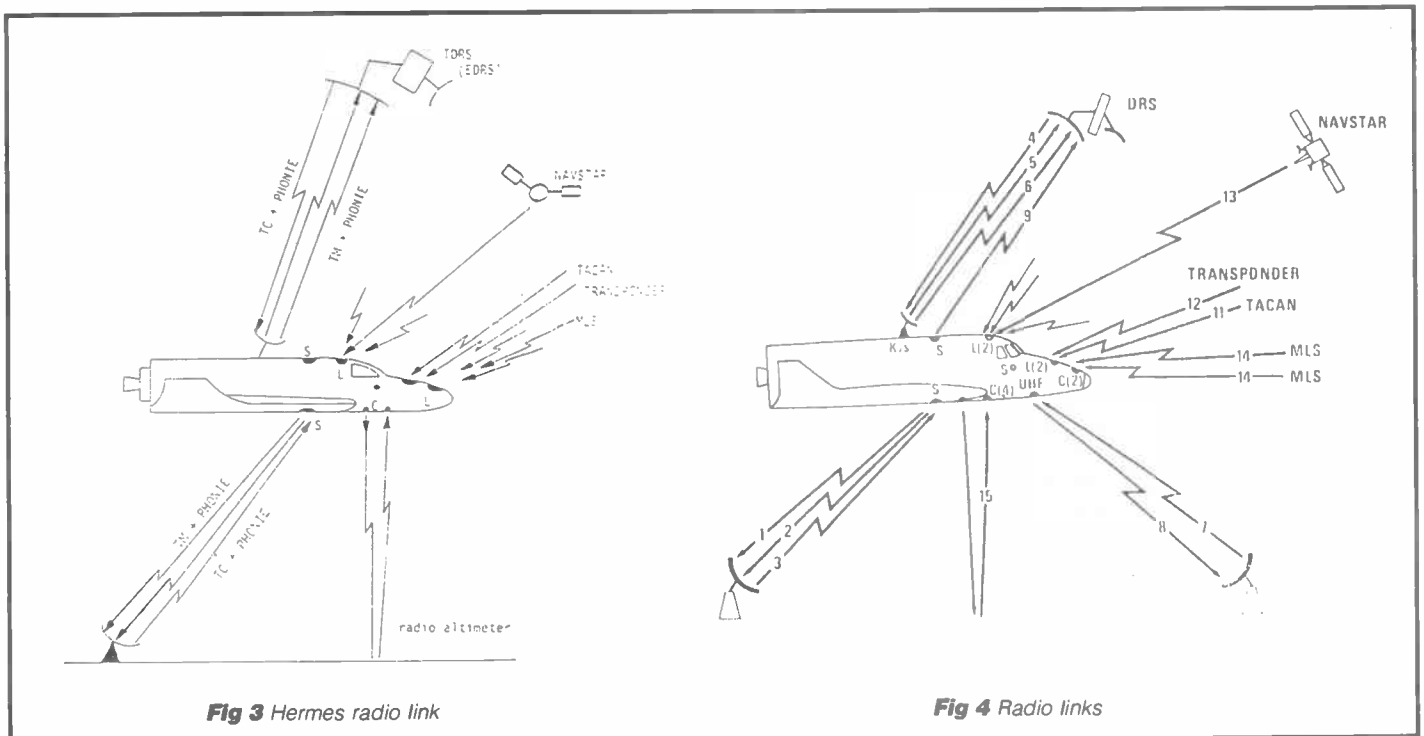
With the launch of a space station predicted for 1995 and its offspring of unmanned platforms, some of which will

be polar orbiting, the survey showed that the present US tracking data relay satellite network would be inadequate for the forecast growth. This has been particularly the case when considering the European polar platform whose prime use will be to carry earth's observation instruments into a low (850km) earth orbit inclined at 98°.

## APPLICATIONS

The US TDRSS (Tracking Data Relay Satellite System) will be linked into a global system in which it is proposed that European and Japan will participate, each providing their own satellite capable of intersatellite and ground links.

A significant application for the European data relay satellite will be to co-





ordinate the data link for the Ariane 5/Hermes launched spaceplane system, which will rendez vous with both manned and unmanned stations and platforms.

It would perhaps be helpful at this point to explain to those readers who are not familiar with either Ariane or Hermes just what the system comprises and how it will operate in a data relay network.

Ariane is the launch vehicle, sponsored by the French National Space Agency, CNES, which is now a direct competitor to the US Shuttle. It is also used for placing unmanned satellites into geostationary orbits from the Kourou (French Guiana) launch site, +5°N. Hermes, named after the Greek messenger of mythology, is a manned spaceplane which sits atop the Ariane 5 launch vehicle and is launched after separation from the booster stage.

## R. G. W. Hathaway investigates

Hermes is able to play a specific role in the platform servicing concept and, more precisely, is a contender for servicing the polar platform as it can attain the selected orbit height for earth's observations instruments. *Figure 1* shows the general arrangement of the Hermes/Ariane 5 concept ready for launch. *Figure 2* depicts some of the Ariane 5 configurations.

### SPECIFIC COMMUNICATIONS LINKS

Data acquisition and communications information must be gathered, processed and exchanged between all the elements of the Hermes system: mission centre, landing sites, relay satellites and ground station, space station and automatic platforms.

The telecommunication subsystem includes radio links for the American (TDR55) and European (EDRS) data relay satellite and ground networks of CNE5, ESA and NASA, which accept the same standard of data communication.

*Figure 3* presents all the radio links which are used during the different flight phases. It shows the major systems units and also the frequency bands C, L and S, which are used for specific functions.

The subsystem comprises low and high data rate telemetry and low and high data rate remote control, which are summarised as follows:

- a low data rate telemetry (LRTM): transmission rate = 50kb/s
- a high data rate telemetry (HRTM): transmission rate = 3 to 10Mbit/s
- a low data rate remote control (LRTC):

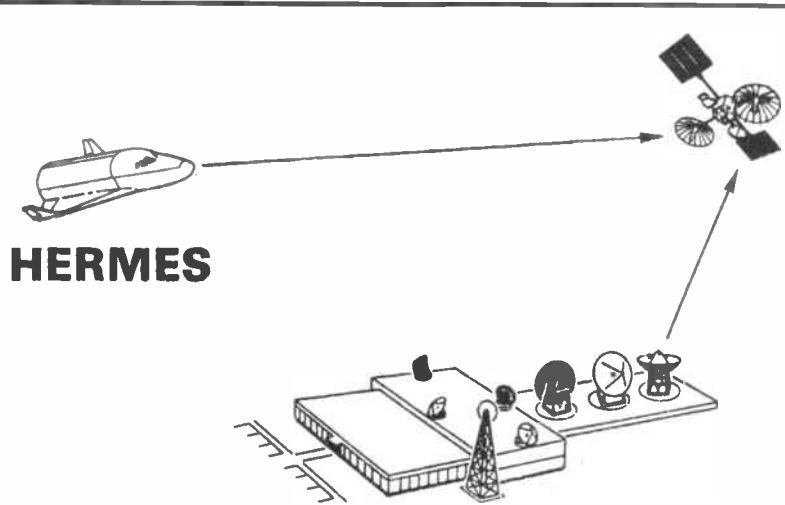


Fig 5 Hermes relay satellite interfaces - video, voice and housekeeping links

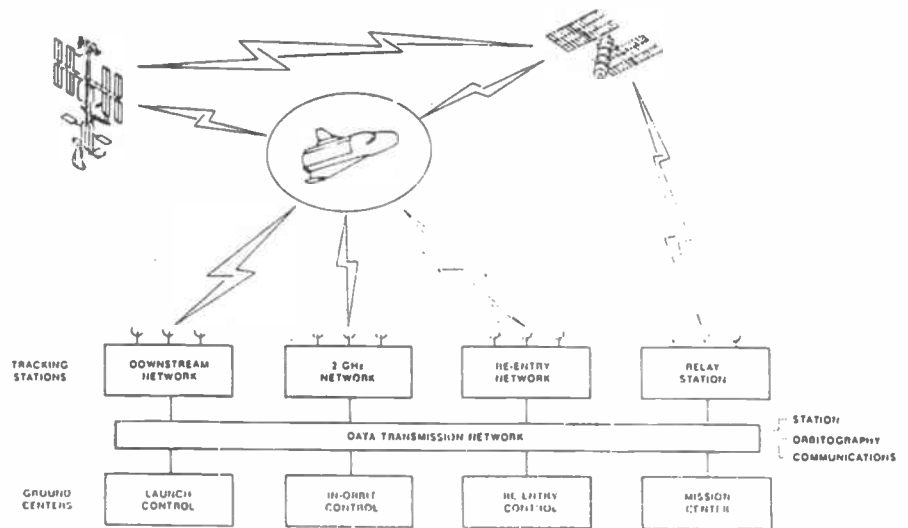


Fig 6 Communications

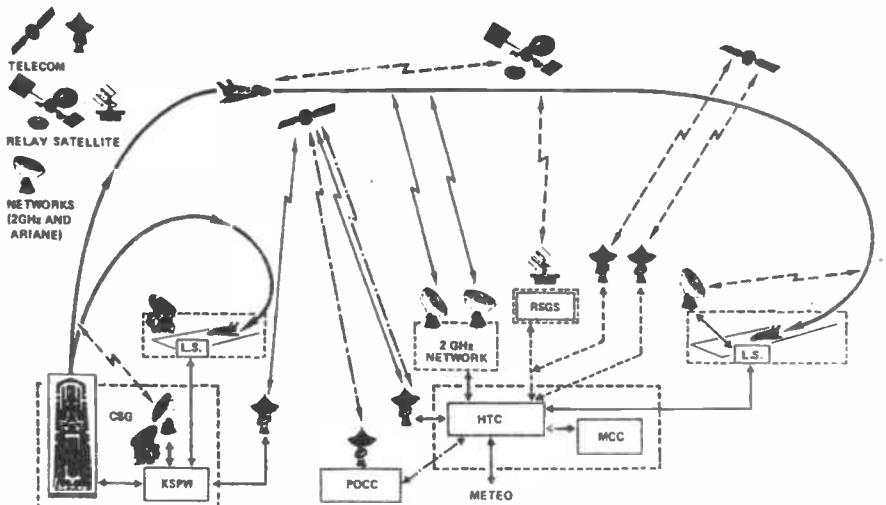


Fig 7 Communications and tracking networks

# DATA RELAY SATELLITES

transmission rate = 10kbit/s

- a high data rate remote control (HRTC): transmission rate = 300kbit/s

A high gain antenna, which is parabolic, is used in orbit for the radio link with the data relay satellite. It is stowed in the folded position during flight and re-entry and released when on-orbit prior to transmission.

## HERMES RELAY SATELLITE INTERFACES

For planning purposes the data relay satellite interfaces are to embrace radio links for video, voice and housekeeping telemetry. S-band uplink for telemetry is provisioned, as are K-band (two uplinks, 1 downlink) links for video and voice. These are shown in Figures 4, 5 and 6.

## DATA RELAY SATELLITE COMMUNICATIONS AND TRACKING

From the point of launch, during orbit and until after safe landing, the data relay satellite will monitor the health of any allocated satellite and is particularly designed to work the communications and tracking network required by the Hermes spaceplane.

Referring to Figure 7 and commencing at the extreme left-hand side, the dotted box contains the links (2-way) from the Kourou Space Plane Workshop (KSPW) and the Control Support Group (CSG), which are ready for any eventuality including an abort mission, shown in the adjacent dotted box with landing system (LS) which is a microwave system sometimes referred to as MLS.

The centre dotted block contains the Mission Control Centre (MCC) and, specific to Hermes, the Hermes Telemetry Centre (HTC). Other elements of the network are the Post Operations Control Centre (POCC) and the Relay Satellite Ground Station (RSGS).

## GROUND STATION COVERAGE AND LANDING FACILITIES

Advantages of being linked to the data relay satellite are clearly shown by reference to Figure 8, which has been plotted for Hermes in an inclined 28½°

orbit at a height of 400km. The visibility with DRS is 75%, whereas without that facility it is reduced to about 30%.

As a conclusion it is worth studying Figure 9 because, having been launched into orbit in our future space journey, it is

as well to know that our progress has been monitored by ground control through the data relay satellite and that we are now cleared to land at one of two planned runways, Kourou or Istres (France). NEW

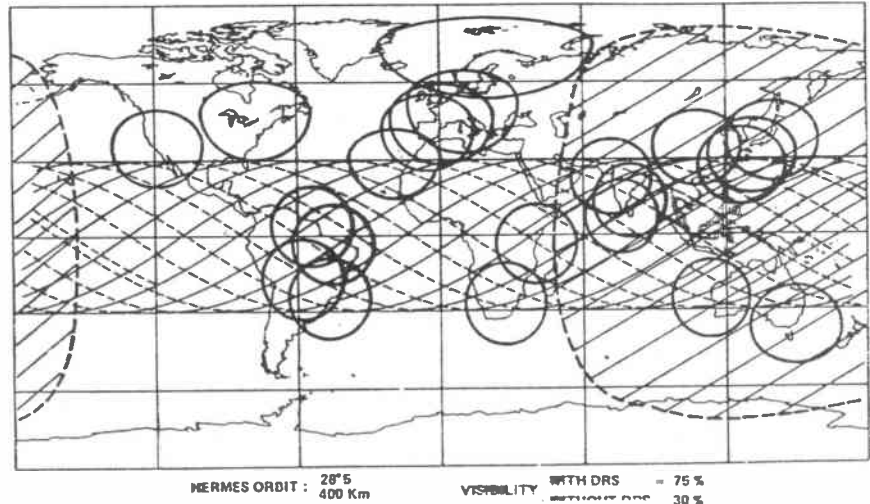


Fig 8 HGS: Example of DRS-ground station coverage

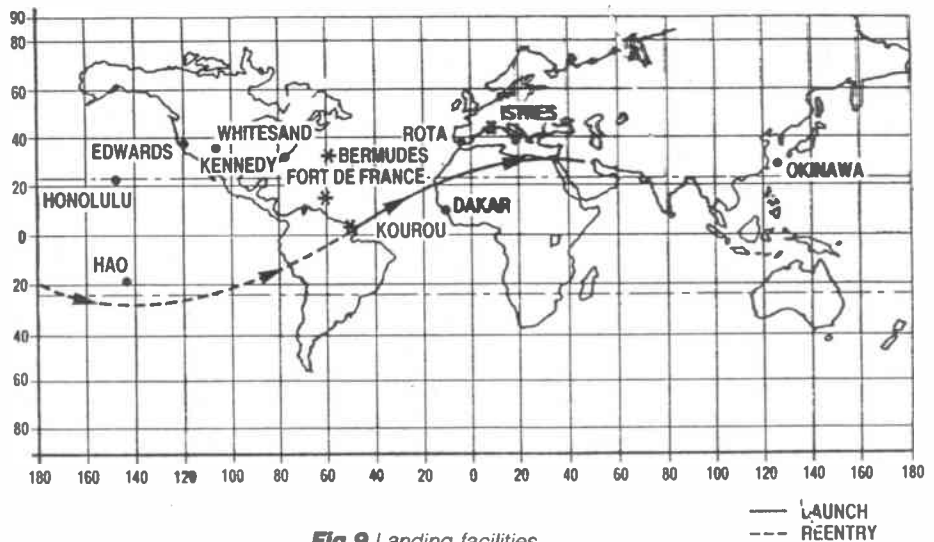


Fig 9 Landing facilities

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# AUDIO SIGNAL GENERATOR

By R A Penfold

# GENERATOR

**A**udio signal generators seem to fall into two main categories these days: very high quality Wien bridge circuits with thermistor stabilisation, or function generators.

The Wien bridge type is ideal for use where very low levels of distortion are required, but has the disadvantage of requiring some relatively expensive and difficult to obtain components. Function generators operate by generating a triangular waveform, and then use a clipping circuit and a non-linear ampli-

fier to provide square wave and sine wave signals respectively.

Although this may seem to be a rather complicated way of doing things, these units can be quite simple and reasonably inexpensive if based on one of the function generator integrated circuits. Their main drawback is that they often give an output signal of comparatively low quality (although this is still perfectly adequate for most audio testing).

This audio signal generator was designed in an attempt to find a practical

alternative to the continuous stream of traditional Wien bridge and function generator types. It offers quite good output quality without requiring any difficult to obtain or expensive components, and certainly represents a perfectly viable alternative to Wien bridge and function generator circuits. The distortion level is typically well under 1% over the range of frequencies covered, which is from a few hertz to over 20kHz. A square wave output can also be provided.

The sine wave output level is approximately 1 volt RMS, which is about 2.8 volts in terms of peak to peak voltage. The square wave output signal is also about 2.8 volts peak to peak in amplitude. There is a switched output attenuator which provides 0dB, 20dB or 40dB of attenuation, as well as a continuously variable (volume control style) attenuator. The output level is within plus or minus 1dB over the audio range.

### System operation

There are numerous types of oscillator that could be used in an audio signal generator circuit, but most of these are rather impractical in that they require either multi-gang tuning potentiometers

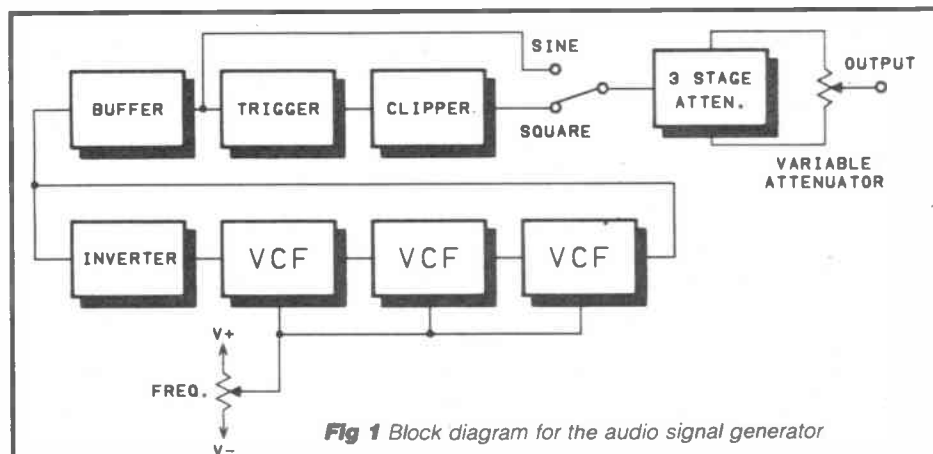


Fig 1 Block diagram for the audio signal generator

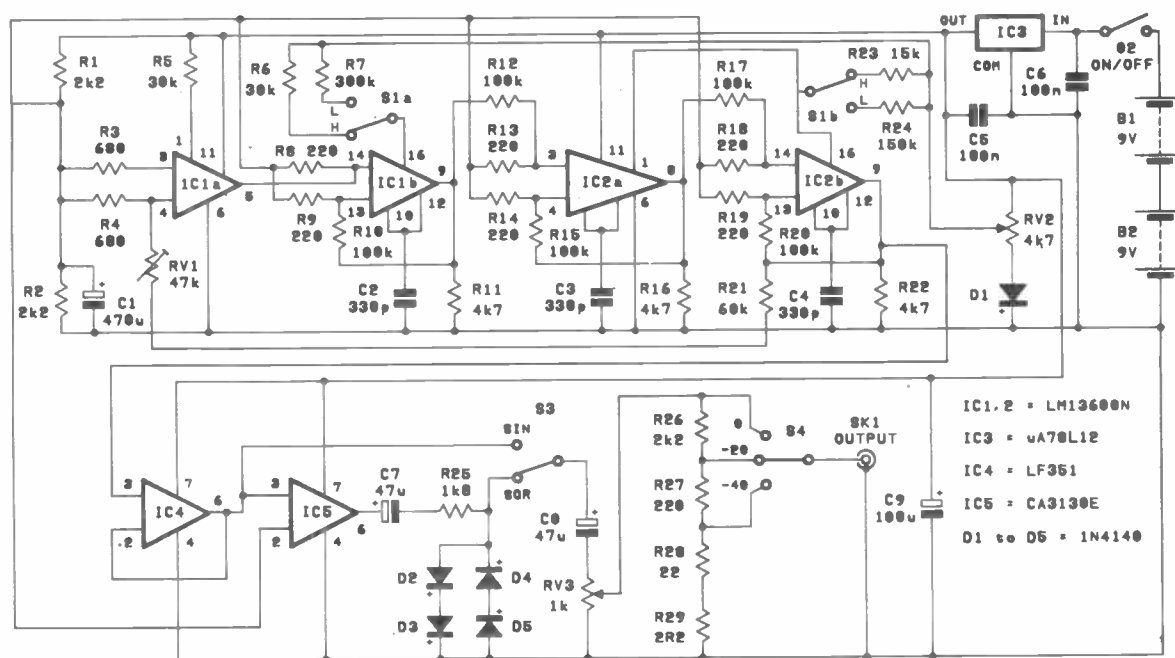


Fig 2 Full circuit diagram

# AUDIO SIGNAL GENERATOR

or large and expensive inductors. The type of oscillator used in this design would normally require a three gang tuning potentiometer, but by utilising voltage controlled circuits it is possible to use an ordinary single gang component. See *Figure 1*.

The oscillator is formed by the inverter and three voltage controlled filters (VCFs). The latter are simple, single pole (6dB per octave) types, which effectively form a three stage (18dB per octave) filter. There is a feedback loop from the output of the third VCF to the input of the inverter, and the circuit oscillates at the frequency where there is a total phase shift of 360 degrees through the four stages. In other words, it oscillates at the frequency where there is a phase shift of 60 degrees through each filter stage, with the inverter providing the other 180 degrees of shift which brings the input and output of the circuit in-phase.

In this respect the circuit is the same as a conventional phase shift oscillator of the type which uses a transistor as an inverting amplifier and a three stage C-R phase shift circuit to provide the feedback.

Although in many ways similar to a conventional phase shift circuit, this type of oscillator has some important differences. The most obvious one is that the use of voltage controlled filters/phase shifters enables the operating frequency to be easily varied over wide limits. All that is required is a single gang potentiometer to provide a variable tuning voltage. Another crucial difference is that the circuit does not require any gain stabilisation. With many oscillator circuits the amount of positive feedback is quite critical. Fractionally too little feedback and the circuit ceases to oscillate, while only marginally excessive feedback results in very strong oscillation with the output signal becoming clipped and grossly distorted.

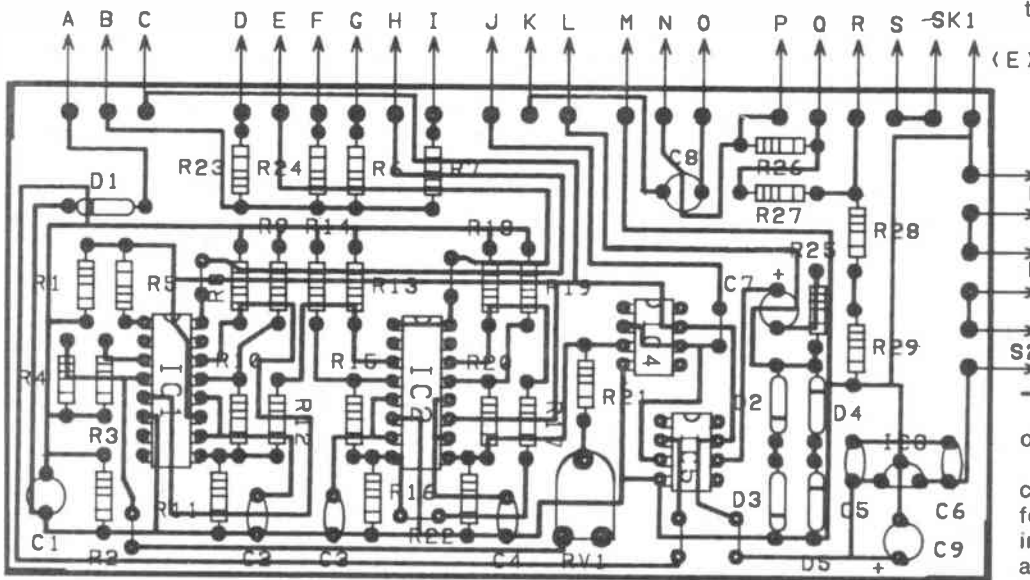
In this case no gain stabilisation is used, and it is not really needed. With the gain set at a level that produces ample feedback to give reliable oscillation over the full operating range of the circuit, the amount of distortion on the output remains quite low. This is due to the filters which, it should be remembered, are not just phase shift circuits, but are also lowpass filters. They give very low

gain and little feedback at frequencies above the fundamental operating frequency, and they also limit the rise and fall times of the signal. This prevents oscillation building up to the point where a virtually square wave output signal is produced, and does in fact dampen oscillation sufficiently to give a sine wave output of quite respectable quality.

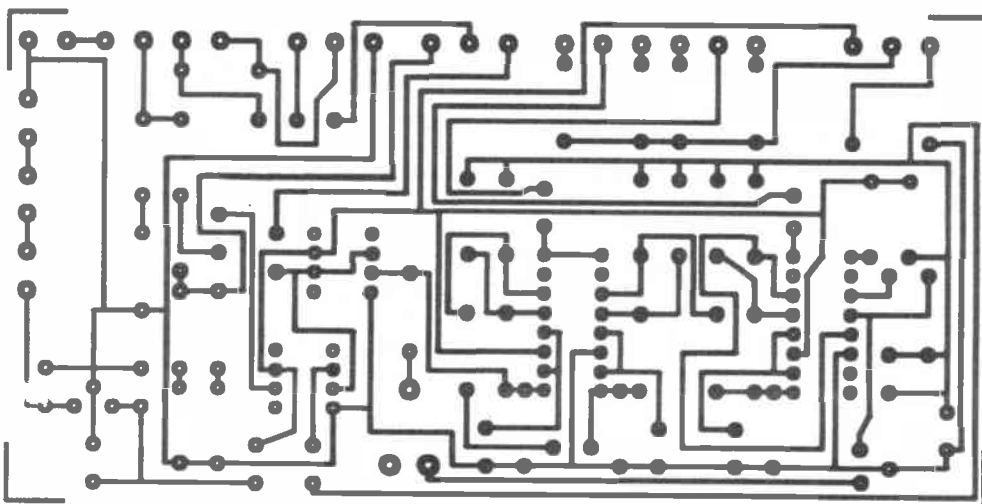
Gain stabilisation in Wien bridge circuits is also used to maintain the output at a virtually constant level, so that changes in output frequency are not accompanied by unwanted shifts in the output level.

The output of the oscillator is fed to a buffer amplifier which ensures that loading of the output, within reason, does not give any significant reduction in the output level. A trigger circuit produces a square wave signal from the sine wave input signal, and a clipping circuit then reduces the signal level to one which is comparable to that from the oscillator. The clipping circuit also improves the wave shape slightly. A switch is used to select the sine wave or square wave signal as required, and to feed it through to the output socket via the attenuators.

*Figure 2* shows the full circuit diagram



*Figure 2* shows the full circuit diagram



**Fig 3** (left and below left) Details of the printed circuit board including component overlay

of the audio signal generator.

Two LM13600N dual operational transconductance amplifiers (IC1 and IC2) form the basis of the unit. IC1a acts as the inverter stage while the other three amplifiers are used in the filters. There are definite similarities between transconductance operational amplifiers and standard operational amplifiers, including the familiar inverting and non-inverting inputs.

There are a number of major differences, though, and the main one is that these devices are current rather than voltage operated. The output therefore responds to the differential input current, but it is an output current and not a voltage that is produced. In practice, transconductance amplifiers are almost invariably used with series input resistors and an output load resistor. This effectively converts them from current to voltage operation.

In this circuit the first filter is driven directly from a transconductance amplifier, and as both are current operated there is no need for a series input resistor. The other two filters are driven



by way of Darlington Pair emitter follower buffer stages which are an integral part of IC1 and IC2, apart from the discrete load resistors. These buffer amplifiers ensure that there is minimal loading on the outputs of the amplifiers, which feed into filter capacitors (C2 to C4) instead of load resistors. The buffers drive the filters via series resistors R12 and R17.

Transconductance amplifiers have an 'amplifier bias' input, for which there is no equivalent on a conventional operational amplifier. The gain of the device is proportional to the bias current fed to this input, or if a series resistor is inserted here, the gain is roughly proportional to the applied voltage. This enables transconductance amplifiers to be readily operated as voltage controlled amplifiers or, as in this case, voltage controlled filters.

Although all three amplifiers have a negative feedback resistor from the output to the inverting input, the feedback networks simply set an upper limit on the voltage gain of the filters, which helps to give more predictable results. The amplifiers are used virtually open-loop, which is essential if the feedback is not to counteract the voltage control of the gain to a point that renders the circuit largely untunable.

Note that, unlike most conventional operational amplifiers, the open-loop distortion of transconductance amplifiers is quite low. The amplifiers in the LM13600N have linearising diodes, and by feeding a bias current to these it is possible to obtain improved linearity. This feature is left unused in this circuit, where it seems to offer no real improvement in performance. Presumably the output signal level is insufficient to permit the diodes to give any significant improvement in linearity.

RV2 provides the tuning voltage. Oscillation cuts off at a voltage of typically just under 1 volt, and so D1 has been used to boost the minimum tuning voltage slightly, so that a minimal amount of RV2's rotation is left unused. S1 provides two switched sets of series resistors at the amplifier bias inputs. The lower value resistors give the full tuning range, but the higher value components provide a maximum frequency of only about 2kHz or so. This lower frequency range makes it easier to accurately set the desired output frequency for low and middle output frequencies. A common series resistor can be used for the two sections of IC2, as these will be accurately matched and will receive virtually identical bias currents. A separate resistor is needed for IC1b to ensure that it receives the correct bias level.

A stable supply is obviously essential if severe tuning drift is to be avoided. The entire circuit is powered from a 12 volt stabilised supply, which is derived from an 18 volt battery supply via monolithic voltage regulator IC3. The transconductance amplifiers require dual balanced

supplies, but in this circuit R1, R2 and C1 form an effective centre tapping on the supply rails, which is used for biasing purposes.

RV1 is the overall feedback level control. This is adjusted for the lowest amount of feedback that gives reliable oscillation over the full range of frequencies covered by the unit.

The buffer amplifier is an operational amplifier voltage follower based on IC4. The trigger circuit is based on a second operational amplifier (IC5) which is used as a straightforward voltage comparator. A reference voltage for the inverting input is provided by the centre tapping on the supply rails, and the non-inverting input is fed with the sine wave signal. As the input signal swings positive and negative of the reference level, the output of IC5 switches high and low respectively, generating a square wave output having a reasonably accurate mark-space ratio.

The CA3130E used in the IC5 position is not an internally compensated device, and in this circuit no external compensation capacitor is fitted either. This still gives stable operation as IC5 is used

open-loop, and the absence of the capacitor gives a very fast slew rate so that a square wave signal with fast rise and fall times is obtained. The output from IC5 is coupled to a conventional diode clipping circuit.

S3 selects either the square wave or the sine wave signal, and couples it through to the continuously variable attenuator (RV3). From here the signal is taken to a conventional switched attenuator, and then to the output socket.

The current consumption of the circuit is about 15 milliamps or so, and medium or high capacity batteries are needed to power the unit economically (eg, two sets of six HP7 size cells in plastic holders). If the unit is to receive a great deal of use it would probably be worthwhile adding a small mains power supply unit.

## Construction

With the exception of the controls, batteries and output socket, all the components are fitted onto the printed circuit board. Full details of the board are provided in *Figure 3*.

Only one of the integrated circuits

## Parts List

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

R1,2,26	2k2 (3 off)
R3,4	680R (2 off)
R5,6	30k (2 off)
R7	300k
R8,9,13,14,18,19,27	220R (7 off)
R10,12,15,17,20	100k (5 off)
R11,16,22	4k7 (3 off)
R21	10k
R23	15k
R24	150k
R25	1k8
R28	22R
R29	2R2

### Potentiometers

RV1	47k hor sub-min preset
RV2	4k7 lin
RV3	1k lin

### Capacitors

C1	47µ 16V radial elect
C2,3,4	330p ceramic plate (3 off)
C5,6	100n ceramic (2 off)
C7,8	47µ 25V radial elect (2 off)
C9	100µ 16V radial elect

### Semiconductors

IC1,2	LM13600N or LM13700N (2 off)
IC3	UA78L12 (12V 100mA positive regulator)
IC4	LF351
IC5	CA3130E
D1,2,3,4,5	IN4148 (5 off)

### Miscellaneous

S1	DPDT sub-min toggle
S2	SPST sub-min toggle
S3	SPDT sub-min toggle
S4	3-way 4 pole rotary
SK1	Phono socket
B1,B2	9 volt (eg 6xHP7s in holder - 2 off)
Case about 150 x 190 x 45mm	
Printed circuit board	
Control knob (3 off)	
8 pin DIL IC holder(2 off)	
16 pin DIL IC holder (2 off)	
Battery connector (2 off)	
Pins, wire, solder, etc	

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(IC5) is an MOS type and the standard anti-static handling precautions should be taken when dealing with this component. I would recommend the use of integrated circuit holders for the other three DIL integrated circuits as well. Note that some suppliers do not supply the LM13600N, but do stock the almost identical LM13700N.

The board has been designed to take modern miniature printed circuit mounting capacitors, and it is unlikely that other types will fit easily into the available space. Seven link wires are required, and these can be made simply from the pieces of wire trimmed from

resistor leadouts. At this stage only pins are fitted to the board at the positions where connections to off-board components will eventually be made.

The prototype generator is housed in a plastic case which has approximate outside dimensions of 150 by 190 by 45 millimetres, and this represents about the smallest case that will comfortably accommodate all the components, including decent sized batteries. The printed circuit board is mounted on the base panel, well towards the front of the unit, so that there is sufficient space for the batteries at the rear of the case. I used 6BA fixings for the board, including

short spacers. It is advisable to include spacers, even if the case is of plastic and not metal construction, since there might otherwise be a tendency for the board to buckle and crack as the mounting nuts are tightened.

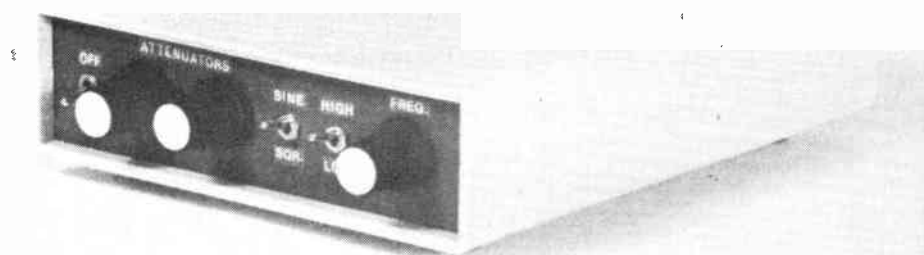
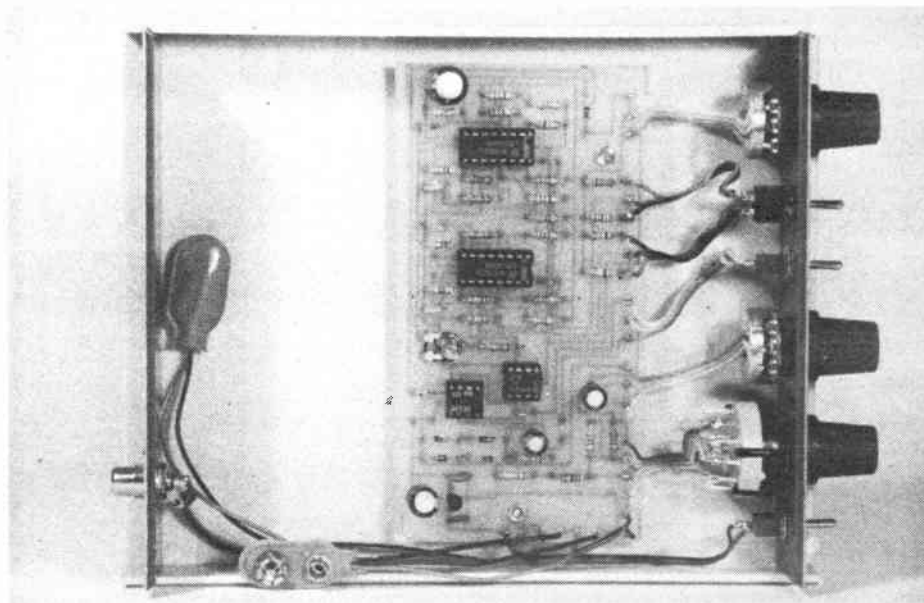
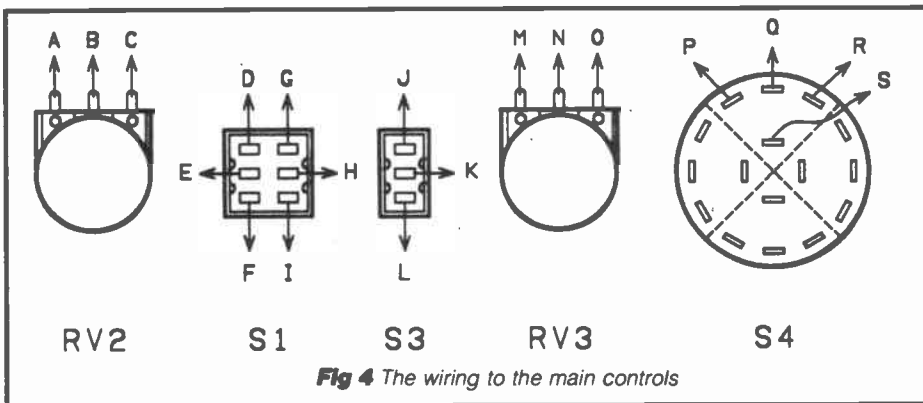
The controls are mounted in a single row along the front panel, and the hard-wiring will be easier if the positioning of these components roughly matches up with their connection points on the printed circuit board. Due to a lack of panel space the output socket is best relegated to the rear panel. I used a phono socket for SK1, but this could, of course, be changed to any type which would be more convenient for your particular set-up. Details of the connections to the main controls are provided in Figure 4, which must be used in conjunction with Figure 3 (eg, 'A' in Figure 3 connects to 'A' in Figure 4, etc). S4 is connected so that each step in a clockwise direction boosts the output signal by 20dB, or a factor of ten in other words.

## In use

Before the unit is ready for use it is only necessary to give preset resistor RV1 the correct setting. With this component adjusted to a roughly central setting, the unit will probably work quite well. In theory, the unit has no minimum output frequency, and has a frequency range which extends from dc to the maximum output frequency of 25kHz or so. In practice, with very low control currents the transconductance amplifiers become inefficient, and this results in insufficient gain and feedback to sustain oscillation. RV1 must be set low enough in value (set far enough in an anti-clockwise direction) to provide reliable oscillation at the lowest frequency that is of interest. It can be adjusted to give operation down to frequencies of just a couple of hertz if desired, but a minimum output frequency of 10Hz or 20Hz is adequate for most purposes.

The switched attenuator might seem pointless, with RV3 enabling any output level from zero to the maximum level to be obtained. However, when setting very low output levels, accurate adjustment of RV3 can be very difficult. Using S3 to reduce the signal by 20dB or 40dB can then make precise adjustment of RV3 very much easier. Similarly, it is easier to set low and medium output frequencies accurately if S1 is set to the 'L' position.

RV2 can be given a scale calibrated in frequency, but some form of frequency standard covering a suitable range will be needed for calibration purposes if this is done. Also, a larger case would be needed so that RV2 could be fitted with a large control knob, which could in turn be equipped with a large calibrated scale. Where possible, it is generally much better if a frequency meter of some kind is used to monitor the output signal and provide accurate frequency indication.





The so-called phase locked loop (PLL) device or technique is widely used in applications such as automatic frequency tracking, frequency multiplication, and frequency synthesis, etc. In this and the next couple of editions of *Data File* we explain the basic operating principles of these systems, look at some popular PLL ICs and show a variety of ways of using these ICs.

A phase locked loop (PLL) can be defined as a circuit that automatically locks the frequency and phase of a variable oscillator ( $f_o$ ) to the mean frequency and phase of an external input reference signal ( $f_r$ ). Such systems are useful in applications such as automatic frequency tracking, frequency multiplication and frequency synthesis, etc. Figure 1 shows the block diagram of a basic PLL system, which consists of a phase comparator, a loop filter and a voltage controlled oscillator or VCO.

The operating principle of the PLL circuit is fairly simple. The phase comparator receives the  $f_o$  and  $f_r$  signals, compares the phase and frequency of  $f_o$  with that of  $f_r$ , and generates a corresponding variable output error voltage. This error voltage is then low-pass filtered and fed to the control input of the VCO in such a way that any frequency or phase differences between  $f_o$  and  $f_r$  are progressively reduced until they fall to zero, at which point the loop is said to be 'locked'.

Thus, if the VCO frequency is initially below that of the external signal, the output of the phase comparator goes positive; its resulting filtered voltage then causes the VCO frequency to increase until both its frequency and phase precisely match those of the external signal. If the VCO frequency rises above that of the external signal the reverse action takes place, and the phase comparator output decreases, again causing the VCO signal to eventually lock to that of the external signal. Thus, the circuit causes the VCO signal to automatically phase lock to the external signal.

Note that the low-pass filter is an essential part of the PLL system, and is used to convert the output of the phase detector into a smooth dc control voltage. Inevitably, it has a finite time constant, so PLL 'locking' is not instantaneous, and  $f_o$  locks to the mean value of  $f_r$  rather than to its instantaneous value. This is useful if a clean output frequency is wanted from a noisy input signal.

In the basic PLL circuit of Figure 1 the output signal frequency simply locks to the mean value of the input signal, and the input and output frequencies are thus identical. Figure 2 shows an alternative version of the PLL circuit, in which the output frequency is precisely ten times greater than that of the input signal; this circuit thus acts as a

## Ray Marston looks at phase locked loop (PLL) principles and circuits in this edition of 'The File'

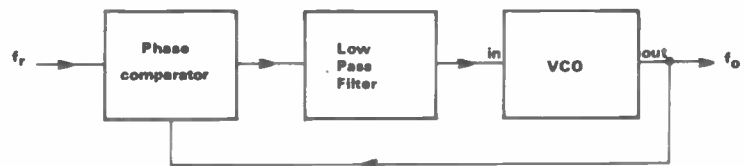


Fig 1 Basic phase locked loop (PLL) circuit

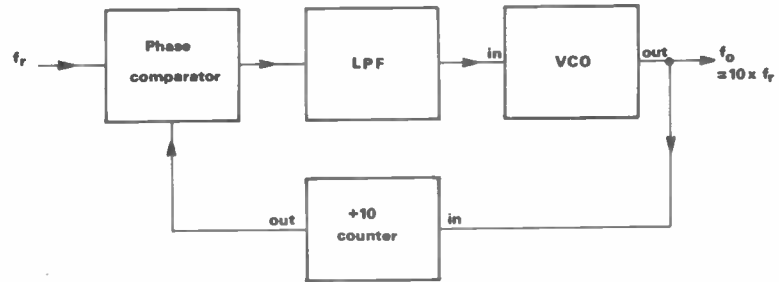


Fig 2 Frequency multiplier circuit

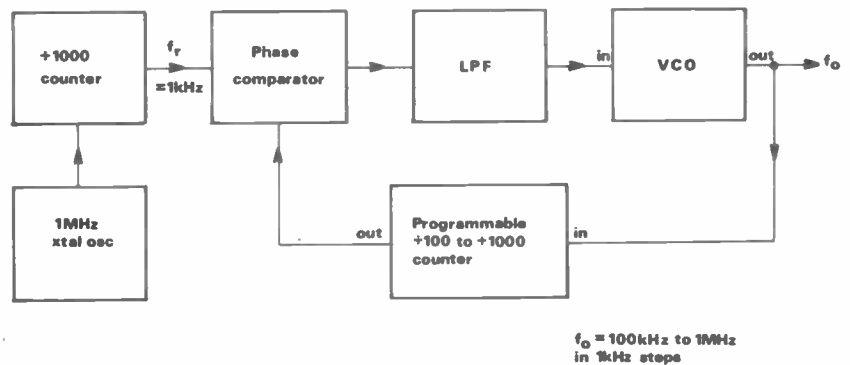


Fig 3 Simple frequency synthesizer

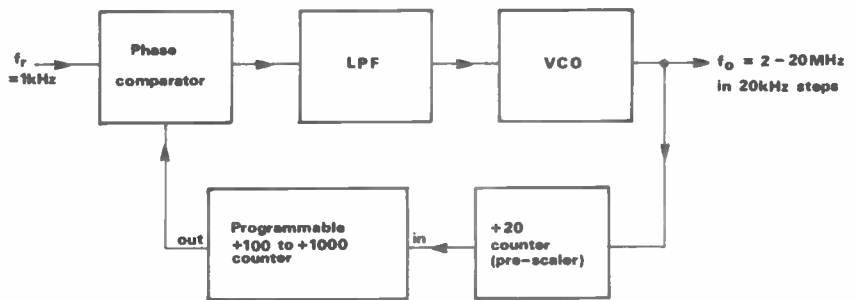


Fig 4 Frequency synthesizer with pre-scaler

frequency multiplier.

Note in the Figure 2 circuit that a divide-by-ten counter is inserted in the feedback loop between the VCO output and the input of the phase comparator. Consequently, instead of the phase comparator locking to the output frequency of the VCO, it locks to the output of the divide-by-ten counter. Thus, at lock, the VCO frequency ( $f_o$ ) is ten times greater than  $f_r$ , and the circuit acts as a  $\times 10$  frequency multiplier. The circuit

can, of course, be used to multiply by any number other than simply by ten using a counter with an appropriate division ratio (in the feedback loop).

Another useful application of the PLL is as a precision programmable frequency synthesizer. Figure 3 shows one version of such a circuit. Note here that the reference input signal of the phase comparator is fixed and takes the form of a precision 1kHz signal that is derived from a 1MHz crystal oscillator via a

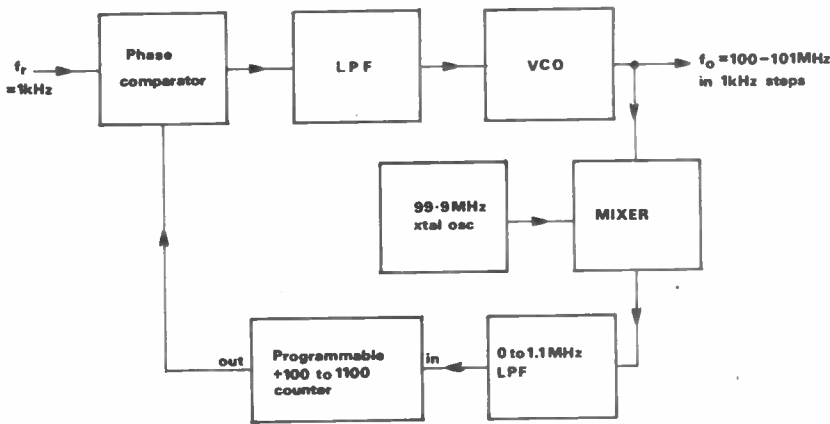


Fig 5 High frequency mixer type synthesizer

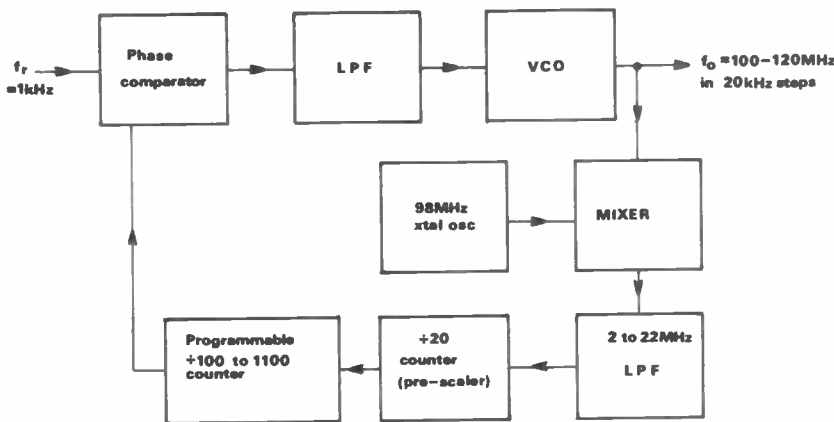


Fig 6 Wide range, high frequency synthesizer

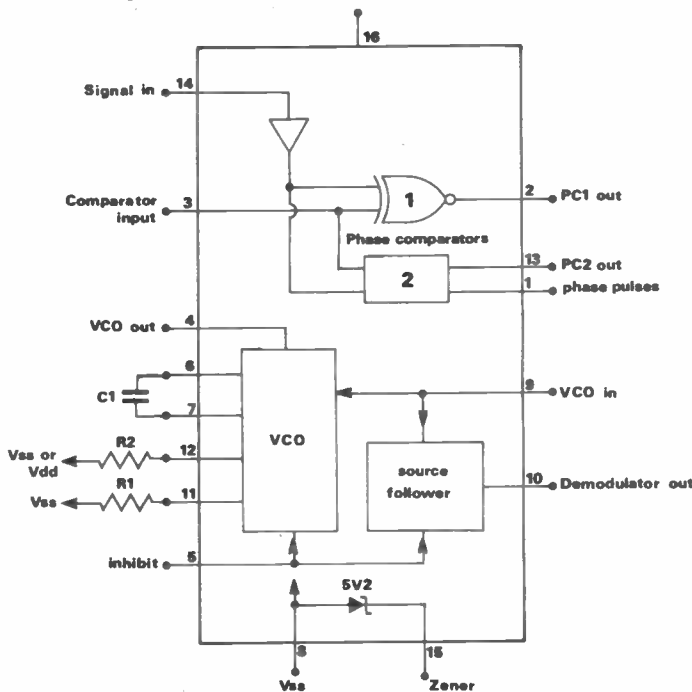


Fig 7 Internal block diagram of the 4046B PLL IC

divide-by-1000 counter. Also note that (as in the case of the frequency multiplier circuit) a counter is wired into the feedback loop between the VCO output

and the phase comparator input, but in this case is externally programmable to give any whole number division ratio value between  $\times 100$  and  $\times 1000$ . Thus, this

circuit can generate or synthesize any frequency between 100kHz and 1MHz (in 1kHz steps), and each generated frequency will have crystal accuracy and stability.

Note in the above circuit that the VCO must have a frequency 'span' range of at least 10:1 to cover the required frequency range, and that the frequency 'step' value corresponds to the 1kHz external input value.

The programmable counter forms an essential part of all frequency synthesizers. In practice, these counters can usually handle maximum input frequencies of only a few MHz, and the basic Figure 3 circuit can thus not be used to directly synthesize high frequency (above a few MHz) signals. High frequency PLL synthesizer circuits are available, however, and Figures 4 to 6 show three alternative versions of such circuits.

The Figure 4 circuit uses a so-called 'pre-scaler' technique, in which an additional 'divide-by-X' fixed value high frequency counter stage (the pre-scaler) is interposed between the VCO output and the input of the programmable counter, to enable the VCO to operate at a frequency X-times higher than the programmable counter stage. In the example shown, the pre-scaler has a divide-by value of  $\times 20$ , enabling the synthesizer to cover the range 2MHz to 20MHz in 900 discrete steps. Note that a disadvantage of this technique is that it causes the step value of the synthesizer to increase by a ratio equal to the pre-scaler value, ie to  $20 \times f_r$ , or 20kHz.

The Figure 5 circuit uses a 'mixer' technique to synthesize frequencies in the range 100MHz to 101MHz in 1000 discrete steps of 1kHz. In this case the VCO output is mixed with a crystal-derived 99.9MHz signal and then low-pass filtered to produce a 100kHz to 1.1MHz 'difference' signal, which is then passed into the phase locked loop via the programmable counter stages. This technique enables the VCO frequency to be varied in steps equal to the  $f_r$  value, but limits the VCO's useful span range to only few MHz.

Finally, Figure 6 shows how the above 'mixer' and pre-scaler circuits can be combined to make a wide range high frequency synthesizer that can generate frequencies in the range 100MHz to 120MHz in 1000 discrete steps of 20kHz. Here, the VCO output signal is mixed with a crystal-derived 98MHz signal and then low-pass filtered to produce an output in the 2MHz to 22MHz range, which is then reduced to the 100kHz to 1.1MHz range via a divide-by-20 pre-scaler stage, before being fed back into the phase locked loop via the programmable counter stage.

In high frequency PLL synthesizers the VCO is normally required to cover a very limited 'span' range, and normally takes



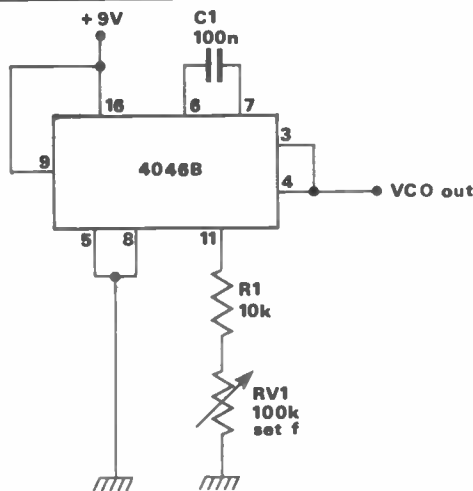


Fig 8 Simple 200Hz to 2kHz square-wave generator

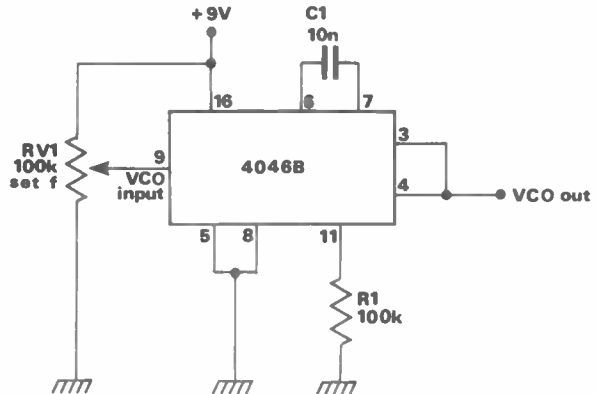


Fig 9 Wide range VCO, variable from near-zero to 1.4kHz via the pin 9 voltage

the form of a varicap-controlled transistor oscillator-plus-buffer circuit. In low frequency synthesizers the VCO is normally required to cover a very wide span range, and normally takes the form of a special CMOS or bipolar oscillator. Some dedicated PLL ICs contain excellent wide-range VCOs that are outstandingly useful in their own rights; amongst the best known of these ICs are the 4046B CMOS chip and the NE565 and NE567 PLL devices from Signetics.

The 4046B is an outstandingly useful PLL IC, based on CMOS technology. Its built-in VCO can be voltage-scanned through a million-to-one frequency range and has a top-end frequency limit in excess of 1MHz. Figure 7 shows the outline and pin notations of the device, which is housed in a 16-pin DIL package. This figure also shows the internal block diagram of the 4046B and the basic external connections of its integral VCO.

The 4046B houses two different types of phase comparator, plus a very sophisticated VCO, a simple Zener diode, and a simple source-follower buffer stage. Phase comparator 1 is a simple EX-OR type; it has a good noise rejection performance, but must be

driven by square waves on both pins 3 and 14 and has only a narrow capture-frequency range. Phase comparator 2 is an edge-triggered logic/bistable type with a 3-state output; it can be driven by grossly non-symmetrical waveforms on pins 3 and 14 and has a very wide capture-frequency range, but has fairly poor noise rejection.

The 4046B's VCO is a wide-range device with a maximum operating frequency in excess of 1MHz. Its operating frequency is determined by the voltage

on pin 9, by the capacitor value between pins 6 and 7 (50pF minimum), and by the values of R1 and R2; R2 enables the minimum operating frequency to be preset, and can be eliminated in many applications. The VCO generates a symmetrical square-wave output, which appears in pin 4.

The pin 9 VCO-input terminal of the IC has a near infinite input impedance and can be driven from a high impedance source; the internal source follower stage, enables the pin 9 voltage to be

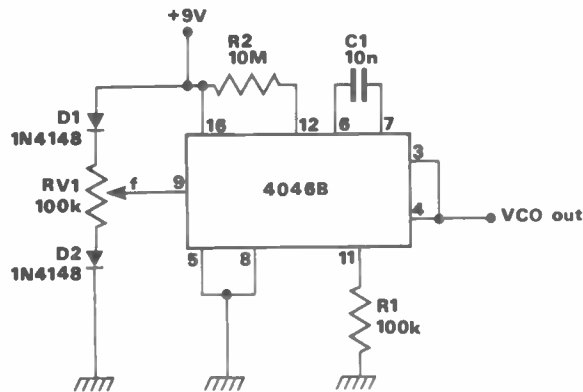


Fig 10 Wide range VCO, with f fully variable down to zero

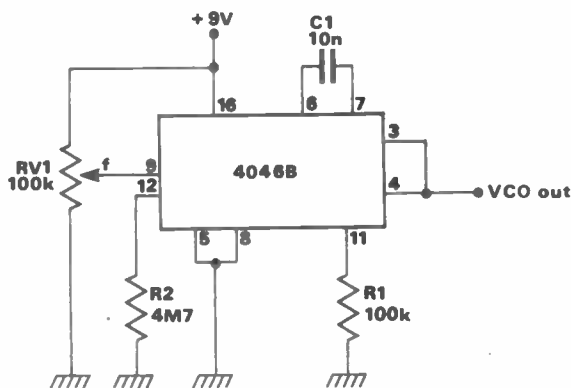


Fig 11 Restricted VCO, variable from 60Hz to 1.4kHz via RV1

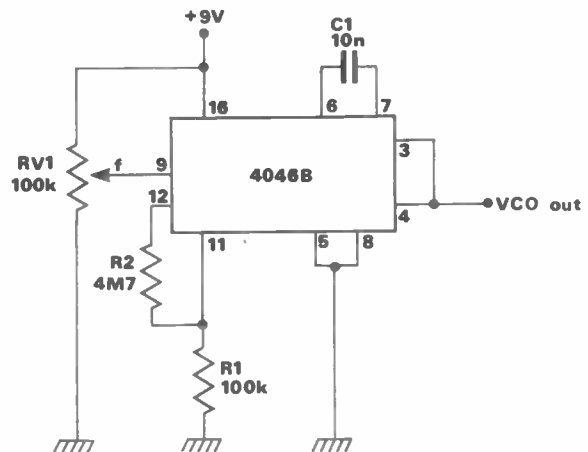
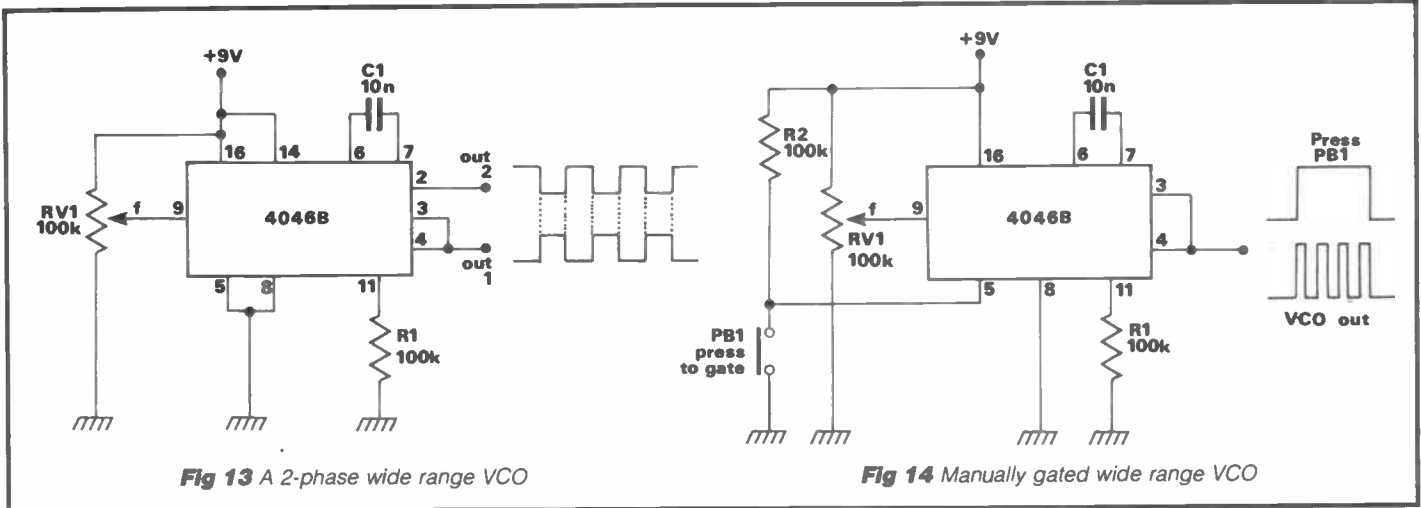


Fig 12 Alternative version of the restricted range VCO



externally monitored without loading this source. INHIBIT terminal 5 of the IC is normally tied to VSS, to 'enable' both the VCO and the source follower. Both of these devices are disabled when a logic 1 is applied to pin 5. The IC's internal Zener diode (between pins 8 and 15) has a nominal operating value of 5V6, and can be used to provide supply regulation. Figures 8 to 16 show some basic ways of using the VCO section of the 4046B IC. Figure 8 shows the simplest way of using the VCO; here, the pin 9 voltage control input is tied permanently high and the circuit acts as a basic square-wave oscillator with its frequency variable over a 10:1 range via RV1. Note at this point that the VCO output (pin 4) is tied directly to the pin 3 phase comparator input; if pin 3 is allowed to float the comparators self-oscillate at about 20MHz and superimpose an HF signal on the top part of the VCO output waveform.

Figure 9 shows how to connect the 4046B as a wide-range VCO. Here, R1-C1 determine the maximum frequency that can be obtained and RV1 controls the actual frequency via the pin 9 voltage. The frequency falls to near-zero (a few

cycles per minute) with pin 9 at zero volts. The effective control range of pin 9 varies from roughly one volt above zero to one volt below the positive supply value.

Figure 10 shows how these 'dead' areas of RV1 can be eliminated by wiring a silicon diode in series with each end of RV1. The circuit also shows how the minimum operating frequency can be reduced to zero by wiring high-value resistor R2 from pin 12 to VDO. Note that, when the frequency is reduced to zero, the VCO output randomly settles in either the logic 0 or logic 1 state.

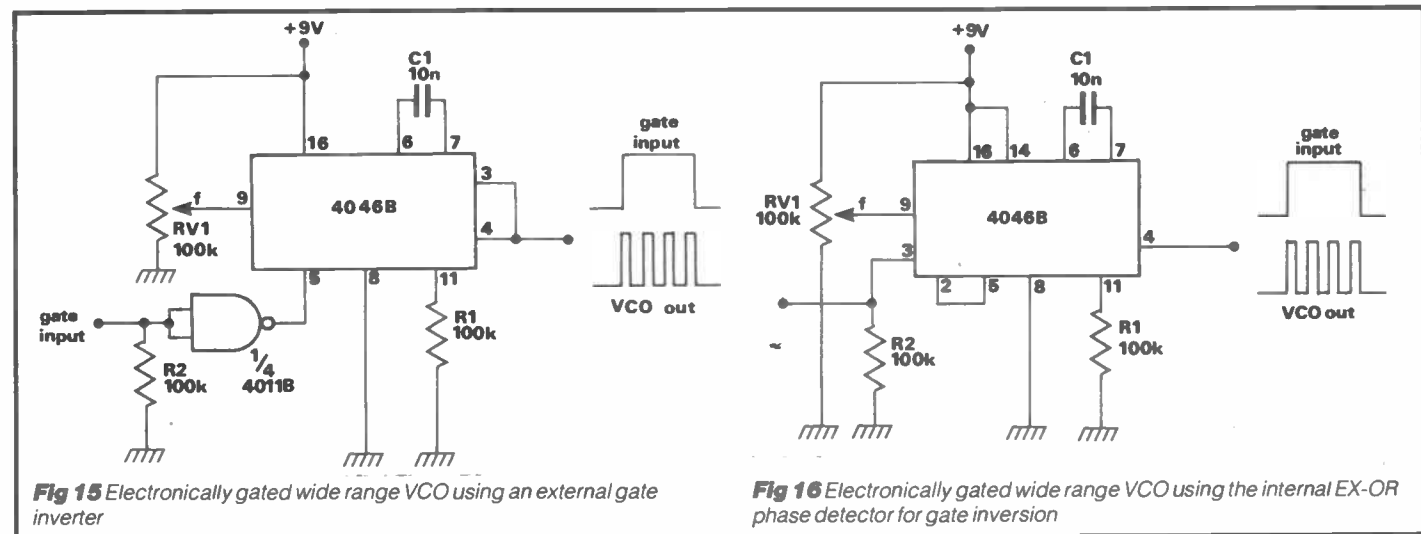
Figure 11 shows how the pin 12 resistor can, alternatively, be taken to VSS and used to determine the minimum operating frequency of a restricted range VCO; the minimum frequency is determined by R2-C1, and the maximum by C1 and the parallel value of R1-R2.

Figure 12 shows an alternative version of the restricted-range VCO, in which the maximum frequency is controlled by R1-C1, and the minimum by C1 and R1 + R2. By suitable choice of R1 and R2 values, the restricted-range VCO can be made to 'span' any range from 1:1 to near infinity.

The VCO can be made to generate a pair of anti-phase square wave outputs by connecting the VCO output to the phase comparator input, taking the signal input (pin 14) high and taking the anti-phase output from pin 2, as shown in Figure 13. Note that this circuit makes use of the IC's built-in EX-OR gate.

The VCO section of the 4046B can be disabled by taking INHIBIT pin 5 high (to logic 1). This feature enables the VCO to be gated on and off via external signals. Figure 14 shows how the VCO can be manually gated via a push-button switch wired to pin 5, and Figure 15 shows how the circuit can be gated electronically via an external inverter stage (made from a 4011B CMOS gate). Alternatively, if the 2-phase output facility is not needed, Figure 16 shows how the internal EX-OR phase detector can be used to give gate control. Note in this latter case that pin 4 is not connected to pin 3.

That completes our look at the basic features of the 4046B's VCO section. In next month's edition of *Data File* we will show how some of these features can be combined or used to make really useful practical circuits.





# LONG LIVE THE SIXTIES!

## Sir Douglas Hall harks back to those halcyon days of home construction and updates two of his receiver designs from that period

**D**uring the 1960s there was a revival in the hobby of making simple receivers and amplifiers. Good transistors had become available to the public, which in some ways brought about a repeat of the position in the '20s and '30s, when designers were competing with each other to produce simple designs for the home constructor and dealers were producing large numbers of kits. As in the '20s, in the '60s unusual circuits attracted unusual interest.

Now, in the '80s, few make their own receivers, or any other electronic apparatus for that matter. There are various reasons for this. The computer, and all that goes with it, has won over many who might otherwise be radio constructors, cheap imported radios are available and some components have increased enormously in price. For

example, a well-known make of tuning capacitor of 365pF appears in a 1969 catalogue at 10/3 (51p), while the same component is advertised in 1987 at £5.12. Nevertheless, many transistors have actually dropped in price, which means that they have fallen a very long way in real terms, and many small components have remained steady in price over a long period.

Above all, I believe that the otherwise very useful integrated circuit has been most responsible for a slackening interest in home construction. The most enjoyable form of home construction, after all, is undertaken by those with enough theoretical knowledge to understand what is happening and why, possibly enabling a few experiments to be carried out with a view to improving results. However, it is very difficult to know what is going on in an integrated

circuit, and quite impossible to experiment with the innards!

I believe that there are still many who have some experience in this subject, although not enough to design their own circuits, who would like to do some simple construction but do not know where to look for help. With this in mind, I have updated two of my designs of the '60s so that they use currently available components and, incidentally, give improved results. I am assuming that those who are interested will be able to read a theoretical diagram and will have had some constructional experience.

The first of these two designs was published in the *Radio Constructor* for November 1965, under the title of *Simplicity and Sensitivity with 3 Transistors*. It was popular, and was referred to by some as the 'SS3'. The very simple circuit, for medium wave only, appears in *Figure 1*. Tr1 amplifies as an RF amplifier in the common emitter mode, followed by Tr2 as an emitter follower RF amplifier. There is a Colpitts controlled reaction. A diode detects, and then Tr1 and Tr2 each amplify as common emitter AF amplifiers. Tr3 is transformer coupled from Tr2 and is a third common emitter amplifier. The reaction control also acts as an AF volume control by progressively damping the interstage transformer.

In the 1987 version, shown in *Figure 2*, the original obsolete transistors are replaced by others and the diode is changed, admittedly to another old one, but one which is still available and gives better results in this particular circuit. The volume switch is modified to control

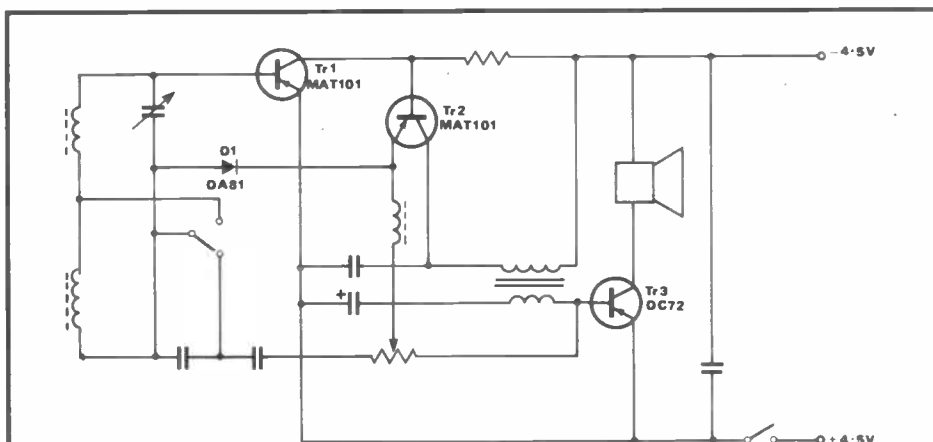


Fig 1

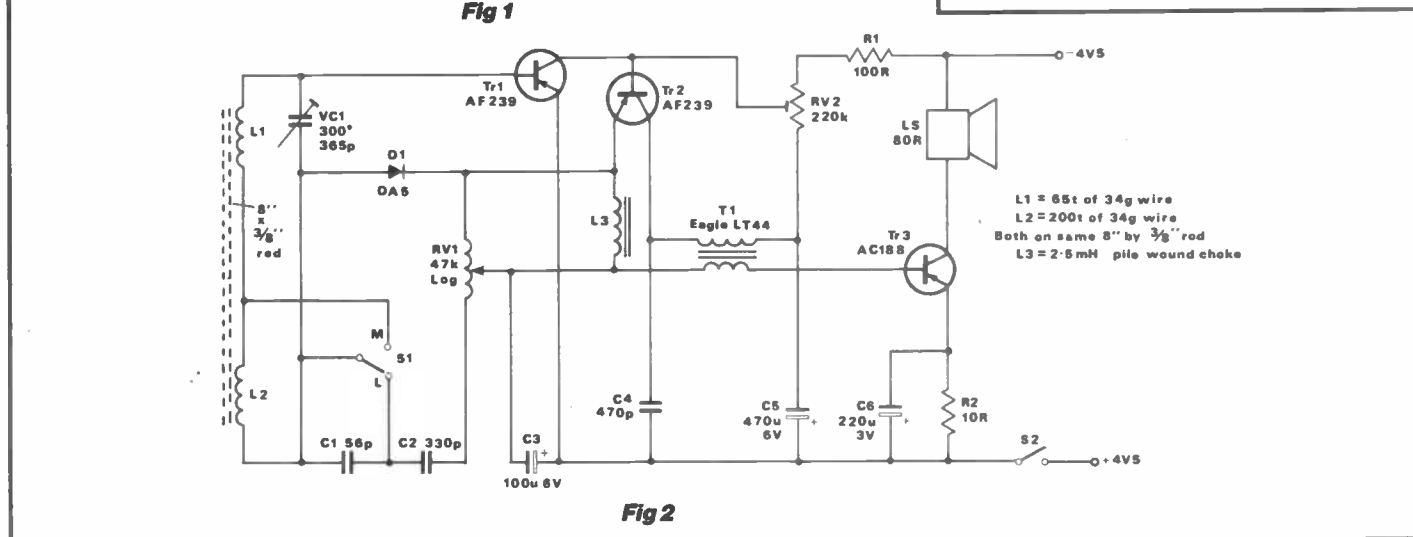


Fig 2

RF rather than AF gain. A long waveband is added.

The layout is simple. The only important point is to remember to arrange for L3 to be within an inch or two of the 'hot' end of L1 (which is mounted on the opposite end of the same rod as L2) and to retain its leads so that it can be twisted to give the optimum orientation for best reaction results.

Setting up is also easy. Adjust the position of L1 on the rod and the orientation of L3 for best results at the long wavelength end of the medium wave band. The long wave band should then look after itself, but it may be necessary to reverse the coil on the rod.

As for components, the four semiconductors and an excellent 4 inch diameter 80 ohm speaker, which will give much better results than a midget, are obtainable from Brian J Reed, of 161 St John's Hill, Clapham Junction, London SW11 1TQ, for a little over £2 plus an SAE. An open postal order must be used for payment, otherwise there will be a further charge of 20p. VC1 will be expensive if bought new, but a suitable 'surplus' air-spaced dual gang component is available, complete with integral slow motion, which is useful in this quite sharply tuning receiver. It can be obtained from Radio Component Specialists, 337 Whitehouse Road, West Croydon, Surrey, for £2 plus 65p postage. Only one gang will be used in practice.

All other components should be available at local radiostores, and the total price should be comfortably under £10. It is useful to obtain catalogues from the two firms mentioned, each being available in return for a stamped addressed envelope. No doubt there are many other firms who could supply suitable components for this receiver.

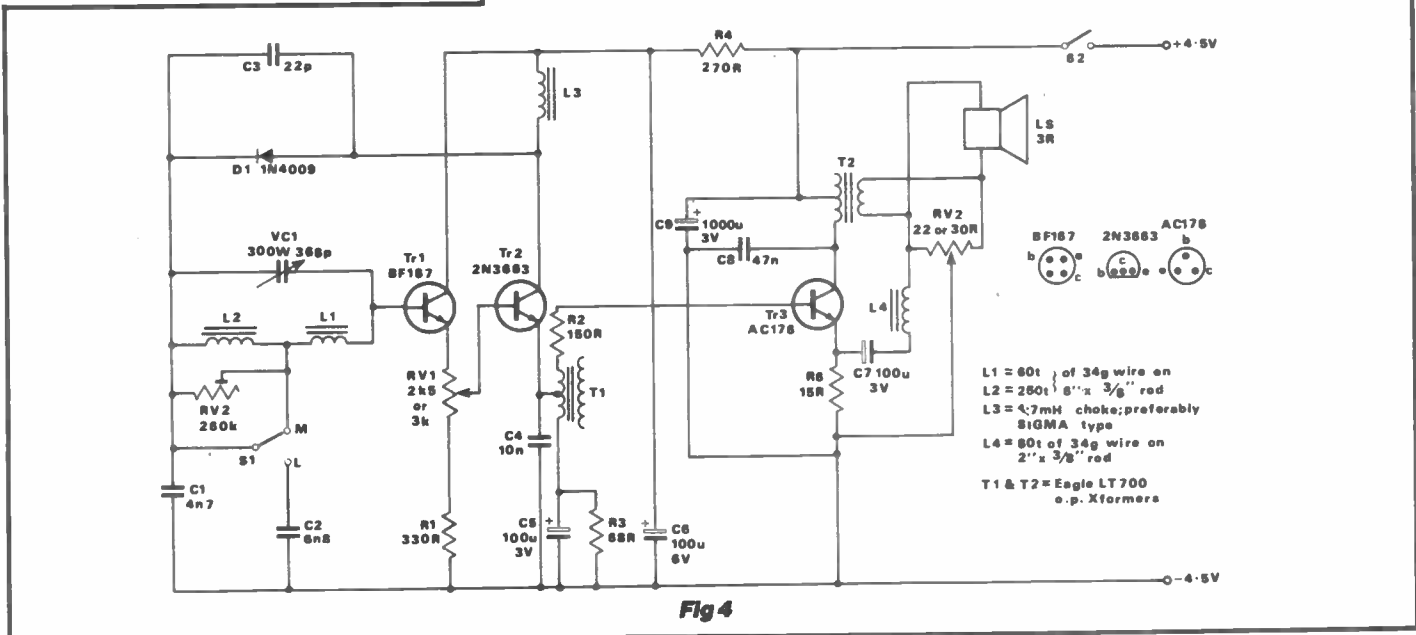
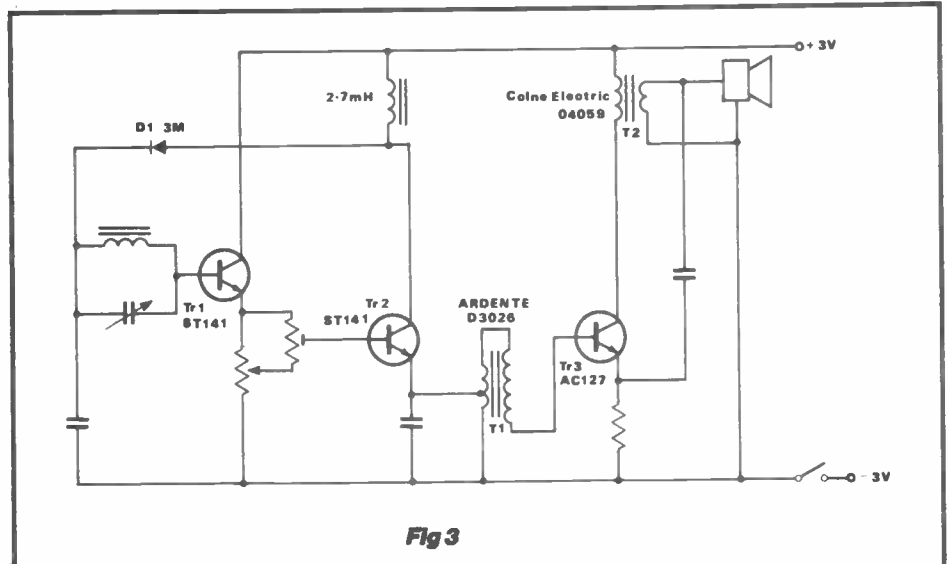
The second design chosen for the purpose of this article was originally published in the *Radio Constructor* for

July 1968, under the title *Developing the Miniflex Circuit*, see Figure 3. The earlier Miniflex circuit had been for a personal receiver. The one now under consideration came to be known as the 'Miniflex Mk II'. In this design, Tr1 acts first as an RF amplifier in the emitter follower mode and is followed by Tr2 as a common emitter RF amplifier. Detection was by a selenium rectifier, now very difficult to obtain, which should be replaced by a silicon type (not germanium) shunted by a capacitor. Reaction is by the Colpitts method, and detection is followed by Tr1 and Tr2, now acting as a super Alpha pair at AF. The output from this pair is at very low impedance which allows a step up transformer to be used for coupling to Tr3.

A fixed degree of AF regeneration takes place within Tr3, which tends to favour the higher audio frequencies and helps to restore the loss of those frequencies brought about by the use of RF regeneration. VR1 acts as a combined

RF reaction control, RF gain control and AF gain control. An interesting feature of the circuit is that as VR1 is advanced to increase volume, the current passed by Tr2 and Tr3 increases; this current also increases with a powerful carrier as a result of the action of D1. Consequently, there is a built-in economy device, the receiver passing less current from the battery when turned down to a low volume level or when a weak station is being received.

T1 and T2 were special types. T1 had windings with a low impedance but fairly high direct resistance, which provided correct bias for the base of Tr3. T2 had sufficiently high impedance to match the output of Tr3, but very low direct resistance, which was needed as there was only a 3 volt power supply. In practice, the two transformers quickly became unobtainable, and although substitutes were found for constructors, these were also only on the market for a short time after the design was first published.





# LONG LIVE THE SIXTIES!

Figure 4 shows the updated version of this circuit. T1 is now a small, easily obtainable output transformer, wired up in an unusual way to provide a voltage step up of 2:1, and is used in conjunction with external resistors (and one electrolytic capacitor) to provide correct bias. T2 uses a similar transformer, in a conventional way, but the power supply has to be increased to 4½ volts because of the increased resistance in the collector circuit. There is some overall gain in output as 1½ volts are added to replace less than the voltage lost. Decoupling arrangements are added to reduce the power supply to 3 volts, as required by Tr1 and Tr2.

Easily obtainable transistors are substituted, as those originally specified for Tr1 and Tr2 are no longer obtainable.

AF regeneration is now variable, and the presence of L4 prevents a tendency for the circuit to become unstable at very high audio frequencies before the full benefits have been obtained.

As to layout L3, which should be a sigma type, this should be within a few inches of L1 and L2 and arranged so that it can be orientated for best reaction results. A suitable sigma choke is available from Electrovalue, 28 St Judes Road, Englefield Green, Egham, Surrey,

and from other dealers. A pile wound choke in this position may make setting up much more tricky.

Again, the four semiconductors are all available from Brian Reed, as also are the two wire wound potentiometers. The total cost for these six components comes to a little over £1, plus the 18p stamp. The same tuning capacitor as suggested for the other circuit can be obtained from Radio Component Specialists, who can also supply the two LT700 transformers at 75p each, and a suitable 8in by 5in 3 ohm speaker for £3. Other components should not present problems and the total cost should come to between £10 and £15.

Setting up consists of adjusting the position of L1 on its rod and the angle of L3, for best results on the medium wave band, and adjusting the position of L2 on its separate rod for best results on 1500 metres. It will probably be found that other long wave stations will not be received on this band in most parts of the British Isles. If reaction on this band cannot be properly cut back by VR1, L3 should be shunted by VR3, which need not be fitted until it is found necessary. VR3 would then be adjusted for proper reception of Radio 4.

If AF regeneration is not obtained, the

connections to the secondary of T2 should be reversed. It may be found that a very powerful signal will cause overloading and severe distortion when the volume control is turned well back. In this event, turn the receiver for reduced pickup by the aerial rod.

Of the two designs described, the SS3 is probably the easier to construct and set up. All components can be mounted on a piece of plywood about 8in square, using group boards or tag strips for transistors, resistors, capacitors, etc, and there will be room for a 1289 battery too. Sensitivity is quite high and it will be possible to receive many stations in most parts of the country. Selectivity is also quite good for such a simple receiver.

Both sensitivity and selectivity will be a little lower with the Miniflex Mk 11, especially on the long wave band, but quality is surprisingly good and it is well worth using a largish speaker such as the 8in by 5in one suggested. Three type D cells should be used as a battery. This receiver will clearly be larger than the SS3, as described. Perhaps the Miniflex is the more interesting technically of the two. The method of obtaining economy of current consumption and the way AF regeneration is used are both very unusual, if not unique.

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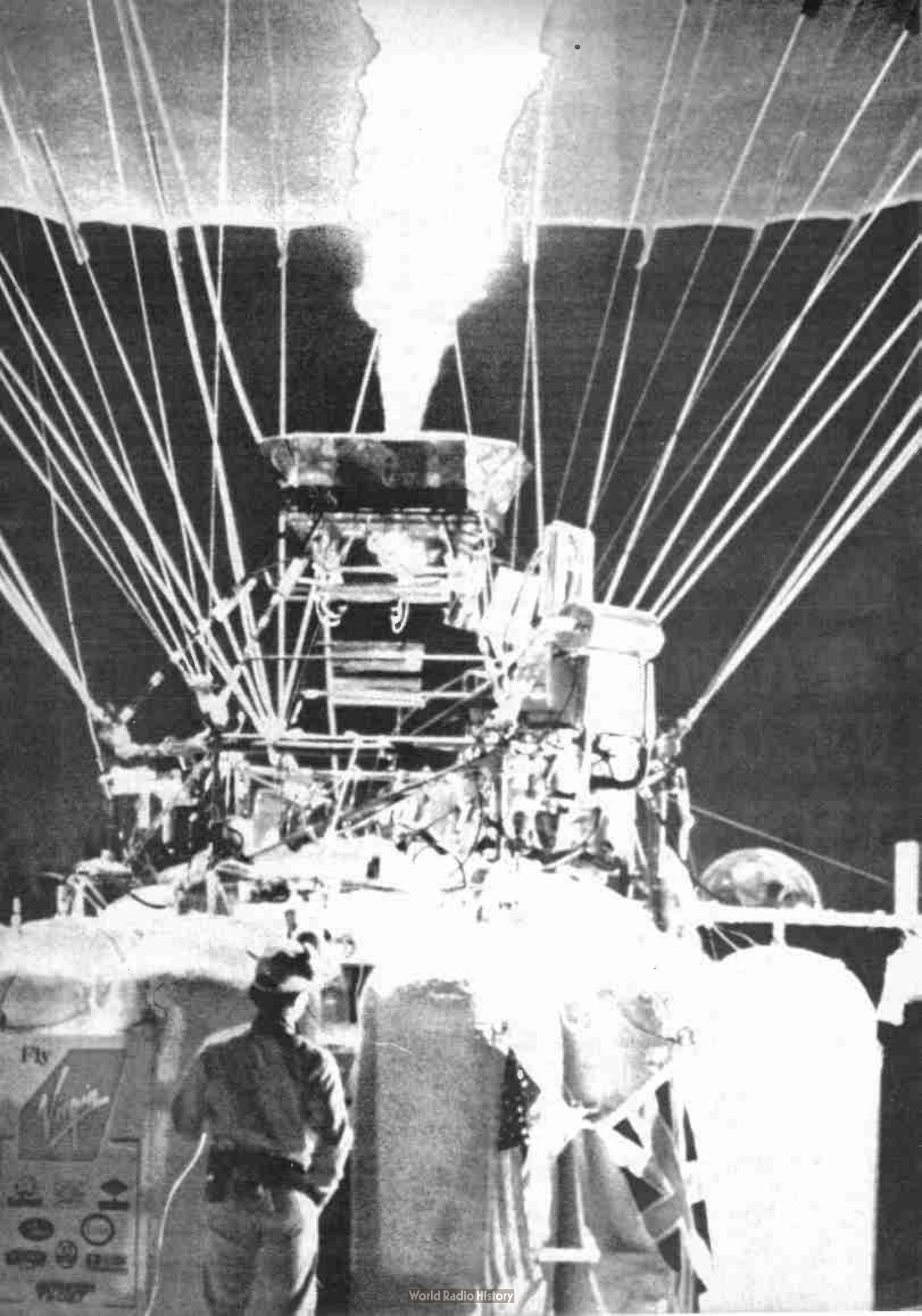
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# LOOPSTICK TECHNOLOGY

The loopstick is a component in the common transistor radio. It goes unnoticed and is taken for granted. It is also known as the ferrite rod antenna or aerial, or the ferrite loop; in the USA it has been described as the scoop loop! The ferrite loop is probably the most correct designation.

The writer has spent many happy hours researching and experimenting with ferrite loop designs. They seem simple, yet are complex devices. The loopstick is a loop antenna, believe it or not, consisting of a coil wound on a ferrite core (the rod) and resonated to a specific frequency by a capacitor. It is as easy as that! Very little information on the subject appears in the textbooks.

If scientifically designed and made, it can produce long distance (DX) reception on the long waves/medium waves and on the lower frequency short waves. Unfortunately, in a transistor radio it is often so inefficient that the expression 'big is beautiful' does not apply. For example, take the large transistor 'blasters', made to be carried with a shoulder strap, costing a fortune in their chrome and colour glory, with two integral speakers and lots of beautiful audio watts. A peep inside one of these reveals a tiny, poor, inbuilt ferrite loop, which picks up only the nearer high powered European stations, which it enthusiastically audio amplifies. With a top class radio, such as a Grundig or a Sony, etc, long distance reception is possible because they use efficient ferrite loops. Reception of MW East Coast American stations is possible in the dead of night.

The ferrite loop antenna first appeared

at the time when valve radio production still existed and the first transistor radios were being tentatively introduced. Before that it had, in various forms, been used as a direction finder.

Originally the frame aerial was used in portable radios, which consisted of large turns of wire often wound in a basket weave and fixed to the inside rear of the radio. It was both the RF input tuned circuit and the aerial. Facilities usually existed for plugging in an external long wire aerial for more distant reception. Ultimately, the inbuilt frame aerial was replaced by the ferrite loop, which performed the same function in a similar way. Yet the modern enthusiastic MW-DXer invariably still uses a largish frame/loop antenna!

The ferrite loop consists of a coil of wire wound over a ferrite rod and resonated to the station frequency with a variable capacitor. Figure 1 shows it in its simplest form for LW and MW reception.

On LW, the two coils L1 and L2 are connected in series. On MW, switch S shorts out the larger L2. The whole is resonated by a variable capacitor, VC. This forms the combined RF input circuit and antenna and is directional.

The polar diagram is shown in Figure 2. It will be seen that the maximum signal arrives at the 'long' side, and the null (minimum signal) is off the ends. Antenna rotation can assist in the reduction/elimination of other station interference and man-made electrical noise.

Ferrite rod loops consist of a coil wound around a rod of magnetic material known as a 'ferrite', which, for me,

conjures up childhood memories of messing about with iron filings on a piece of paper with a magnet underneath. The ferrite is a *non-metallic* magnetic material which concentrates the magnetic field through the coil. Various rod materials are used, but are usually manganese-zinc or nickel-zinc mixtures.

In the course of research and experimentation, some interesting properties have been discovered about a coil wound on a ferrite rod:

1. The inductance of a given coil increases as it is moved from the rod end towards the centre.
2. The pick-up range and nulling increase as the ferrite rod used is lengthened. One loop exists using an 18in long rod!
3. A narrow wave or pile wound coil gives better nulling and pick-up range than a simple single layer side-by-side winding.

When considering the design of a ferrite loop for DX work, it is necessary to bear all these properties in mind. They often seem to be neglected in popular transistor radios, yet results can be truly remarkable with adequate loop experimentation.

## Reasons to be cheerful

Readers interested in using ferrite loops will fall roughly into three main categories:

1. Those wishing to use a ferrite loop in a home-built transistor radio.
2. Those wishing to use a ferrite loop with an existing communications receiver requiring an external antenna, ie one with no internal antenna.
3. Those interested in DX reception on

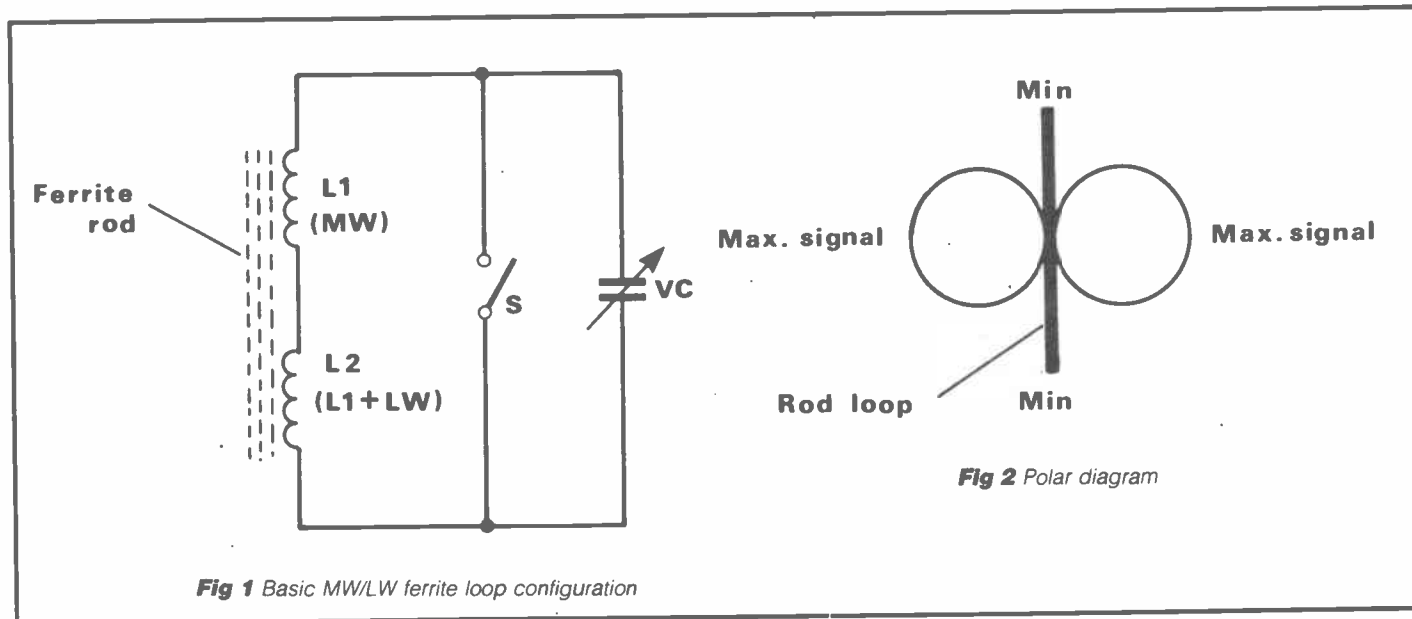


Fig 1 Basic MW/LW ferrite loop configuration

Fig 2 Polar diagram



# by Richard Marris G2BZQ

long wave, medium wave and the LF end of the short wave bands.

## Home-brew transistor radios

Circuits, layouts and parts lists appear in various magazines from time to time. The Maxi-Q/Denco range of standard ferrite loop antennas is particularly useful, especially their Technical Bulletin, DTB4, and General Catalogue which provide useful circuits, layouts and components. Figure 3 shows typical Denco ferrite loops. Figure 3A shows a typical rod loop by Denco for valve circuits and Figure 3B is more suitable for transistor circuits.

## External ferrite loops

Many SWLs have a general coverage receiver which also has the MW band; usually neglected as SW is their main interest. Also, there are many other radios around requiring an external antenna. An external ferrite loop is ideal, and a very simple design will be found in an article entitled *The MW Ferriter* (see references).

A design for LW and MW is included in an article entitled *An External Ferrite Loop Antenna* (see references). LW, MW and antenna coupling coils plus rods can be obtained from Cirkit (Park Lane, Broxbourne, Herts. Tel: 0992-444111). You buy these separately and make up a combination to suit your own particular needs.

## Long range LW-MW-SW reception

Those interested in DX reception on LW, MW and SW require an excellent communications type Rx plus a good loop. The loop is usually of the frame/wire type, but it is not generally realised that DX reception is possible using a ferrite loop. The writer has loops working from about 4MHz (75 metres) to 140kHz (2142 metres).

Long rods are necessary for DX but they cannot be purchased. The longest rods available commercially in the UK appear to be 8in long x 3/16in diameter. The largest identified, in the USA, has been a massive 12in long x 3/4in diameter and its cost, including freight, etc, is about equal to the purchase price of two cheap transistor radios!

So, if really long rods cannot be purchased, the answer is to make them! The writer has designed and published an article, *LW Rod Loop DXer*, using an 18in long x 3/16in diameter rod with a massive home-wound coil. This, with a good receiver, will bring in loud and clear stations which cannot be heard on a good middle of the road commercial transistor radio! To this must be added *The Top Band Ferriter* using a 16in long x 3/16in diameter rod. It uses a home-wound coil and has been designed for use on the 160 metre amateur band between 1800-2000kHz with some overlap. A small amount of useful information appears in ARRL publications.


## Summary

It will be seen that there is a lot more to this ferrite loop business than at first meets the eye. There is something there for the newcomer building his first simple transistor radio and, to the other extreme, there is something for the serious experimenter. Remarkable results can be achieved!

Most items required are comparatively low priced - which is a refreshing change these days.

## References and sources

Maxi-Q/Denco ferrite rod coils and Technical Bulletin DTB4 plus catalogue are obtainable from G & P Powles, 8 Brunel Units, Brunel Road, Gorse Lane Industrial Estate, Clacton on Sea, Essex CO15 4LU. Individual LW, MW coupling coils plus rods are available from Cirkit, Park Lane, Broxbourne, Herts EN10 7BR.

1. *An External Ferrite Loop Antenna*, by R Q Marris G2BZQ, *Practical Wireless*, February 1986.
2. *Long Wave Rod Loop DXer*, by R Q Marris G2BZQ, *Radio and Electronics World*, March 1987.
3. *The Top Band Ferriter*, by R Q Marris G2BZQ, *Amateur Radio*, January 1987.
4. *Frame Antennas*, ARRL Antenna Book (updated 14th edition).
5. *Beat the noise with a Scoop Loop*, ARRL Antenna Anthology. 

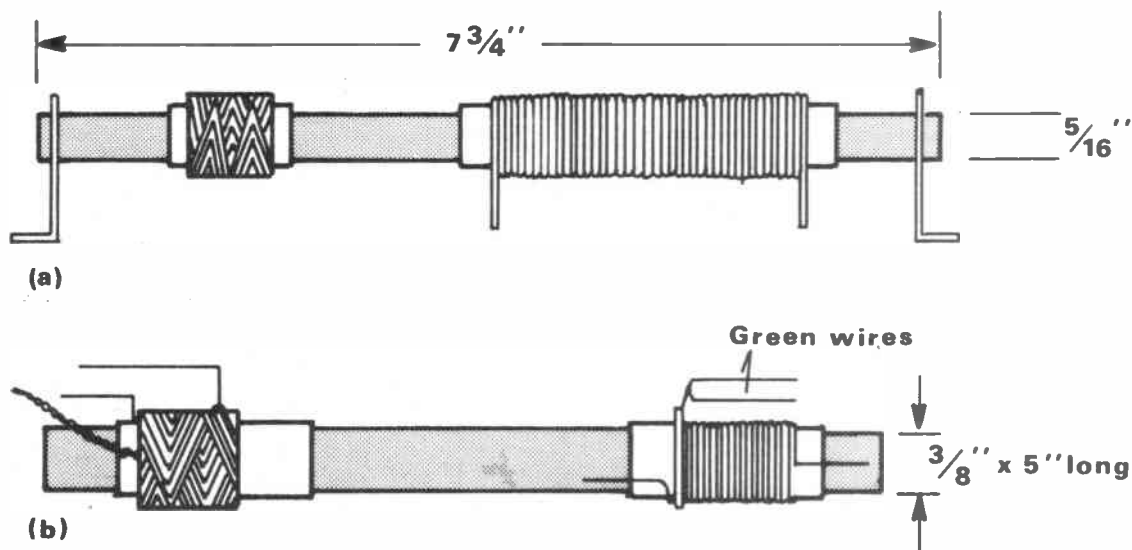


Fig 3 Typical ferrite rod loops (by Denco/Maxi-Q)

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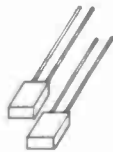
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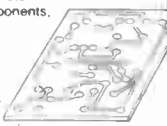


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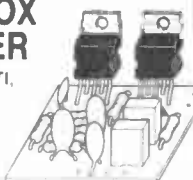
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FEATURED IN ETI,  
SEPTEMBER 1986

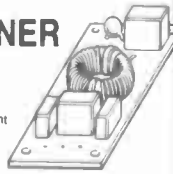
It is astonishing how many people buy or build top-flight hi-fi equipment, and then connect it to a noisy, spiky mains supply. Rainer like buying a Ferrari and trying to run it on paraffin. You might think 'Expecting crystal clear sound, the poor music enthusiast ends up with a muddy, confused mush' and feels that he has somehow been cheated. Is this hi-fi? My music centre sounded just as good!

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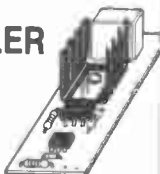
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# WHY WORRY ABOUT POWER SUPPLIES?

by  
Dr C J D Catto

It is self-evident that all active electronic equipment needs a power supply of some kind, even if it is just a battery or solar cell as in the case of a pocket calculator. Power hungry machines, such as computers, generally need a mains driven power unit, and this accounts for a significant proportion of the total cost and weight. The basic principles of linear and switched mode supplies will be discussed in this article.

## Series regulator

Audio power amplifiers are commonly designed with good rejection of ripple on the power supply voltage, but instrumentation and computer boards and peripherals generally need well-regulated supplies. The conventional 'series regulator', shown in *Figure 1*, uses a series pass transistor, and has the advantage of simplicity both in design and construction.

Integrated circuit versions, at a variety of power capabilities, are readily available. Current limiting is easily achieved by means of a sense resistor and transistor (*Figure 2*): the idea is to divert base drive current away from the power devices. When a low drop-out voltage is required, for example in the case of battery-powered equipment, a PNP

rather than NPN pass element is preferable, as illustrated in *Figure 3*.

When current in excess of an amp or so is to be supplied, the disadvantages of the series regulator soon become apparent: the size and weight of the mains transformer, the input capacitor and the heatsink are seen to be a large percentage of the total package. Furthermore, wasted power in the transformer and the pass transistor can lead to excessive build-up of heat within the equipment housing. Although fans and blowers have improved considerably in recent years, it is well worth considering alternative methods of power regulation in order to keep overall cost and weight down.

## Switching regulator

If the series pass transistor is replaced by a switching element and a smoothing choke, as in *Figure 4*, then considerable power saving can be achieved. Admittedly, there are still some losses – in the mains transformer and rectifiers, in the switching transistor, and in the

'flywheel rectifier' attached to the inductor. In order to reduce the size of smoothing components, as well as to eliminate audible noise, it is advisable to keep the switching frequency high, eg above 25kHz. Losses in semiconductors and magnetic cores become significant above 50kHz or so, so care is required in the choice of devices, and some compromises are inevitable.

A certain amount of power is also consumed by the control circuitry, which operates in a feedback loop so as to regulate the on/off ratio of the power switch in response to varying load, fluctuations in line voltage, etc. However, there has been considerable development of control integrated circuits in recent years, and relatively cheap devices such as the UC and SG3524 are readily available from Unitrode and Silicon General. Where an all-in-one solution is desired, the L296 from SGS is worth investigating: this has the power switch (though not the flywheel diode) built in, and can now be purchased within a metal-cased module (the GS-R family) containing nearly all the components, including the inductor.

Even telephone equipment has not escaped the progress of power supply technology. A recent offering by Silico-

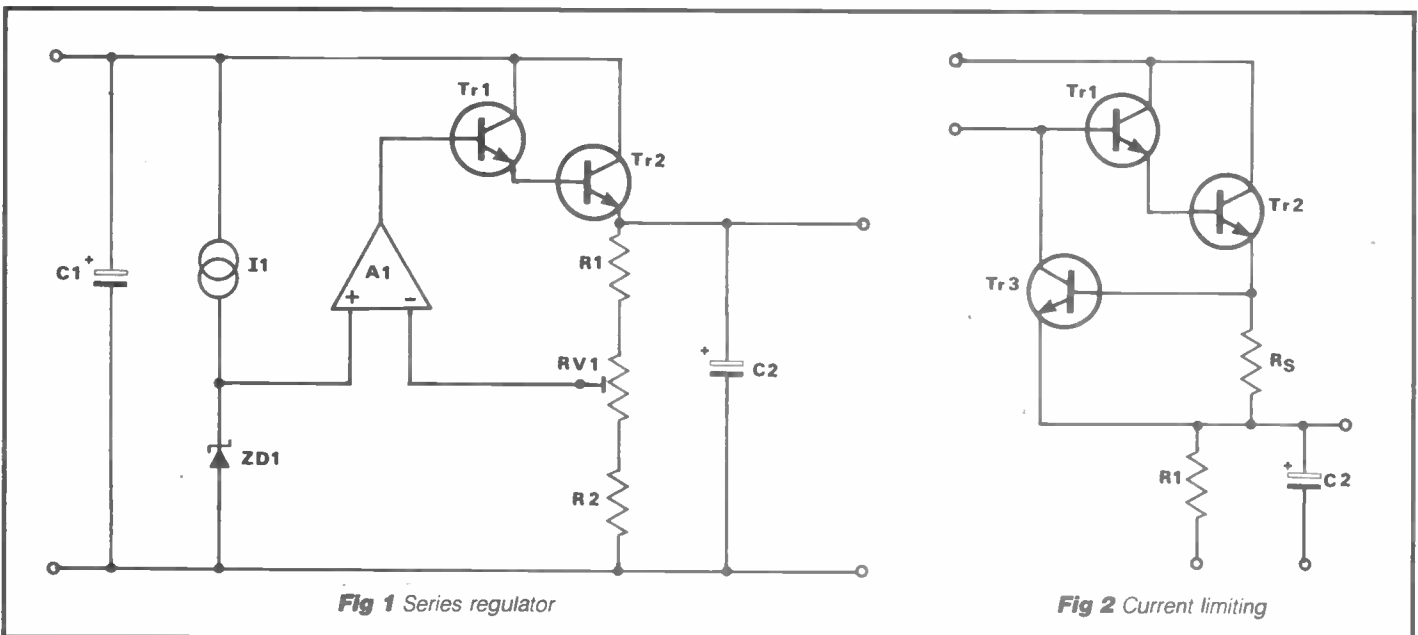


Fig 1 Series regulator

Fig 2 Current limiting

# WHY WORRY ABOUT POWER SUPPLIES?

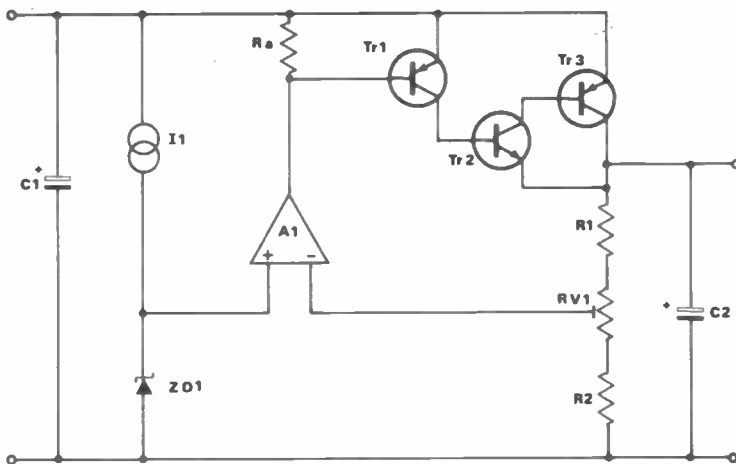


Fig 3 Low drop-out regulator

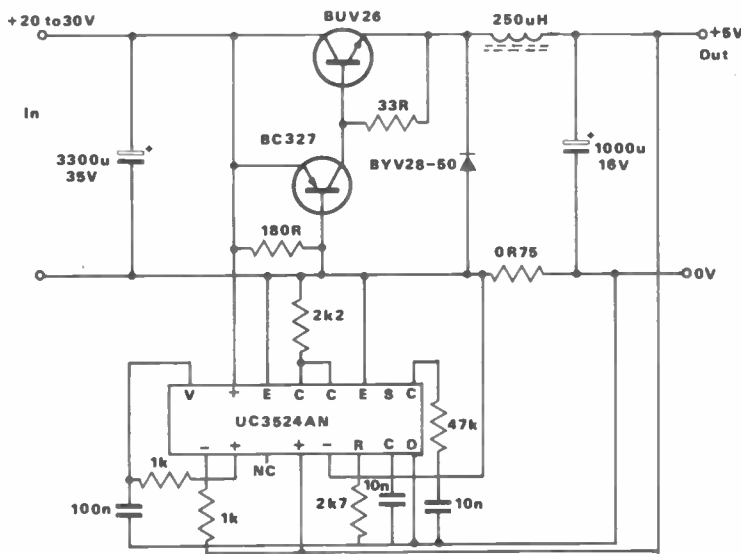


Fig 4 Switching regulator (dc/dc converter), 2 amps using Unitrode chip

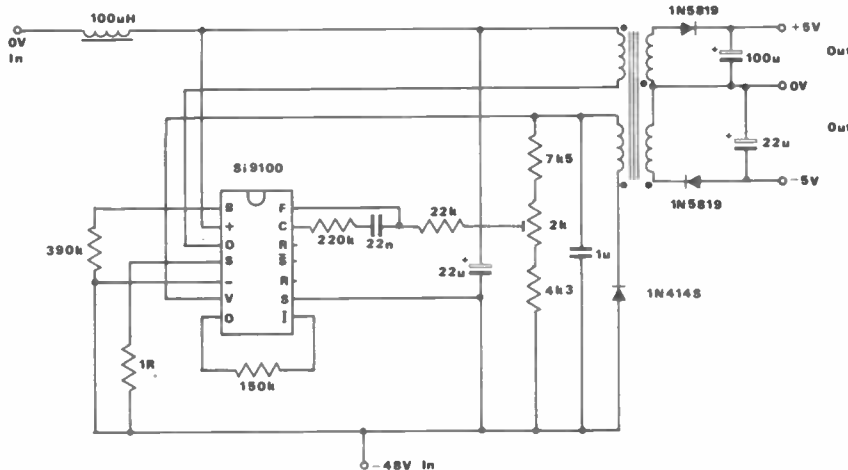


Fig 5 One watt flyback converter, using Siliconix chip

nix (see Figure 5) caters for low current consumption circuitry requiring a stable +5V rail and yet running from the telephone line.

## Higher powers

The simple switching regulator fed from a low voltage dc source is all very well, but it does not eliminate the bulky 50Hz mains transformer or battery bank. Better use of space and weight can be made by employing a 'direct off line' switching technique, where the mains voltage is rectified direct. The raw dc rail is around 300V for European mains supplies, and an additional advantage is thereby obtained: energy stored in a capacitor is proportional to  $CV^2$ , whereas capacitor volume is proportional to  $CV$ , and so considerably more energy per unit volume can be stored at 300V than at, say, 10V.

The electrical stress on all circuit components, particularly the active devices, is an important factor with regard to reliability, and one way of achieving an efficient off-line switcher whilst keeping transistor voltages within manageable bounds is with the half-bridge circuit shown in Figure 6. This arrangement can give power outputs of up to 1kW per transistor pair (with fan cooling), but for such power levels the losses in all power components should be looked into most carefully at the design stage. When a 5V output is to be generated, the losses in output rectifiers form a large proportion of the total, whereas for, say, a 48V output they are relatively much less.

## Multiple outputs

In instrumentation-type equipment as well as in microcomputers, a variety of output voltages are generally required: for example, +12V, +5V and -5V in the case of the BBC Micro. For multi-rail power units, an economical method that gives adequate regulation without additional control elements is the fly-back circuit, illustrated in Figure 7. In this arrangement, power is transferred to the secondary side when the power transistor turns off, in contrast with the forward converter circuit exemplified in Figure 6.

Returning to Figure 7, the main +5V rail is normally the one needing the tightest regulation, and this is best achieved with feedback to the primary switching controller via an opto-coupler or a pulse-transformer attached to the output voltage sensing circuit. The auxiliary rails will not be so stable, due to some 'cross-regulation' effects, and considerable skill is required in the design and winding of the power transformer in order to minimise this deregulation. In any case, it is important to maintain some load on all rails in order to keep the output voltages within bounds, and some care is needed when interpreting sales specifications in this respect. Nevertheless, the choice of standard units available on the British market is now



# WHY WORRY ABOUT POWER SUPPLIES?

enormous, and the necessity to make a special unit should be very rare. Since the rules regarding safety and RFI are quite strict and approval can turn out to be costly, the incentive to buy a proven variant from a manufacturer of repute rather than build in-house is overwhelming.

## Ripple and noise

Whereas with linear regulators it is relatively easy to achieve output ripple and noise levels down to a few millivolts, any kind of switching regulator requires much greater skill in design, choice of components and layout to get down to even ten times this level. The switching technique can deal with fluctuations in mains voltage, and 100Hz ripple, by virtue of controller bandwidth of typically a few kHz, but the high frequency components resulting from the power switching can be troublesome. Although inductors and capacitors able to deal with the fundamental ripple components can be quite small now, keeping down the 'spikes' (switching transients) needs careful attention to layout, screening and filtering.

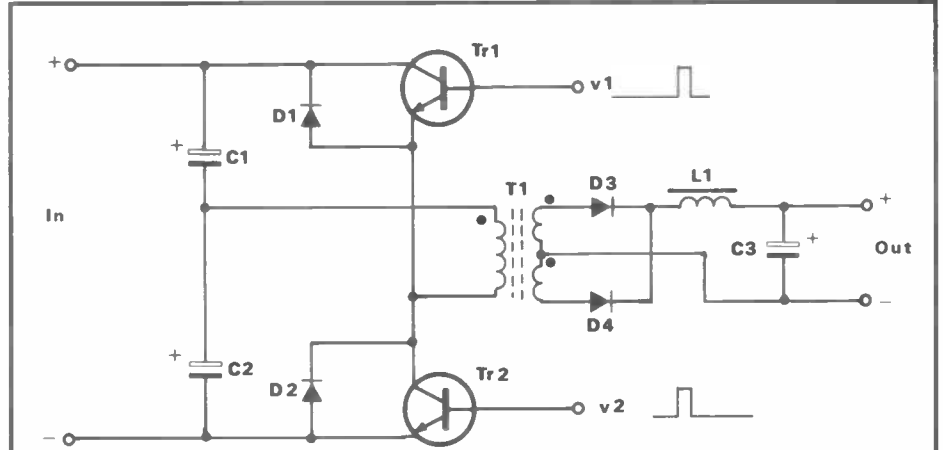
On the mains input side, it is essential to employ some kind of  $\pi$  filter, as shown in *Figure 8*. The inductor need not be large, since the circuit is dealing with high frequencies, but mains creepage clearances must be observed. Also, the capacitors must be suitably rated: 'X' is for line to line and 'Y' is for line to earth.

The power switching device is subject to very high  $dV/dt$  at turn-off, giving rise to excessive voltages and unpleasant 'ringing', so an effective 'snubber' is mandatory for a one transistor forward or flyback converter. It is generally necessary to employ an energy recovery winding and diode (see *Figure 7*), as well as the RC damping network.

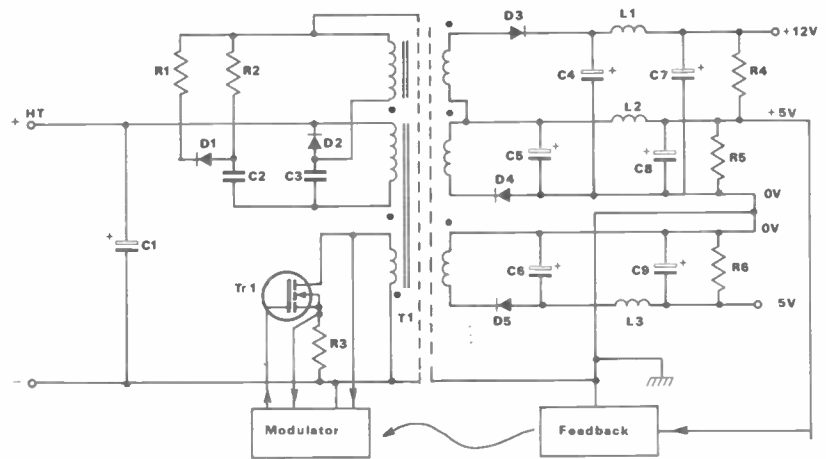
On the output side, the rectifier diodes usually need RC damping networks, especially if Schottky devices are chosen, since these have rather modest reverse voltage ratings. The rectified output capacitors may be followed by additional LC filtering, but care is required if ripple is not to be improved merely at the expense of regulation and dynamic response.

Electrolytic capacitors especially designed for switch mode circuits are vital; they require low equivalent series resistance (ESR) and inductance (ESL) in order to minimise power dissipation, ripple and noise.

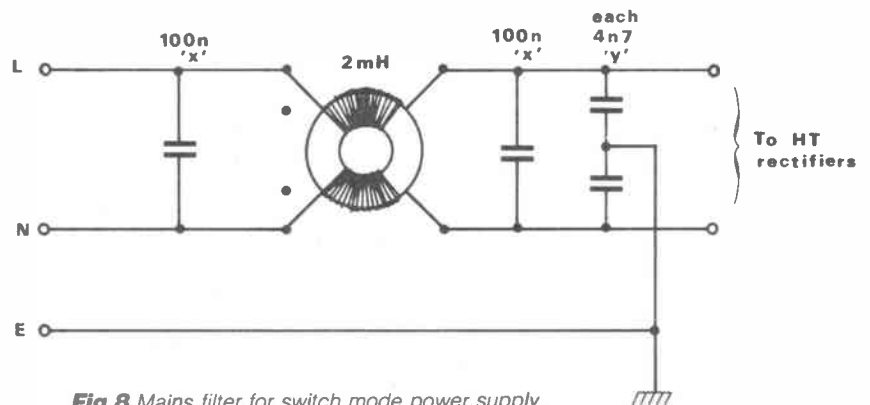
The design of a switching regulator is an iterative process, since there is so much interaction between the constituent parts. In order to maintain some order in production and stock-holding, commercial designs attempt to keep the variations in components and assemblies within sensible bounds. For example, judicious combination and connection of transformer secondary windings can reduce the number of individual types that need to be manufactured.



**Fig 6** Half-bridge converter (v1 & v2 come from pulse-width modulator)



**Fig 7** Flyback converter, providing multiple outputs



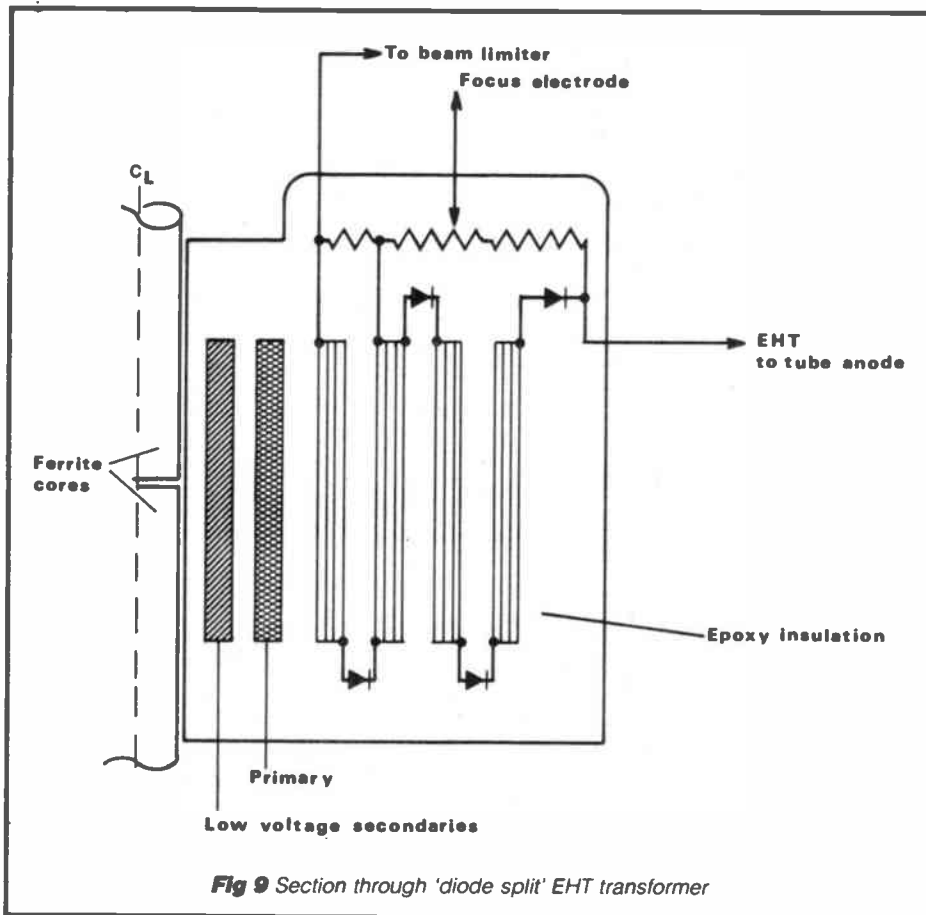
**Fig 8** Mains filter for switch mode power supply

## Safety

Since the raw supply comes off the rectified mains, all components on the primary side of the power transformer must be regarded as electrically 'hot'; anyone servicing a mains switcher should use great caution and is strongly advised to employ an isolating transformer on the mains inlet. In order to comply with the increasingly stringent safety

regulations and approvals standards, adequate creepage clearances are required, and this can lead to difficulty when designing the power transformer. Tight coupling is desirable to maintain good regulation and to minimise turn-off spikes (which increase with leakage inductance), but good electrical isolation between primary and secondary reduces the magnetic performance.

# WHY WORRY ABOUT POWER SUPPLIES?



For ease of assembly and for reasons of cost, plastic-cased semiconductors are preferable, but only the latest package designs provide sufficient creepage lengths on the power switching transistor. In any case, the turn-off spike on the collector (or drain, for a MOSFET) can be of the order of 800V, and much care is needed both in assembly and testing. Better semiconductors and magnetic cores have allowed switching frequencies to be increased, thereby permitting considerable size reduction, but this has led to greater problems in maintaining 'legal' clearances; one solution is to opt for special heatsink mounts, novel transformer bobbin designs, etc, but this can require costly tooling that only the manufacturer with large volume sales can afford.

## Components and assembly

The size of a typical 100W switcher has been reduced considerably in recent years, not just through higher switching frequencies but by the introduction of components developed specially for this market (eg, electrolytics with low ESR and ESL) and by improved construction techniques. In addition to dedicated integrated circuits, which by themselves have shrunk the PCB area used for control of the power supply, a large impact on miniaturisation has been made by surface mount technology. In a current design, the control circuitry is generally on a small board mounted

perpendicular to the main PCB, leaving the maximum free area for power components and tracking.

Incidentally, manufacturers have taken to using a thicker copper layer than the traditional 1oz tracking, as resistive losses in these conductors can otherwise become significant.

## Reliability

Switching supplies, by their nature, are more complex than their linear counterparts, but this does not mean that they are necessarily less reliable. First of all, increased efficiency means less power loss, and consequently less of a temperature rise – an important factor as far as most components are concerned. Secondly, modern power switching devices, such as transistors and rectifiers, have been developed with much more exacting performance in mind, and can therefore be more rugged than, say, a three-terminal linear regulator. In fact, a well-designed switcher is more likely to survive spikes on the mains, and other abuse, than may a linear one, which has negligible RF filtering and transient protection.

## Current and future trends

From the customer's viewpoint, the power supply is often regarded as a 'fit and forget' unit, but there will always be the desire for smaller size and weight, lower cost and higher efficiency. These can be conflicting requirements under

any mature technology, but in the past year there have emerged some surprisingly small units, such as the Vicor VI-100 series, which pack about 25 watts per cubic inch. This has partly been achieved by making use of the power transformer's leakage inductance (rather than simply fighting it!) in a resonant circuit, where the power switching device in fact turns on and off at zero current, thereby reducing losses considerably.

The resonant method is fine for a single output unit, but, for a multi-rail supply, additional sub-regulators are needed if voltage levels are to be well maintained. By employing special 'magnetic amplifier' cores, this secondary regulation can be at high efficiency, and Unitrode have even introduced a control chip for this purpose (the UC3838).

It is relevant to ask: 'Why don't the end equipment designers simply employ CMOS and do away with heavy power requirements altogether?' The answer to this can be found by taking a perspective view of semiconductor technology as it has developed over the past couple of decades; any advance that has provided more performance for given cost or power consumption generally serves merely to advance the base line performance of the next generation of products employing such devices. For example, availability of denser memory chips has led the end user to expect more memory on board. Similarly, power requirements have not diminished to near zero, as the computer user has come to demand more RAM and more processing power.

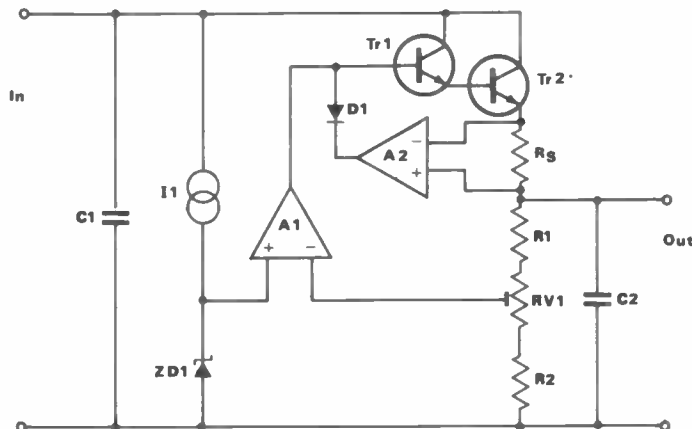
In instrumentation, such as oscilloscopes and logic analysers, the customer looks for a faster front end, more processing capability and a brighter/sharper trace. The power unit in such equipment has shrunk in size and weight, but if anything has a more exacting specification than before. In equipment using a cathode ray tube (CRT), such as a 'scope or a TV set, the generation of the EHT for the final anode of the tube is performed by a resonant or a driven ('line output') transformer with a multi-turn secondary followed by a Cockroft-Walton multiplier (typically a voltage tripler). Economy can be achieved by making use of the transformer and tube's capacitance, as in the 'diode split' design, where the EHT rectifiers are potted within the secondary layers (see *Figure 9*).

## Conclusion

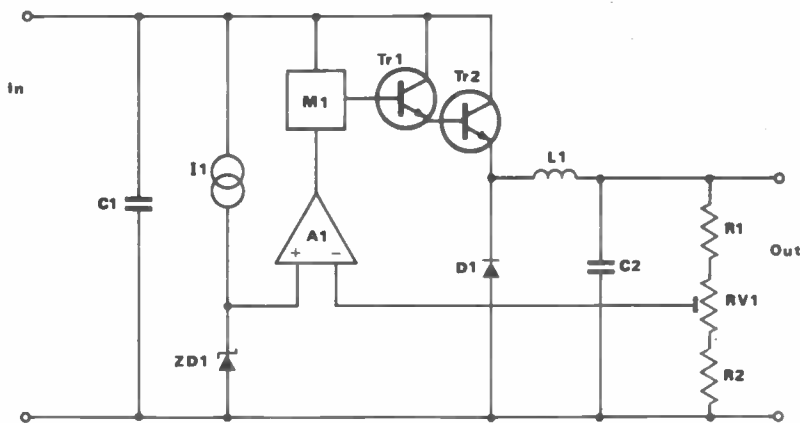
It is a paradox that improvements in technology do not necessarily lead to simpler products. Faster and more complex integrated circuits have offered the consumer more performance per cubic inch, per dollar, or whatever, and the power supply has had to keep up with these advances, as well as meet increasingly stringent safety and RFI regulations. The move from linear to



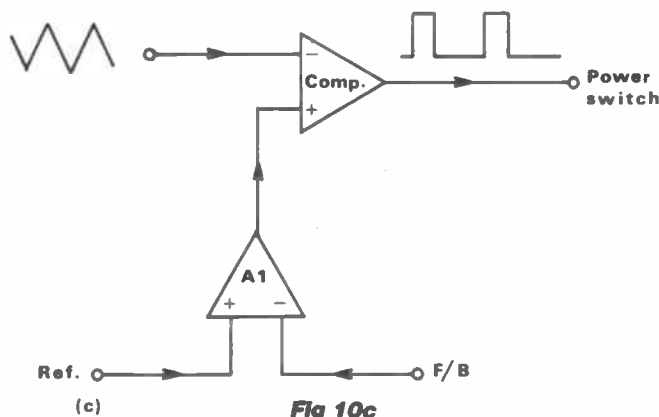
# WHY WORRY ABOUT POWER SUPPLIES?



(a) **Fig 10a**



(b) **Fig 10b**



(c) **Fig 10c**

switching techniques has placed greater demands on the designer and the constructor, but the vast range of standard units available at reasonable prices has made the buyer's job relatively easier.

## Linear regulator

The output voltage is sensed by the potential divider R1P1R2 and compared with the reference voltage Z1 (see

Figure 10a). The error is amplified by A1 and fed back to the series pass transistor Tr2 via its driver Tr1. The output therefore remains substantially constant, despite variation in the load current drawn or fluctuations in the input voltage. Assuming the latter is sufficiently higher than the desired output, then very little of the ripple on C1 gets through to C2 by virtue of the sizeable loop gain at 100Hz. If the output terminals

are short circuited, some means of limiting current is essential, eg, using a sensing resistor  $R_s$  in the collector or emitter lead of Tr2 and an amplifier A2 to override A1.

## Switching regulator

The output voltage is sensed by the potential divider R1P1R2 and compared with the reference voltage Z1 (see Figure 10b). The error is amplified by A1 and fed back to the pulse-width modulator M1, which varies the on/off times of the switching transistor Tr2 via its driver Tr1. When Tr2 is on, current flows from the raw supply to the output via the inductor L1. When Tr2 is off, the junction of Tr2L1 swings down until it is caught by the flywheel diode D1, and the load current is maintained by virtue of the stored energy in L1 and C2.

The latter components being of finite size, for reasons of loop stability and economy, there is measurable ripple voltage (at switching frequency) on the output. If the raw supply is considerably higher than the desired output voltage, then Tr2 is on for a relatively short time during each conversion cycle, whereas D1 is on for a relatively long time. If the output is short-circuited, a sensing circuit (not shown) is needed to override M1 and drastically reduce the on time of Tr2.

## Modulator

Control of the on/off times of the power transistor in a switching regulator is best explained by a simple example of a modulator (see Figure 10c). The voltage from the error amplifier A1 is compared with a triangular waveform running at the desired switching frequency. If the error voltage is high, then the comparator's output is high for a relatively long time in each cycle; conversely, if it is low, then the comparator's output is high for only a short time. In this way, the on/off ratio of the power switch driven by the comparator is controlled in a smooth manner. In consequence, the voltage at the output terminals of the regulator can be kept substantially constant, despite variations in line and load conditions.

A new generation of control chips (such as the Unitrode UC3842) operates in a somewhat different manner, known as 'current mode', in which the current is in effect metered out cycle-by-cycle. As well as offering reduced complexity, this technique provides a rapid response to line and load changes.

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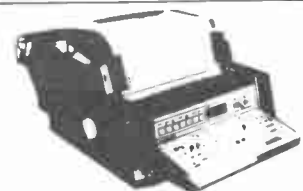
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In the third instalment of his occasional series on this fascinating subject, Brian Kendal explores approach and landing systems

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# Latest Literature

## TRANSMITTER HUNTING: RADIO DIRECTION FINDING SIMPLIFIED

by J D Moell and T Curlee

Transmitter hunting is not a new aspect of amateur radio, but it has been largely ignored by ham radio publications. Nevertheless, DFing is a flourishing hobby, and this American book seeks to rectify the current situation in this chatty and informative book.

A short and fascinating history of 'foxhunting' is given, and handy hints on which rig to buy – although it must be stressed that this book was clearly intended primarily for the US market; some material may be irrelevant and some items unavailable in this country.

The section on antenna construction for mobile use is most handy and contains plenty of detailed ideas for home construction enthusiasts. Hunting techniques are discussed, and different support units are shown, with circuit diagrams and construction details, all of which should make this book very popular.

John Wiley and Sons Ltd,  
£14.50. ISBN 0-8306-2701-4

## MANUAL OF AVIONICS

by B Kendal

In this new and fully updated edition, the knowledgeable Mr Kendal unravels the mysteries of civil aviation electronics. An essential reference text for the professional, this book is also an enjoyable read for the layman, with fascinating sections on the development of radio and radar and a totally new section on space systems.

As those who regularly read this magazine will know, the author is an expert in this field, with the ability to communicate highly technical information accurately and straightforwardly, with the minimum fuss.

Recommended for all enthusiasts.

Blackwell Scientific  
Publications, £17.50. ISBN 0-632-01863-1



## THE SECRET OF LEARNING MORSE CODE

by M Francis

Written from first-hand experience, this book provides hope for Class A aspirants who previously believed that Morse was beyond them. If the subject seems intimidating to those who have tried and failed, the text is not. Mr Francis constantly encourages and amuses with this anecdotal voyage through the learning process.

Numerous exercises and sample tests are provided, and some of the myths surrounding the code are exploded. The author's tips on easy ways to learn really do help the uninitiated – in fact, the temptation is to exclaim: 'Now why didn't I think of that?' It should be remembered that the ability to produce this response is the hallmark of a good teacher.

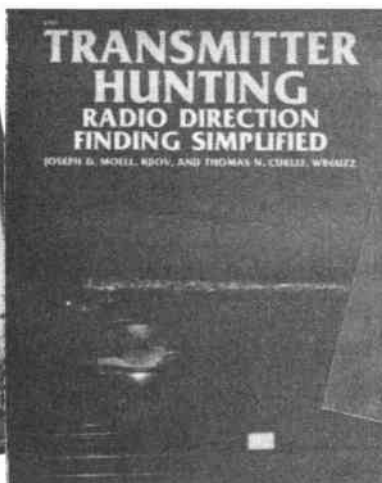
A useful and inexpensive book, this should be on every beginner's list of invaluable texts.

SPA Publishing Ltd, £4.95.  
ISBN 0-9512729-0-X

## A TUTORIAL INTRODUCTION TO OCCAM PROGRAMMING

by D Pountain and D May

Written in conjunction with Inmos International – the company that created occam and its implementing transputer – this text aims to introduce the reader to concurrent programming using the latest version of occam.



The authors do not assume extensive knowledge of high level languages or machine-level programming, as the relationship between occam and its transputer is more intimate – occam acts as the assembly language of the transputer, being implemented fairly directly; the transputer is described as a 'hardware occam process'.

This may sound like a difficult concept to swallow, but fortunately the authors thoughtfully signpost passages that need careful study, and include helpful hints for learning occam. This is a valuable aid to programmers, engineers and designers involved with the transputer or parallel processing, and those using occam on conventional computers.

Blackwell Scientific  
Publications, £9.95. ISBN 0-632-01847-X

## ELECTRONIC SYSTEMS AND TECHNIQUES

by K F Ibrahim

The title does not reveal that the text does in fact start with four chapters dedicated to introducing the basic principles of electricity. In consequence, it should be recommended to beginners as a very well explained guide to elementary electronics.

The book goes on to cover a variety of electronic systems in block diagram format, from single stage amplifier to computer systems. The 'building blocks' themselves



are then examined; the characteristics of components and circuitry are explained and modern digital techniques are emphasised. Finally, instruments, testing and fault finding are looked at, with the same functional and non-mathematical approach which characterises the early chapters.

Longman Group UK Ltd,  
£7.50. ISBN 0-582-98817-9

## STANDARDS FOR OPEN SYSTEMS INTERCONNECTION

by T Knowles, J Larmouth and K G Knightson

This book describes the Open Systems Interconnections Basic Reference Model and the individual standards within this framework.

Chapters are devoted to the model itself, and further chapters describe the individual layers.

OSI is a significant step towards the realisation of the rewards which should come from Information Technology. Bearing in mind that the development of this work is still going on, the authors have endeavoured to represent the current state of this form of communication.

The text is intended for systems managers, datacom managers, programmers and engineers, as well as students of computing.

Blackwell Scientific  
Publications, £30. ISBN 0-632-01868-2

# MEDIUM WAVE

# DXING



by Steve Whitt

This month I hope to unravel some of the mysteries behind skywave radio signals, on which nearly all long distance medium wave reception depends. I have also got news of the sunspot cycle and of a useful publication about radio in the Irish Republic. But first a quick introduction to this hobby of ours.

It's always good to hear from readers who are curious about MW-DXing and are keen to find out what the hobby is all about. A recent correspondent was Thomas Jones of Leicester, who asks the very important question: 'How do I get started?' Well, over the months this column has tried to cover a range of subjects which would all form part of a general answer to this question. To do justice to the question would take more space than I have available now, so I'm afraid I'll have to refer back to some earlier issues of *Radio & Electronics World*.

MW-DXing is a very easy hobby to start, particularly if you don't want to spend much money until you are hooked. Nearly everyone has access to a portable transistor radio or similar and this will form a suitable, if simple, receiver to start with. The only other thing needed is some good information on what can be heard at what times. For this I would suggest that it is a good idea to subscribe to a magazine like *Radio & Electronics World* and to join a radio club. Additionally, if you were to invest in just one book, I would suggest that it was the *World Radio TV Handbook* which lists just about every broadcasting station in the world. For more information try the following back issues which may be available at your local library or which can be ordered direct from *Radio & Electronics World*:

Receivers, how to choose, November 1986;  
Interference, cause and cure, May 1987;  
Aerials, loops and beverages, etc, January and February 1986;  
Radio propagation, April and August 1986 and August 1987;  
*World Radio TV Handbook*, January 1987;  
QSLs, what are they? April 1987;  
Basics, how to start, March 1987;  
Radio clubs and DX radio programmes, April 1986.

Last month I took a quick look at MW

aerials and showed that a bigger aerial was not necessarily a better aerial and that the only way an aerial can really help with MW reception is if it has directional characteristics. To help illustrate this it is probably a good idea to have a portable transistor radio handy, since this has an internal aerial (the ferrite rod coil) that is very directional.

Firstly, tune the radio to a strong steady signal such as a local BBC or IBA station (the national BBC networks are not suitable for this experiment since they use a chain of synchronised transmitters around the country). Then slowly rotate the whole radio around its vertical axis; a point should be reached where the signal gets noticeably weaker and it is likely that interference from another station may be heard. Continue turning the radio and the signal will increase again; you should notice two peaks and two dips in strength in one whole rotation of the radio. *Figure 1* illustrates this basic directional behaviour.

Now try tuning in a European signal (a German station is a good one to try) during the evening after dark and again try rotating the radio slowly; this time it is highly likely that as you turn the set you will hear stations from two or more countries competing with one another. In one position one station will be dominant whilst in another a second station will be clearest (*Figure 2*). If this does not happen, try another station on a different frequency. You have just used a directional aerial to enhance your reception and although it was with a portable radio, the technique is just as valid with

specialised aerials, such as loops, used by active MW-DXers.

## Skywaves

Most listeners to the MW band will have noticed that long distance reception is normally only possible during the hours of darkness, but if you've read this column in previous issues you'll know that skywave propagation is responsible for this effect. Skywave propagation is often quite variable in its behaviour, resulting in great changes in received signal strength. This unpredictability is a problem for the broadcast engineer who is trying to plan a station's service area, but it is a boon for the DXer who is trying to hear rare or unusual signals. Although it is difficult to say with certainty how strong a given signal will be at any specific time, there are some well proven guidelines.

**Frequency:** During the transition hours of dusk and dawn, skywave signal strengths are found to be very frequency dependent. For example, signals at 1530kHz will be on average 15dB stronger than a station on 700kHz - assuming that both stations radiate the same power of course. However, about two hours after darkness falls the difference in strength is only about 3-5dB and by about midnight any frequency dependence has more or less vanished.

**Latitude:** This parameter is a very, if not the most, influential factor in determining the received strength of a skywave signal. MW skywave field strength decreases with increasing geomagnetic latitude, but unfortunately there is not much the average DXer can do about latitude, short of emigrating!

**Solar and magnetic activity:** Evidence shows that increased solar activity reduces MW night-time signal strengths and this is clearly evident in the better DX heard during the period of the sunspot minimum. Additionally, magne-

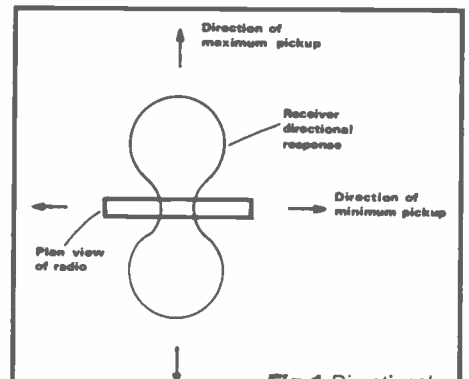


Fig 1 Directional behaviour

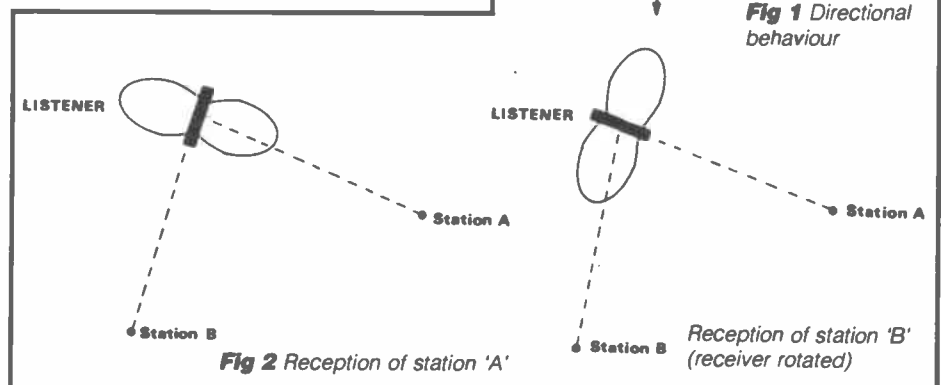


Fig 2 Reception of station 'A'



tic storm activity causes very significant signal absorption, particularly during the first five to ten days immediately following the onset of a storm. The absorption effect becomes greater with increasing frequency and with higher latitude locations. Around 1500kHz signal absorption of 30dB or more is not unusual as a result of storm activity.

**Season:** In low latitude regions (such as the Caribbean) very little seasonal variation in night-time signal strength has been observed, but in Europe skywave signals are usually weakest in summer and strongest in spring and autumn, exhibiting a seasonal variation of about 6-10dB. In winter, daytime skywave strengths show a very marked increase, particularly at mid to high latitudes when the difference between daytime and night-time skywave signals is often less than 25dB (on average, however, skywave signals at noon are about 45dB weaker than at midnight)

**Probability:** Despite the above rules it is still possible for signals to be occasionally much stronger or much weaker than expected for the conditions prevailing. The DXer is, of course, interested in when and how often the former case arises. Unfortunately, it is very difficult to say when, but some figures do exist to say how often unusually strong signals may be heard. In a year of low solar activity (eg, 1986-87-88) it is found that for about 1% of the time signal strengths will exceed the

expected median value by some 10-15dB; this suggests that really fantastic DX signals are likely to be heard on only about 3-4 days per year!

Latest reports on solar activity as manifested by sunspots indicates that the sunspot minimum was reached in September 1986, when the smoothed sunspot number stood at 12.6. We are now entering sunspot cycle 22 (the 22nd since records were first kept) and scientific attention is now focused on predicting how high the forthcoming sunspot maximum will be. This is still an imprecise activity and current estimates range from 106-185 peak in either 1990 or 1991.

As many readers will appreciate, the radio scene in the Republic has been in a very volatile state for quite some years now, due to the absence of any suitable broadcasting legislation or regulatory authority. Consequently, it can be quite a task for the listener to find his way around the radio dial without some sort of guide to the 150 or so independent stations that operate throughout the country. One such guide I can recommend is the recently updated *Irish Radio Stations List*, published by Anoraks-UK. This 4 x A4 page booklet lists all AM, FM and SW stations, together with announced station names, addresses and phone numbers - ideal material for both the casual listener as well as the DXer. Copies are available for 50 pence + SAE by writing to Anoraks-UK, PO Box

539, Blackpool FY1 4RE. Please remember to mention who sent you!

#### DX file

Despite the usual summer lull in MW-DX as a result of the shorter nights, some interesting stations were still being reported by listeners. The cream of the crop includes:

R Oriental CX12 in Montevideo, Uruguay on 770kHz;

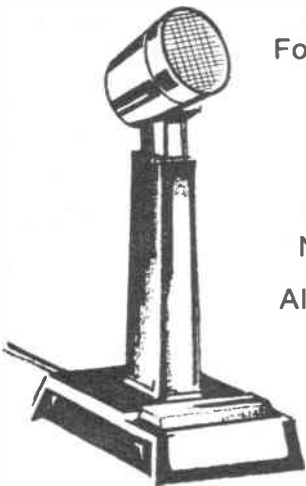
R Tahino, Cuba with English tourist programme on 1040kHz;

WCHY Savannah, Georgia on 1290kHz; WEZY Cocoa, Florida, a rare 1kW station on 1350kHz.

At the time of writing, in early September, radio conditions appeared to be quite good with a good number of transatlantic signals audible well before midnight UTC. I have noted many of the 'regulars', such as CJYQ 930, WINS 1010, VOXM 590 and the Caribbean Beacon on 1610kHz. Unusually, one of the strongest signals was the Radio Caribes relay from Martinique on 1090kHz; this station carries French programmes in parallel with 1210kHz which is more usually heard.

It's just about now that the MW-DX scene begins to pick up as the nights draw in, so why not have a go to see what you can hear lurking between the European stations? Let me know how you get on. Your reports and tips will be most welcome for this column. Until next month, may the DX be with you. **REW**

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# THE TRIO TS-430S

## AN OWNER'S REVIEW

by Ken Michaelson G3RDG

This is not a review in a normal sense, because the Trio TS430S discussed is a unit which I purchased second-hand for my own use. The previous owner hadn't had it long and it was only just out of guarantee. There were three extras supplied with the rig, an FM board (FM-430), an AM filter (YK-88A) and the service manual.

I was fortunate in having a 20 amp 13.8 volt power supply available for use with this rig, otherwise I would have had to obtain one and they are not cheap. It is a small unit, really designed for mobile or portable use, measuring 270mm (10.6in) wide by 96mm (3.8in) high by 257mm (10.1in) deep. It weighs 6.5kg (14.3lbs) and is equipped with a carrying handle. There are blank screw holes on both side panels to take the mobile mount, MB-430, but since neither the previous owner nor myself intended to run mobile, the mount was not supplied.

At switch-on everything worked first time, so I will give you a few details of the technical specification of the TS-430S. The transmitting side operates on all nine amateur HF bands (160, 80, 40, 30, 20, 17, 15, 12 and 10 metres), and the receive

side acts as a general coverage receiver tuning from 150kHz to 30MHz. It transmits and receives in four modes, A3J (USB/LSB), A1 (CW), A3 (AM) and F3 (FM). The FM option is dependent upon the installation of the optional FM-430 board, and fortunately the first owner had already fitted this.

The general coverage receiver section acts as a double conversion superheterodyne in SSB, CW and AM, but as a triple conversion superheterodyne in the FM mode. The IFs are 48.055MHz and 8.83MHz, and for FM, the third IF is 455kHz.

Unusually, the microphone impedance can be anything from 500 ohms to 50k ohms. However, if a high impedance microphone is used, the owner's manual suggests that an attenuator be connected in circuit, otherwise input overload and distortion may result. The attenuator is quite simple, being a 10kohm resistor across the mic lines with a 10k to 33kohm resistor in series. I use the microphone supplied with the unit which, in addition to the push to talk button, has two buttons which can move the frequency up or down.

Interestingly, there are two speeds of frequency shift, which are altered using the 'step' key. This can be set either at 10kHz or at 100kHz. The sensitivity of the receiver, as quoted in the manual, is less than 0.25 $\mu$ V for 10dB S/N over a frequency range of 1.8MHz to 30MHz in the SSB mode. This amounts, in my opinion, to the greater part of the range one would use and was more than adequate for my requirements.

The selectivity with the standard SSB filter is quoted as being 2.4kHz at the -6dB point. This seems to be adequate when used for phone contacts, but since my main interest is Amtor and HF packet (when I can get a contact!) I do not think that it is good enough. I have therefore ordered the optional YK-88SN SSB filter giving a passband of 1.8kHz at the -6dB point. Hopefully, this will make an improvement.

While on the subject of filters, I remarked above that the previous owner had already installed the YK-88A AM filter. This makes a vast difference when listening to commercial broadcast stations. In fact, the quality of reproduction is surprisingly good, bearing in mind that the speaker is only about 3.5in in diameter.

On the transmitter side, the power input is stated to be 250 watts PEP on SSB right the way through the nine amateur bands and 200 watts dc in the CW mode. I have a KW109 Supermatch with a power indicator, and it gives a reading of about 140 watts out in CW, which is well up to standard. The power available is all that I require, personally. I would not go in for a 1kW linear, because of 'neighbour trouble'!

The stability, too, is of a very high order, stated to be within  $\pm 200$ Hz within the first hour and  $\pm 30$ Hz during any 30 minute period thereafter. I know that when the receiver section is used to copy FAX from the Meteo stations, there is never any drifting. The same applies to the reception of any RTTY station.

The TS-430S has a pleasing appearance, being finished in two shades of silver grey metallic paint. On the left of





the front panel, apart from the push on/push off power switch, there are five rocker type switches controlling 'send/receive', 'vox/manual', 'processor', 'ALC/IC' (IC being the reading of the current to the final transistors), and 'narrow/wide' for the filters. To the right of these are five microswitches which control the various modes of operation. The particular mode which is being used has a little orange LED illuminated at its side to show that it is in use.

Under the five rocker switches are the 8-pin microphone socket, phone socket and concentric mic, and carrier gain controls. In the centre of the front panel is the tuning knob. This is very pleasant to operate, having the now familiar friction brake (called VFO dial drag in the manual!) which can be adjusted. I have come across some shocking tuning knobs in my time, on makes other than Trio, which have completely spoilt the pleasure of using the unit concerned.

The TS-430S has two VFOs.

A rotary switch gives a choice of VFO 'A' in use, VFO 'B' standby, or the other way round. Alternatively, VFO 'A' can be used during reception with VFO 'B' for transmission, or the VFOs can be reversed.

There are eight memories available, which hold both mode and frequency, and I must say that their operation is far simpler than a number of transceivers that I have operated recently. You merely tune to the station you want to memorise with its correct mode, turn the memory channel switch to the desired channel and press 'M.IN' on the keyboard panel. The unit beeps to show that the command has been accepted and that is that. Next time you want the station you just press the 'M.CH' on the keyboard, turn the switch to the channel previously selected and there is your station. In addition, you have a programmed scan available between memories 6 and 7.

I am very pleased with the simple methods of controlling this rig, and do not have to refer to the owner's manual constantly to see how to do everything, as I have with other units.

Naturally, there are certain facilities which are not catered for – there is no means of varying the AGC rate (but more of that later), no preamplifier, no tone control, no dimmer switch, no indication of power out and no monitor facility (this I am looking into further). However, the TS-430S does have RIT, IF shift, a notch filter, squelch and a 20dB RF attenuator. The frequency up or down control, combined with the two speeds of tuning, makes it a simple matter to move from one part of a band to another, or from one band to another. The fact that the TS-430S has broadband final amplifier both in the receive and transmit condition makes it a very easy rig to operate.

Five LEDs along the bottom of the display area show 'ON AIR', 'F.LOCK', 'F.STEP', 'RIT' and 'NOTCH'. I find the display area, although smaller than on

some other transceivers, quite adequate for me. On the left is the S-meter showing S units on receive and either ALC or IC in amps on transmit. The indicators for the VFOs are also shown in the area. The actual frequency readout indicates the true frequency in all modes to an accuracy of 100Hz. If the operator would like a 10Hz display resolution it is only necessary to cut a jumper adjacent to R202 on the control unit. I tried it, but at normal speeds of tuning it was ridiculous as the 10Hz figure was completely unreadable.

The biggest disadvantage that the rig suffered from was its inability to be used on Amtor, one of my favourite modes of communication. I contacted Lowe Electronics to see if they could help, and the service department very kindly sent me a photostat of the modifications necessary to speed up both the transmit and receive recovery time. I give the list here for the benefit of any other amateur who might be in the same position.

- 1) Change C164 from 0.22 $\mu$ F to 0.01 $\mu$ F.
- 2) Change C60 from 10 $\mu$ F to 4.7 $\mu$ F.
- 3) Change C57 from 0.47 $\mu$ F to 0.1 $\mu$ F (this is already done on some sets. It was on mine).
- 4) Remove C58.
- 5) Remove R97 and replace with wire link.
- 6) Change R96 from 100k to 47k.
- 7) Locate 3 spare switch terminals on 1MHz band switch.
- 8) Connect middle contact to earth.
- 9) Lift earth end of C159 and connect to N/C (normally closed) contact of switch with length of wire.
- 10) Connect length of wire between N/O (normally open) contact and cathode of D45.
- 11) This switch, when pushed in, now speeds up the AGC for Amtor use.
- 12) All components except the switch are

to be found on the IF board.

13) If you are using a CW or SSB filter add 10 $\mu$ F across C10 or C8, depending on the filter in use, to remove switching clicks.

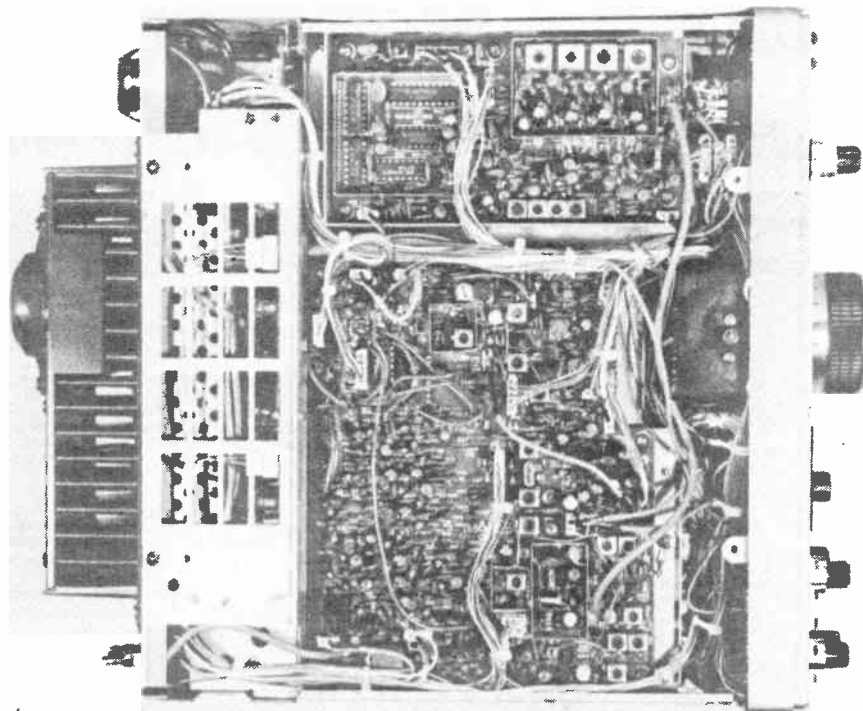
It was quite a tricky job to carry out these modifications. I don't think that I would have been able to do them without my binocular magnifiers, my solder sucker and a small 15 watt Antex soldering iron. I was helped, too, by the possession of the service manual. The service manual showed both sides of the board, so with care, holding the board up to the light, I was able to see what was what.

Having completed all the modifications, I am glad to say that the rig now performs perfectly on Amtor and, of course, on all the other modes. I mentioned previously that there was no means of varying the rate of the AGC. Well, now I am able to do that.

Lowe Electronics' service department also suggested that a monitor pick-up might be obtained from connector no 5 pin 3 (MV 2) on the IF board. I haven't yet tried this out, but the lead would have to be taken to the transmit/receive switch so that it would only connect on transmit. The TS-430S can be connected to the AT-130 automatic antenna tuner from the accessory connector on the rear panel, but I don't think I shall be using one; I prefer the manual KW109. It is also possible to use a transverter with the rig from an eight-pin DIN connector, also on the rear panel.

All in all, I am very satisfied with my new rig, and feel that I shall be using it for some considerable time.

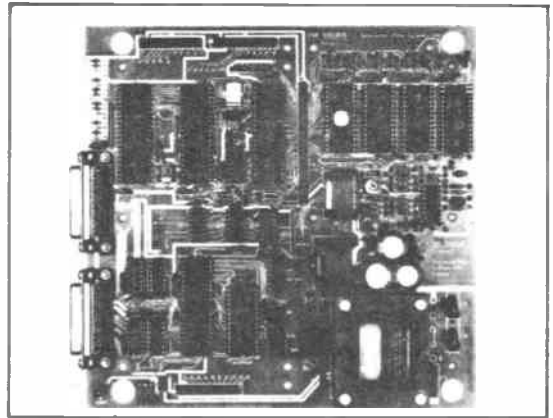
Acknowledgement and thanks go to Lowe Electronics Ltd, Chesterfield Road, Matlock, for the information on the Amtor modifications and general helpfulness. REW



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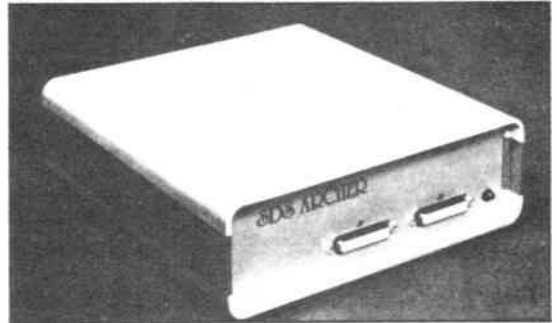
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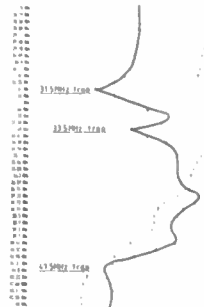
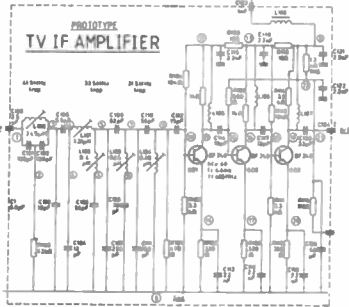
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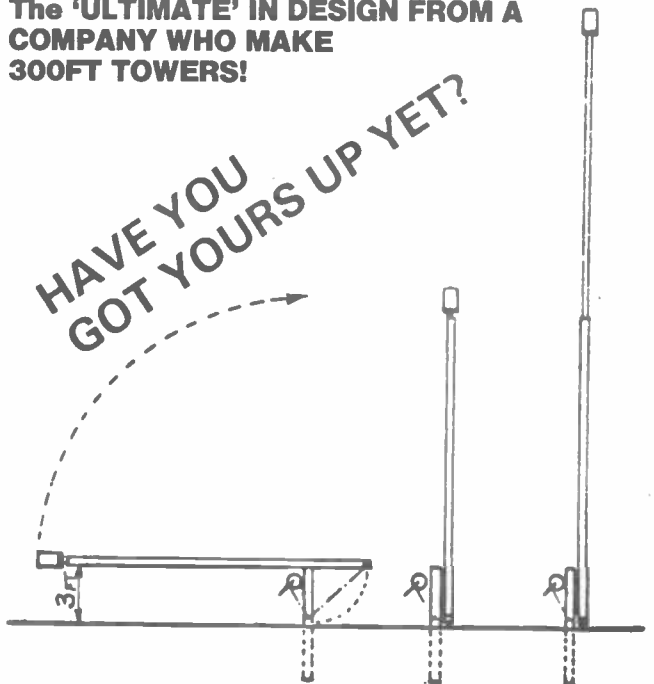
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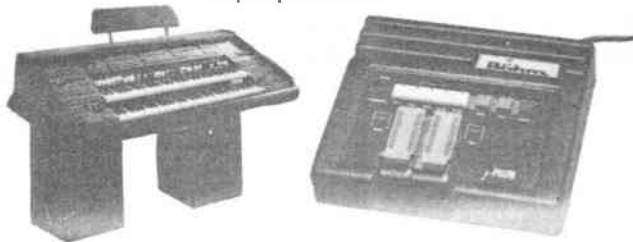
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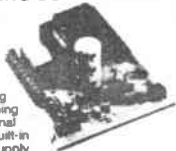
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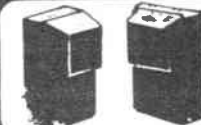
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# DX-TV RECEPTION REPORTS

Compiled by Keith Hamer and Garry Smith

**E**xotic long distance television signals continued to flood in during July, indicating that the current sporadic-E season could be a record breaker. The season has certainly been one of the best for more than a decade. The growth in the use of Band I for TV broadcasting continues and this has created new possibilities for the TV DX enthusiast. So much for sporadic-E reception, but what about other modes of propagation?

Tropospheric DX in Band III and UHF was a stark contrast. Activity was minimal, with only minor openings to West Germany, Sweden and Denmark on July 4th and 5th.

## Sporadic-E rundown

The main areas of interest continued to be the new Italian private stations in Band I and the various sightings of Arabic broadcasts. Unfortunately, most of the latter were showing programmes which made positive identification virtually impossible, even with subtitles present.

DX from Russia has provided a source

of interest, too. The trend is to include some form of regional test pattern on the UEIT electronic test pattern. During many of the openings a wide variety of identifications have been noted. These include 'MTR', 'UT 0167', 'LENINGRAD' (but in the Cyrillic alphabet!), 'LRRTPC', 'LATVIJAS TV', 'UT 1987' and a version with the letters 'UT' followed by a digital clock display at the top of the pattern.

A noticeable feature of the log reports is the amount of early morning sporadic-E openings around 0700BST. Most countries tend to broadcast test patterns around this time before the start of school's TV or breakfast TV. As a consequence, much of the reception can be positively identified during this period. The Russian network now commences an hour earlier, so we've been told, but you'll have to get up in the middle of the night if you wish to see them come on the air. Iain Menzies of Aberdeen has seen programmes on channel R1 as early as 0300BST. It's not clear whether these were the previous night's offering or the next day's!

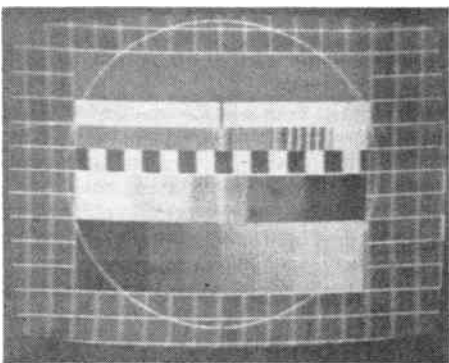
Two memorable days spring to mind which produced an unusual display of signals. On 10th July, an early morning opening brought in stations located in central Europe. The opening seemed fairly typical with countries such as Italy, Austria, Czechoslovakia and Hungary present. The skip distance then progressively reduced bringing in West German transmissions followed by the Belgian Liège E3 outlet and Lopik on E4 from the Netherlands. The latter was carrying the 'PTT NED 1' PM5544 at the time and several enthusiasts have commented on it.

It is extremely rare for such short-skip DX to occur, although the Gort channel B transmitter in Eire has been received in central England via sporadic-E propagation on occasions.

Kevin Jackson of Leeds noted the Lopik E4 outlet during the morning and within a few hours experienced double-skip DX into Norway from the E3 Kautokeino transmitter, which is located well within the Arctic Circle.

On July 21st, an all-day opening

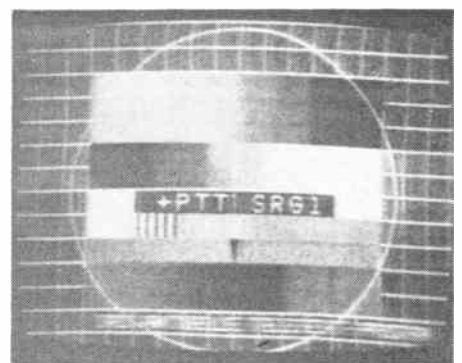
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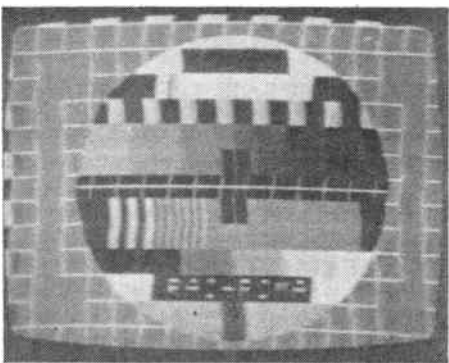
**Fig 1** New Austrian test card received on channel E2a



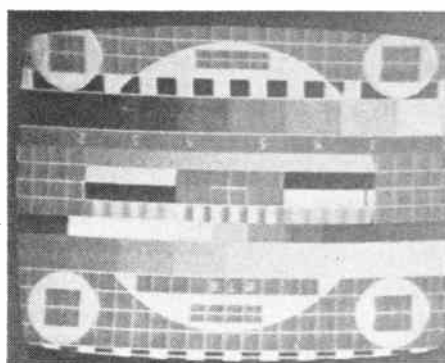
**Fig 2** Austrian PM5544 test card with programme schedule superimposed



**Fig 3** Swiss FuBK test card with moving line of text at the bottom



**Fig 4** Italian test card with 'RAI-ROMA' identification



**Fig 5** Russian UEIT test card with 'MTR' identification



**Fig 6** Spanish television opening caption from TVE-1

# DX-TV RECEPTION REPORTS

occurred with reception from literally all points of the compass. One lucky enthusiast, Ray Davies of Happisburgh in Norfolk, managed to receive what could be the ultimate in DXing – the Middle East at lunchtime and the USA or Canada shortly before midnight!

## Canada again?

We mentioned in the June column that USA and Canadian TV signals had been monitored by a couple of TV DXers/radio amateurs on June 19th. A further example of US/Canadian DX occurred between 2330 and 0010BST on July 21st. Chris Howles telephoned from his Lichfield home with startling news of a suspected 525-line signal he had located on channel A2 (this shares the same vision frequency as E3, namely 55.25MHz).

Other vigilant DXers who witnessed the event include Ray Davies of Norfolk and Roger Pates of Nottingham.

## DX-TV log for July

Many thanks to those of you who have found time to contribute logs and reception reports. It is always appreciated how much effort goes into preparing reports, whether typed or handwritten, especially where several pages are involved.

Kevin Jackson of Leeds has again submitted an excellent log, which highlights the recent conditions. Reception occurred every day, but for reasons of space we have included only the more interesting days. The log is in chronological order to enable readers to compare reception trends during each opening. All times shown are in BST. Programmes were received unless otherwise indicated.

**03/7/87:** TSS (Russia) on channels R1 and R2 at 0545; unidentified Italian private station on IA at 0548; TSS R2 'LRRTPC' UEIT test pattern at 0829; TVR (Rumania) R2 colour bars at 0833; RAI (Italy) IA and IB PM5544 at 0853; ORF (Austria) E2a at 0855 – also E3 (100W relay at 0804); JRT (Yugoslavia) E3 and E4 prog at 0919; SVT (Sweden) E2 PM5534 at 0820; SRG-1 (Switzerland) E2 '+PTT SRG1' FuBK at 1144 – also E3 at 1202; TDF Canal Plus L3 at 1151; RAI IB at 1202; ARD-1 (West Germany) E2 at 1204; TSS R1 'UT 0167' UEIT test card at 1213; TVE-1 (Spain) E4 at 1228 and 'TVE CATALUNYA' caption at 1231; TVE-1 E3 'AITANA' caption at 1331; TVE-1 E2 at 1332.

**10/7/87:** SWF-1 (Südwestfunk, West Germany) E4 'SWF 1 RBG' FuBK at 0723; SR-1 (Saarländischer Rundfunk) E2 'SR1 SAAR' FuBK at 0723; ORF E2a on modified FuBK at 0723 – on to PM5544 at 0726; CST R1 EZO test card at 0726; unidentified Italian private station at 0737; CST R2 'ODK 3' FuBK at 0739; SRG-1 E3 FuBK at 0742; ORF E4 PM5544 at 0749; BR-1 (Bayerischer Rundfunk) E2 'GRUNTEN' FuBK at 0750; SWF-1 E4 'SWF BADN

1' FuBK at 0823; RTP E3 low frequency test pattern at 0845; BR-1 E4 'OCHSENKOPF' FuBK at 0847; BR-1 E3 'KREUZBERG' FuBK at 0847; NOS-1 E4 'PTT NED 1' PM5544 at 0910; TDF Canal Plus L3 prog at 0923.

**11/7/87:** TSS R1 at 0656 – R2 at 0728; TVP R1 at 0743; DFF-1 (East Germany) E4 'AK' news caption at 0829; RAI IA and IB PM5544 at 0846; JRT E3 and E4 at 1001; FM band full of Italian transmissions at 0931; TVE-1 E2 and E3 at 1001; TDF Canal Plus L3 at 1002; TVE-1 E4 at 1039; JRT E3 'JRT BGRD' PM5544 at 1148; RTP E3 at 1258; TVE-2 E2 GTE test card at 1310; ARD-1 E2 at 2109; TVE-1 E2 at 2112; RAI IA and IB at 2117.

**15/7/87:** RAI IA and IB teletext at 0942; TVE-1 E3 prog at 1151; TVE-2 vertical bars pattern at 1257; RTP E3 prog at 1257; TVE-1 E4 (two transmitters) progs at 1258; TVE-1 E4 'TVE CATALUNYA' caption at 1300; TVE-1 E2 prog at 1316; TVE-2 E2 'tve tve 2' GTE test card at 1542.

**17/7/87:** MTV R1 and R2 at 1944; JRT E3 Beograd at 1946; JRT E4 'EPP' adverts at 1948.

**20/7/87:** RAI IA and IB PM5544 at 0747; TVE-1 E2 and E3 at 0750; SRG-1 E2 FuBK at 0757; TVE-1 E4 at 0812; YLE E3 and E4 blank FuBK at 0837; RTP E3 low frequency test pattern at 0855 then 'RTP-PORTO' FuBK with digital clock at 0943; TSS R1 and R2 'UT 0167' UEIT test card at 1012; unidentified R1 colour bars at 1017; unidentified R1 low frequency test pattern at 1108; TSS R1 'LENINGRAD' UEIT test card at 1159; TVE-1 E3 'VALENCIA' test pattern at 1229; TVE-2 vertical bars test pattern at 1315; TVE-1 E4 'TELESUR' caption at 1330; TVE-2 E2 'tve tve 2' GTE test card at 1415; TVP R1 PM5544 at 1610; RAI IA at 1711; JRT E4 Zagreb at 1712; ORF E2a and E4 at 1613; CST R2 at 1715; CST R1 at 1719; JRT E3 Beograd at 1720; TVR R2 colour bars at 1725 then 'TVR BUCURESTI' FuBK at 1750; SVT E2 PM5534 at 1729; TDF Canal Plus L3 at 1743; NRK E2 at 1758; YLE E3 weather map at 1851; NRK E3 and E4 at 1907.

## Test card news

Several new or modified test cards have been noted by DX-TV enthusiasts during the sporadic-E season. These are as follows:

**Austria:** At least one brand new test pattern has appeared in service. ORF are now using a pattern which resembles an FuBK, but features a distinctive chequered band across its centre. The colour difference bands in the lower half of the pattern have been replaced by a plain, unshaded grey area. No identification is present on the card and it only seems to be shown until 0730 before it switches over to the normal PM5544, with ORF FS1 identification. On July 21st, it was received with superimposed programme details moving vertically.

**Czechoslovakia:** CST are radiating the

FuBK test pattern with 'ODK 3' identification on channels R1 and R2 prior to station opening. 'ODK 1' and 'ODK 2' versions have been radiated in the past and, to confuse matters, the letter 'O' can easily be mistaken for a 'D'. This has misled many DXers into thinking the test card has originated from an East German DDR-1/DFF-1 source, despite its appearance on channels R1 and R2 rather than E4!

**Unmarked FuBK test cards:** Beware of FuBK test patterns on E3 being broadcast without identification. The Portuguese first network (RTP-1) radiates a blank FuBK during the early morning before switching to the low frequency (black-white-black) pattern which precedes the 'RTP-PORTO' FuBK. Unfortunately, Finland also radiates a blank version at times, so extreme caution is needed when receiving this test card!

**Portugal:** Recent reception of the 'RTP-PORTO' FuBK has revealed a smaller clock display in the lower right-hand corner of the screen.

**Mystery pattern:** A pulse and bar test pattern was seen by Chris Howles on channel IC on 20th July. At first Albania was suspected but the time of reception was around 1730 BST, which seems rather late for their test transmissions.

## Reception reports

Signals from the low power Greek transmitter on channel E3 were identified by Kevin Jackson and Chris Howles on July 4th during the morning and by Ray Davies on the 21st. The PM5534 test pattern was being radiated with 'EPT' in the upper identification block. A programme with Greek subtitling was noted on E3 at the home of Chris Howles on the 9th. At 1430, the programme was co-channelling with a mystery signal consisting of a film with Hebrew-looking subtitles. One explanation could be that the signal originated from Syria. For some reason, the Arabic script used for Syrian captions and subtitles is much larger and appears different in shape to that used by other services.

Other DX signals from the Middle East were logged by Bob Brooks, of South Wirral, who noticed a film on channel E3 with Arabic subtitles at 1447 on the 9th. Ray Davies also reports an unidentified Arabic station on channel E3 but later in the month during an intense all-day opening on the 21st.

Despite a somewhat sheltered location for DXing, Vincent Richardson of Conwy has enjoyed a most successful season so far. Virtually every European country has emerged, including an exotic PM5544 test pattern on channel E2 bearing the identification 'TELE UNO'. This was seen on June 16th at 0715 and the name suggests another Italian private station in operation. Shortly after, another Italian private station, 'TVA', appeared on channel IA.



Simon Hamer of New Radnor in Powys has been concentrating on Band II channels R3, R4, R5 and IC during many of the openings, when high mufs have been expected. This extra vigilance has paid off, and at least twice this season Russian signals have been resolved on R5. The vision frequency is 93.25MHz, but unfortunately for most of us this is heavily obscured by the many local FM radio stations operating in this part of the band. It would appear that local reception is very bad for Simon, but the DX possibilities, especially in Bands I and II, are endless. We wonder how long it will be before Simon receives the Bulgarian 100kW outlet at Sumen!

Other Band II successes came from Italy and Albania on channel IC plus, of course, Russia on R3 and R4. On the 18th, Italian RAI signals were located on channel E2 from the 40W Campione d'Italia relay situated atop Mt San Salvatore in the Swiss Ticino beaming signals over the lake to the Italian town of Campione. Another Italian E2 station came through on the 21st, which was eventually identified as 'Telemarket', a private channel broadcasting mainly adverts from the Milan area.

July 10th must have been a hectic day judging by Bob Brooks' log. At least three

new test patterns appeared on the screen. The first was the new ORF pattern which remained clear long enough to make a sketch of it, and within twenty minutes the Czechoslovakian 'ODK 3' FuBK had made an appearance on channel R2 in SECAM colour. A West German FuBK was resolved on channel E4 shortly after 0800 carrying the transmitter name 'OCHSENKOPF' across the central black bar. Bayerischer Rundfunk was the programme originator. Other signals noted throughout the day included Russia, Sweden, Norway, Spain and Italy. The log for the day ended at 2326 with the 'RS-KH' EZO test pattern from Czechoslovakia being shown for a few minutes after close down. The 11th was less intense but one exciting catch was Rumania on channel R3, transmitting the 'TVR BUCURESTI' FuBK at 1050.

On the 31st, Andy Webster of Billinge near Wigan watched an 'RTS' caption emerge from out of the noise on channel E3. There seemed to be a shield present and he wonders if this could be a new Albanian transmitter or relay in service. The only other explanation we can think of is that his reception was of Yugoslavian origin from the 25W Pisvir relay of Radio Televizija Sarajevo.

The 'LRRTPC' UEIT test pattern comes

from the channel R2 Vilnius transmitter, according to Mark Dent of Leeds. At least two test patterns are in use by EESTI TV in Estonia on channels R1 and R2. The main one is the Philips PM5537 'colour blockboard' pattern with 'EESTI TV TALLINN' in large lettering. An alternative pattern is the UEIT with 'UT 1987' at the top when the transmitters radiate the main Russian 1st network. The Italian private station 'Radio-Tele-Uno' was around on the 7th with a caption followed by a music programme at 2100. Finally, on the 4th and 5th, tropospheric DX provided a break from the hectic conditions imposed by sporadic-E.

## Service information

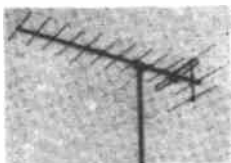
**Netherlands:** All Nederland-2 TV transmitters broadcast '2T' sound during test transmissions on weekdays. The sound of 'Radio 5' appears on the left channel and 'Radio 1' on the right. Using a standard TV set only the 'Radio 1' broadcast can be heard.

The new Nederland-3 channel E34 transmitter at Roermond started test transmissions on July 6th for a six-week period.

The above information was kindly supplied by Gosta van der Linden of Rotterdam in the Netherlands. 

## FERNSEH-ANTENNA

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We are also offering the very popular Antiference UP1300 amplifier at a special price. If purchased with the above Band 3 aerial, the price is only £14.95. This amplifier covers 40-230MHz, which means it covers all Band 3 frequencies, the gain is 19dB, with a low noise figure of 2.5dB. This unit requires 12v DC @ 6mA from its power supply via the coaxial downlead.

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## ARE YOU A BUDDING WRITER?

We are particularly keen to receive construction articles, so if you have designed and built a project which you think could be of interest to other readers we would be pleased to receive your contribution. Construction tips and techniques would also be of great interest.

You do not need to be an expert writer to see your name in print. Accuracy in the design of your project is far more important. If you can put your ideas down on paper, typewritten if possible, and illustrate them with clear drawings and photographs where appropriate, the *Radio and Electronics World* editorial team will sort out the style, grammar, spelling, etc.

We will, of course, pay for all articles which are accepted for publication.

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

## Touch wood

Wimbledon and District Amateur Radio Society are clearly not a superstitious lot, for they are holding a general activity evening on Friday, November 13th... fingers crossed.

Later in the month, on the 27th, a mini-lecture will be given at 7.30pm in the club HQ, which is St Andrews Church Hall, Herbert Road, Wimbledon, London SW19. To find out what the lecture is about, or indeed to discover more about any W&DARS activities, contact the Hon Secretary, George Cripps G3DWW, on 01-540 2180.

## Sausages galore

RTTY is Tony G6OPM's subject on Monday, November 2nd at Sheffield Amateur Radio Club's first meeting of the month.

On Monday 9th, the club has a special event lined up - a

junk sale and sausage spectacular... wonder how good sausages are as antennas? Doubtless all concerned will be able to distinguish the edible from the electronic!

The club's committee meeting will be held on November 16th, and that concludes the list of events for the month. Any Mondays not set aside for special events are Morse/RAE or Natter nights. The club meets at 8pm every Monday in the Firth Park Pavilion, Sheffield. Details can be obtained from Alan G8ZHG, on (0742) 395287.

## Hendon RAE

Hendon College is once again offering its popular and successful course for the Radio Amateurs Exam. Classes will be held on Tuesdays from 7.30 to 9.30pm. Anyone who wants more details should contact Chris Holford, the senior lecturer in

WAB square D15, using the callsign GB3MKB. The two other WAB squares on the island, D14 and DO5, were worked under the club's own callsign, G13FFF/P. Both HF and VHF were active.

To contact the club for more information, write to 70 Nursery Road, Gracehill, Ballymena, Co Antrim, N Ireland.

## Rathlin Island expedition

Rathlin Island was the destination of the recent expedition of the Ballymena Amateur Radio Club.

In what has become an annual event to commemorate the work done by Marconi for Lloyd's of London 89 years ago, the club set up a station in square IO65VH and

Ballymena ARC on their recent Rathlin Island expedition



Technology. The college address is Corner Mead, Grahame Park, Colindale, London NW9 5RA.

## RAE Wythall

The Wythall Radio Club will be continuing their successful series of RAE classes at their HQ in Wythall House, Wythall Park, Silver St, Wythall - this is south of Birmingham, off the A435.

For details of the classes and other club activities, phone Chris G0EYO, QTHR, on (021) 430 7267.

## Yo ho ho!

For readers interested in marine matters, Fareham and District Amateur Radio Club have a talk scheduled for November 4th which will warm the cockles of the heart.

Entitled 'Amateur Radio in the RN', it will be given by G3JFF.

The club meets every Wednesday at Portchester Community Centre, Westlands Grove, Portchester, Hants. For more information contact the Secretary, G3CCB, on Fareham 288139.

## Farnborough AGM

Farnborough and District Radio Society are holding their 22nd Annual General Meeting on November 11th, and on November 22nd they have the Chairman's Evening, so this is clearly a good month for official events.

The club meets at 7.30pm on Fridays at the Railway Enthusiasts Club, Hawley Lane, Farnborough. For more details of forthcoming events, get in touch with the club secretary, Tim, on Camberley 29231.

## RAE for all

Everyone is welcome to attend the RAE open evening which Dunstable Downs Radio Club are holding on November 13th.

The club meets every Friday at 8pm, at Chews House, 77 High Street South, Dunstable, Beds. Details of events can be obtained from the Secretary, Tony C0COQ, on (0582) 508259.

## FirewoRx

Remember, remember - on the third of November, at Rugby there is going to be a

fireworks display and barbecue.

Rugby Amateur Transmitting Society would like to extend an invitation to the XYLs and harmonics too, so at last they will see what the OM gets up to in the evenings...

The society meets at 7.30pm every Tuesday, at the cricket pavilion outside Rugby radio station. Visitors and new members are always welcome. Most meetings are informal natter nights, but there is also a programme of talks, slide shows and videos. For further information, please contact Kevin Marriott G8TWH on (0788) 77986.

## Microwaves at Bath

Bath and District ARC plan to have a talk on microwaves on November 11th - XYLs take note - after this he will be able to cook the dinner (*could this have been written by a woman?* - Ed).

Later in the month, on November 25th, the club is holding an open night - an apt introduction to the season of goodwill.

All meetings are held at the Englishcombe Inn, Englishcombe Lane, Bath, at 8pm. Club contact is H Welchman G6E1Y on Bath 28010 daytimes or Bath 318128 evenings.

## Junk sale

Chelmsford Amateur Radio Society will be holding a junk sale on November 3rd, so members should start collecting their surplus equipment together now.

For more information about club events, please contact Roy G3PMX or Ela G6HKM on (0245) 360545.

## Where are they?

The North Staffordshire Raynet Group are keen to find the whereabouts of G6RNS or G8RNS. If anyone has any information would they contact Allan Drake G1EBD, the group controller, on (0782) 612868.

## Felixstowe socials

Felixstowe is the place to be if you're feeling sociable in November, as Felixstowe and District Amateur Radio Club have two social evenings lined up, on the 16th and 30th. A night on the air is also planned for November 2nd -



the club must like keeping in contact.

All lecture and social meetings take place at 8pm in the Scout Hut, Bath Road, Felixstowe unless otherwise specified, and the club contact is Paul Whiting G4YQC on (0473) 642595, daytime.

### Competition time

A construction competition is going to be the main event in Southgate Amateur Radio Club's November schedule, to be held on Thursday 12th. After this exciting start to the month, members can relax at the informal evening scheduled for Thursday 26th.

The club meets at Holy Trinity Church Hall (Upper), Green Lane, Winchmore Hill, London N21, and information about events can be obtained from D C Elson G4YLL, the club publicity officer.

### Amps and AGMs

AGMs are in the air again as Chesham and District Amateur Radio Society pre-

pare for theirs on November 18th.

Club members' diaries will be full this month, for not only is there a talk and demonstration of high power linear amps lined up for November 11th, but also a talk on the history of stereo by Tony G4BPC.

Chesham and District meets every Wednesday at 8pm, in 'The Stable Loft', The Bury Farm, Pednor Road, Chesham. Club contact is the secretary, Liz G0ETU QTHR.

### STARS come out

Amateurs on the air on November 7th and 8th may well find Stourbridge Amateur Radio Society about, as these are the dates when the DX contest is to be held.

STARS are also on the air on November 2nd, but later in the month will be selling equipment rather than using it, with their annual surplus sale on the 16th.

To find out where in the Galaxy STARS hang out and

on what dates, contact the Hon Secretary, Derek Pearson G3ZOM on Kingswinford 288900.

### Hi-tech talk

Verulam ARC is holding an activity evening on November 10th, and on Tuesday 24th Robin Hewes G3TDR is going to give a talk on advanced receiver technology, for those who want to brush up on their technical knowledge.

Club meetings are held at the RAF Association HQ, New Kent Road, St Albans, on the second and fourth Tuesdays of the month. Information can

be obtained from Hilary G4JKS on St Albans 59318.

### MARS video

Mansfield Amateur Radio Society are watching a video this month. The video in question is the RSGB's and will be shown on Friday 6th.

Keith G4AAH will give a talk on the Grid Dip Oscillator on Tuesday 17th. The club's meetings take place on the first Friday and third Tuesday of the month (how complicated!) and for dates, if you don't have a calendar handy, or venues please contact Keith Lawson G4AAH QTHR.

## Amdat corrections

In Ken Michaelson's review of the MFJ-1274 on page 38 of the September issue, Amdat's address was given incorrectly. It is: Amdat, Crofters, Harry Stoke Road, Stoke Gifford, Bristol BS12 6QH. We apologise for any inconvenience caused.

# BI-PAK BARGAINS

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VP4	200	1/2-1 watt Resistors mixed values & types	£1.00
VP18	50	Wirewound Resistors mixed watt values	£1.00
VP140	50	Precision Resistors. 1% Tol	£1.00
VP181	100	1 and 2 watt Resistors, assorted values	£1.00
<b>CAPACITORS</b>			
VP5	200	Assorted Capacitors all types	£1.00
VP6	200	Ceramic Capacitors Min. mixed values	£1.00
VP9	100	Assorted Polyester/Polystyrene Capacitors	£1.00
VP10	60	C280 Capacitors. Metal foil, mixed values	£1.00
VP11	50	Electrolytics all sorts	£1.00
VP12	40	Electrolytics. 47mf-150mf, mixed volts	£1.00
VP13	30	Electrolytics. 150mf-1000mf, mixed volts	£1.00
VP14	50	Silver Mica Caps, mixed values	£1.00
VP15	25	01/250V Min Layer Metal Caps	£1.00
VP18	25	Tantalum Bead Caps, assorted values	£1.00
VP182	4	1000µf 50V Electrolytics	£1.00
VP182	30	Min Electrolytics mixed values. 47mf-1000µF 6-16V	£1.00
VP193	6	Sub Min Electrolytics. 2 x 1000/2200/3300µF 10-16V	£1.00
<b>OPTOS</b>			
VP24	10	125° clear showing Red LED's	£1.00
VP25	10	Mixed shape and colour LED's	£1.00
VP26	15	Small 125° Red LED's	£1.00
VP27	15	Large 2° Red LED's	£1.00
VP28	10	Rectangular 2° Red LED's	£1.00
VP29	25	Opto special pack. Assorted. Super Value	£3.00
VP130	6	RED 7 Seg. CC 14mm x 7.5mm RDP FND353 LED Display	£2.00
VP131	4	GREEN 7 Seg. CA 6° LDP XAN 6520 LED Display	£2.00
VP133	6	RED Overflow. 6° 3 x CA 3 x CC 6630/50 LED Display	£2.00
VP134	5	GREEN Overflow. 6° X CAN6530 LED Display	£2.00
VP138	20	Assorted LED Displays. Our mix, with data	£5.00
VP147	1	Pair Opto Coupled Modules	£0.60
VP199	4	LD707R LED Displays CA	£1.00
VP203	15	Triangular shape LED's. Mixed colours	£1.00
VP204	10	Large Green LED's 5mm	£1.00
VP205	10	Small Green LED's 3mm	£1.00
VP206	10	Large Yellow LED's 5mm	£1.00
VP207	10	Small Yellow LED's 3mm	£1.00
VP208	10	Large LED's clear showing Red, 2°	£1.00
VP241	2	ORP12 Light Dependant Resistor	£1.50
VP242	4	Tri-colour LED's. 5mm Dia 5mA 2v RGY	£1.00
VP243	3	Tri-colour LED's. Rectangular 5mm RGY	£1.00
<b>DIODES &amp; SCRS</b>			
VP29	30	Assorted volt Zeners. 50mw-2w	£1.00
VP30	10	Assorted volt Zeners. 10w, coded	£1.00
VP31	10	5A SCR's T066, 50-400v, coded	£1.00
VP32	20	3A SCR's T066, up to 400v, uncoded	£1.00
VP33	100	Sil Diodes like IN4148	£1.00
VP34	200	Sil Diodes like BA200/BAX13-16, 40v	£1.00
VP35	30	1A IN4001 Diodes, all good uncoded	£1.00
VP49	30	Assorted Sil. Rectifiers. 1A-10A, mixed volts	£1.00
VP141	40	IN4002 Sil. Rectifiers. 1A 100v, preformed pitch	£1.00
VP142	4	40A Power Rectifiers, Silicon, T048 300 PIV	£1.00
VP143	5	BY187 12KV Sil. Diodes, in carriers, 2.5MA	£1.00
VP184	3	4A 400v Triacs, plastic	£1.00
VP187	10	SCR's 800MA, 200v, 2N5064, plastic, T062	£1.00
VP184	50	OA91 point contact germ Diodes, uncoded	£1.00
VP195	50	OA47 gold bonded germ. Diodes, uncoded	£1.00
VP196	50	OA70-79 detector germ. Diodes	£1.00
VP197	50	OA90 type germ Diode uncoded	£1.00
VP198	45	BA248 Sil Diodes 350v 2A, fast recovery	£1.00
VP222	20	3A Stud Rectifiers. 50-400v. Assorted	£1.00
<b>TRANSISTORS</b>			
VP38	100	Sil. Trans. NPN plastic, coded, with data	£3.00
VP39	100	Sil. Trans. PNP plastic, coded, with data	£3.00
VP47	10	Sil. Power Trans. similar 2N3055, uncoded	£1.00
VP48	5	Pairs NPN/PNP Plastic Power Trans. 4A, data	£1.00
VP50	60	NPN Sil. Switching Trans. TO-18 and TO-92	£1.00
VP51	60	PNP Sil. Switching Trans. TO-18 and TO-92	£1.00
VP60	100	All sorts Transistors, NPN/PNP	£1.00
VP150	20	BC183B Sil. Trans. NPN 30v 200mA Hfe240+ T092	£1.00
VP151	25	BC171B Sil. Trans. NPN 45v 100mA Hfe240+ T092	£1.00
VP152	15	TIS99 Sil. Trans. NPN 40v 400mA Hfe100+ T092	£1.00
VP153	15	TIS91 Sil. Trans. PNP 40v 400mA Hfe100+ T092	£1.00
VP154	15	MPSA56 Sil. Trans. PNP 80v 80mA Hfe50+ T092	£1.00
VP155	20	BF395 Sil. Trans. NPN eqvt BF184 HF T092	£1.00
VP156	20	BF495 Sil. Trans. NPN eqvt BF173 HF T092	£1.00
VP157	15	ZTX500 series Sil. Trans. PNP plastic	£1.00
VP158	15	ZTX107 Sil. Trans. NPN eqvt BC107 plastic	£1.00
VP159	15	ZTX108 Sil. Trans. NPN eqvt BC108 plastic	£1.00
VP161	25	BC108 Sil. Trans. NPN 30v 200mA T092	£1.00
VP162	5	SJE5451 Sil. Power Trans. NPN 80v 4A Hfe20+	£1.00
VP163	2	PNP/PNP pairs Sil. Power Trans. like SJE5451	£2.00
VP164	4	2N6289 Sil. Power Trans. NPN 40v 40mA Hfe30+	£1.00
VP165	6	BT33 NPN Sil. Trans. 80v 5A Hfe50-200 T039	£1.00
VP166	5	BT34 NPN Sil. Trans. 100v 5A Hfe50-200 T039	£1.00
VP167	1	BUY69C NPN Trans. TO3 VCB 500, 10A, 100v, Hfe15+	£1.00
VP168	10	BC478 eqvt BCY71 PNP Sil. Trans. TO18	£1.00
VP169	10	BX521 eqvt BC394 NPN Sil. Trans. 80v 50mA TO18	£1.00
VP170	10	Assorted Power Trans. NPN/PNP coded and data	£1.00
VP171	10	BF355 NPN TO-39 Sil. Trans. eqvt BF258 225v 100mA	£1.00
VP172	10	SM1502 PNP TO-39 Sil. Trans. 100v 100mA Hfe100+	£1.00
VP200	30	OC71 type germ. AF Transistors, uncoded	£1.00
VP201	25	OC45 germ. RF Transistors	£1.00
<b>I.C.S.</b>			
VP40	40	TTL I.C.s all new gates - Flip Flop - MSt.Data.	£4.00
VP59	20	Assorted I.C.s linear etc. all coded	£2.00
VP209	12	74LS00	£2.00
VP210	12	74LS74	£2.00
VP211	10	CD4001B	£2.00
VP212	10	CD4011B	£2.00
VP214	10	CD4098B	£2.00
VP215	10	741P 8 pin	£2.00
VP216	10	555 Timers 8 pin	£2.00
<b>MISC</b>			
VP17	50	Metres PVC single strand Wire, mixed colours	£1.00
VP18	30	Metres PVC multi strand Wire, mixed colours	£1.00
VP19	40	Metres PVC single/multi strand Wire, mixed colours	£1.00
VP22	200	Sq. inchest solid copper clad board	£1.00
VP23	10	40mm track slider pots 100K Lin	£1.00
VP42	10	Black heatshinks, fit TO3 and TO220, drilled	£1.00
VP43	4	Power-frm heatshinks, 2 x TO3, 2 x TO66	£1.00
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VP56	100	Semiconductors from around the world, mixed	£4.00
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VP83	1	Electronic Buzzer, 8v, 25MA	£0.95
VP84	1	Electronic Buzzer, 8v, 25MA	£0.95
VP85	1	Electronic Buzzer, 12v, 25MA	£0.95
VP86	1	TECASBOTY Components Pack, semiconductors, caps, etc	£8.00
VP87	1	Telephone pick-up coil with 3.5mm jack plug	£1.25
VP88	1	Pillow Speaker with 3.5mm jack plug	£1.45
VP95	1	Plastic Vice, small, with suction base	£1.75
VP97	1	Logic Probe/Tester, Supply 4.5v-18v. DTL, TTL, CMOS	£8.50
VP99	1	Universal Tester, with ceramic buzzer	£5.00
VP107	1	Piezo Buzzer miniature 12v	£1.25
VP108	1	Piezo Buzzer, miniature 240v	£1.25
VP113	1	Coax Antenna Switch, 2 way	£4.50
VP114	1	Coax Antenna Switch, 3 way	£4.75
VP115	1	High Pass Filter/Suppressor, CB/TV	£0.50
VP116	1	Low Pass Filter, VHS/TV Band	£3.00
VP122	1	Precision Morse Key, fully adjustable	£1.85
VP128	1	Miniature FM Transmitter/Babyphone	£7.50
VP144	4	100K Lin multi turn Pots, ideal vari. cap. tuning	£1.00
VP145	10	Assorted Pots, inc. dual and switched types	£1.00
VP148	30	Presets horizontal and vertical mixed values	£1.00
VP174	5	DIL Switches, 1 & 2 way slide, 6 way SPST, assorted	£1.00
VP178	30	Fuses, 20mm & 1 1/4" glass, assorted values	£1.00
VP177	1	Pack assorted Hardware, nuts, bolts, etc	£1.00
VP178	5	Assorted Battery holders and clips. PP3/9, AA/D, etc	£1.00
<b>TOOLS</b>			
VP103	1	6 pc STANLEY Screwdriver Set. Flat & crosspoint	£1.50
VP139	1	Pick-up Tool, spring loaded	£1.75
VP217	1	Helping Hand	£4.00
VP218	1	Watchmakers Screwdriver Set, 6 pieces	£1.75
VP219	1	Miniature Side Cutters	£1.50
VP220	1	Miniature Bent-nose Pliers	£1.50
VP221	1	Miniature Long-nose Pliers	£1.50

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# SHORT WAVE NEWS FOR DX LISTENERS

By Frank A Baldwin

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

It is at the end of this month that signals emanating from transmitters located in the Indian sub-continent, carrying the various regional services, start to be heard on the 60 metre (**4750 to 5050**) and the 90 metre (**3200 to 4000**) bands here in the United Kingdom.

As the few weeks following pass, stations in that general area will be heard with ever increasing signal strengths, culminating with the reception of Indonesian and other Far Eastern and South East Asian stations, with the season extending from mid-September through to late March.

Drawing the attention of readers to the first target area, that of the Indian sub-continent, I will set the scene, and this will be followed by an update of schedules pertaining to regional transmitters currently operating on the 90 metre band and information about those on the 60 metre band.

## India

The peninsula of India has an eastern line of Ghats through which flow the rivers Cauvery, Godavari, Kistna and Manahadi, forming large deltas when entering the Bay of Bengal. In the extreme north are the Himalayas of which the three main ranges are the Greater Himalayas, Lesser Himalayas and the Siwaliks. Between these lie sediment filled troughs drained by the Ganges and Indus rivers and their tributaries.

The hot season is that from February to May, June to October being the period during which heavy monsoon rainfalls occur.

Comprised of seventeen states and ten centrally administered territories, India has its capital at New Delhi. Among the states, are Maharashtra, Madras, Kerala, Mysore and Uttar Pradesh. Sikkim is a protectorate.

The Republic of India is

bounded in the north east by Bangladesh and China, in the north by Nepal and Tibet and in the north west by Pakistan. India is a member of the Commonwealth.

## When to listen

The signals from India can best be heard from 1530 to around the sign-off times indicated below, a listening session from 0025 also producing results sometimes. News bulletins in English make station identification an easy matter, note being taken of the fact that schedules are liable to be extended on those occasions when cricket matches are the order of the day.

## 90 metre band

AIR (All India Radio) Lucknow is scheduled with the North Regional Service on **3205** from 0025 to 0215 in Hindi and from 1100 to 1740 in Hindi and English with a power of 10kW. Newscasts in English are timed from 0035, 1530 and 1730.

Lucknow is the capital of Uttar Pradesh State. During the Indian Mutiny (Sepoy Rebellion) the British garrison suffered a five month siege, the city being retaken by a column under the command of Sir Colin Campbell.

On **3223** AIR Simla operates from 0100 to 0200 in Hindi and from 1130 to 1740 in Hindi and English, with a power of 2.5kW carrying the North Regional Service. English newscasts are at 1530 and 1730. Due to its low power it is only seldom heard by UK based DXers.

The town of Simla is the capital of Himachal Pradesh territory at an altitude of 7,100 feet in the Himalayas. It is the headquarters of the Indian Army.

AIR Gauhati is on the air with the East Regional Service from 1230 to 1700 (Sunday from 1230 to 1740) on **3235** with a power of 10kW in Indian vernaculars and with English newscasts at 1230 and 1530. Gauhati, the temporary capi-

tal of Assam, is regularly heard by DXers world-wide.

Indian vernaculars are Assamese, Kannada, Malayalam, Marathi, Oriya and Telegu.

AIR Ranchi has a power of only 2kW on **3305** and, as may be expected, is only rarely heard by UK DXers. It operates from 0025 to 0200 in Hindi and from 1200 to 1700 in Hindi, with English news bulletins at 1530 and 1730 in the North Regional Service.

Ranchi is a town on the Chota Nagpur plateau in Bihar State, set in the Ganges Basin in North West India. It is the hot season seat of local government.

AIR Bhopal may be located on **3315**. It is on the air from 0025 to 0215 in Hindi and from 1200 to 1740 in Hindi with the English newscasts at 1530 and 1730 in the North Regional Service. The power is 10kW.

The city of Bhopal is the capital of Madhya Pradesh and an industrial centre for the region.

Rarely heard in Europe are the signals from AIR Jammu on **3345**. Scheduled from 0125 to 0215 in vernaculars and from 1200 to 1740 in vernaculars, English and Urdu, it has a power of 1kW, therein lying one reason for its non-appearance in UK based DXers' logs.

The officially termed Jammu and Kashmir is a state in north-west India and north-east Pakistan. It is administered in two sections, Indian Kashmir with its summer capital at Srinagar and winter capital at Jammu, and Azad (Free) Kashmir with its capital at Muzaffarabad. In 1947, India annexed part of Kashmir whilst Pakistan continues to occupy the north and west sections of Kashmir.

AIR Kurseong is regularly logged by the writer during each season. It may be located on **3355**, on which channel it radiates the East Regional Service from 1130 to 1740 in vernaculars, with the inevitable English news bul-

letins timed at 1230 and 1530. The power is 20kW.

Kurseong is near Darjeeling, the latter town being a resort in the Himalayan foothills of West Bengal.

Another often heard Indian regional is AIR Delhi on **3365**, carrying programmes in the North Regional Service. It is scheduled with a power of 10kW from 0025 to 0230 in vernaculars but with an English newscast at 0025, and from 1230 to 1740 in vernaculars with the English bulletin at 1730.

Delhi is a territory in north India which encompasses the Delhi plain which is crossed by the Jumna River. It is a hot and arid region requiring extensive irrigation. Delhi was the interim capital of India from 1912 to 1931, being succeeded by the adjacent city of New Delhi which was constructed to replace the former capital of Calcutta. New Delhi is predominantly an administrative centre but is also a transportation hub and trade centre.

AIR Gauhati appears again with the East Regional Service on **3375**, at which frequency it is on the air from 0025 to 0145 and from 1230 to 1730 in vernaculars and Assamese with a power of 10kW.

In the next issue, Indian regional stations currently operating on the more popular 60 metre band will be brought to notice.

## ON THE AIR

Tune in to the frequencies indicated below and listen for these stations.

## AFRICA

### Botswana

Radio Botswana, Gaborone on **4820** at 1915, OM with the news in English until 1924 then into a programme of local music with songs in SeTswana.

The Home Service in SeTswana is scheduled from 0400 to 1100 and from 1500 to 2100. There are news-



casts in English timed at 0510 and 1610 Monday to Friday inclusive and at 1910 daily. The power is 50kW.

### Cameroon

Radiodiffusion Nationale du Cameroon, Yaounde on **4850** at 2046, OM in English with local notices which included announcements of lost property, dates and times of local association meetings and educational examination results. This was followed at 2100 by the station identification and news of local and international events, also in English. Yaounde carries the National Service in French and English from 0940 to 0700 and from 1630 to 2400. English programmes are timed from 0505 to 0600 (Sunday until 0645) and from 1705 (Sunday from 1730) to 1845, although from the foregoing it would appear there is some variation of this schedule on occasions. News bulletins in English are at 0530, 1800 and 2100.

### Ghana

GBC (Ghana Broadcasting Corporation) Accra on **4915** at 2100, the station identification 'Ghana Radio', short chorus, drums then OM with a talk in vernacular.

The schedule of GBC1 in English and vernaculars is from 0525 to 0905 (Saturday and Sunday until 2305) and from 1200 to 2305. The power is 50kW.

### Liberia

LBS (Liberia Broadcasting System) Monrovia on **3255** at 2008, OM with a talk in vernacular followed by local style music and songs. This 50kW transmitter is on the air from 0455 (Saturday from 0520, Sunday from 0558) to 0900 and from 1900 to 2400 daily with English newscasts timed at 0700, 1900, 2100 and at 2300. From Monday to Friday inclusive there are relays of the VOA (Voice of America) news bulletins at 2145.

### Mozambique

Radio Mozambique, Maputo on **4865.8** at 1921, local pops and music with announcements in Portuguese. Emissao Nacional in Portuguese was on the frequency specified when log-

ged but does tend to vary around **4866**. The schedule is from 0255 to 0530 and from 1500 to 2205. For some time now Radio Mozambique has been heard regularly and often on **3210** and in parallel with the aforementioned channel.

Formerly Lourenco Marques, Maputo is the seaport capital of Mozambique. At the head of Delagoa Bay, Maputo is a rail terminus and commercial centre.

### Morocco

Tangiers on **15335** at 1333 with a programme of songs and music during the Arabic transmission for Western Europe, timed from 1000 to 0100.

### Rwanda

Radiodiffusion de la Republique Rwandaise, Kigali on **3330** at 1936, OM with news comment in French. The Home Service in Kinyarwanda, Swahili and French is on this frequency from 0300 to 0600 (Sunday until 2100), from 0900 to 1200 (Saturday until 2100) and from 1330 to 2100 with newscasts in French at 0430, 1115, 1600, 1800 and 1900. The power is 5kW.

## CENTRAL AMERICA

### Guatemala

Radio Cultural, Guatemala City on **3300** at 0343, an American recorded religious talk in English. Heard often around the time stated, the 10kW Radio Cultural is now on the air from 1000 to 0730 (Sunday from 1100 to 0630) in Spanish. The English programme is timed from 0300 to 0430, Monday to Saturday inclusive.

## SOUTH AMERICA

### Brazil

Radio Nacional de Tabatinga, Benjamin Constant on **4815** at 0136, with a programme of sambas and songs in Portuguese. This Radiobras station operates from 0900 through to a variable sign-off time of around 0400. The power is 10kW.

### Venezuela

Radio Rumbos, Villa de Cura on **9660** at 2255, OM with a sports commentary in Spanish, the station identification being at 2300.

## ASIA

### China

Xinjiang PBS, Urumqi on **4735** at 2255 when featuring a talk in Uigher. The Home Service in Uigher is on this frequency from 2300 to 0200, 0330 to 0730 and from 1000 to 1700, which includes relays of the Radio Beijing Minority Language Service in Uigher from 0030 to 0056, 1100 to 1126 and from 1330 to 1356. The power is 50kW.

### Iraq

Radio Baghdad on **9515** at 1818, songs and music in the local manner during the Arabic programme for Western Europe, timed from 1800 to 2200. Also heard on **9555** and **9585** in parallel.

Radio Baghdad has also been logged on **11840** at 1841 with the Arabic presentation to West Africa, scheduled from 1800 to 2400, and in parallel on **11740**.

### Pakistan

Islamabad on **17660** 1007, a talk in the Urdu transmission for Europe, scheduled from 0715 to 1000.

### Qatar

Doha on **11820** at 1835, local style songs and music during the Arabic programme for Europe, timed from 1700 to 2120.

Doha is the capital of the Emirate, Qatar being a peninsular on the Persian Gulf. The economy is based largely on offshore oil.

### Saudi Arabia

Riyadh on **9655** at 1514, Holy Quran programme directed to North Africa and timed from 1500 to 1700 daily.

## SOUTH-EAST ASIA

### South Korea

Seoul on **6480** at 1930, the station identification and schedule announcement. This is followed by a newscast in the English programme directed to Europe from 1930 to 2030.

## PACIFIC

### Australia

Shepparton on **9655** at 0750, a pop song and music followed by announcements in the English transmission for Europe and the South Pacific, timed from 0700 to 1030.

Shepparton on **11910** at 0602, OM with a newscast in English of both local and world events.

This English transmission is intended for the South Pacific area and is scheduled from 0400 to 0630.

## CLANDESTINE

It should be noted by those readers who intend to tune to the channels mentioned below that clandestine stations tend to vary frequency in some degree, often to avoid detection and the consequent onset of jamming. The latter counter measure sounds like bubbling water, now termed by DXers as bubble jamming, this often being accompanied by a broadcast overlay.

Voice of the Communist Party of Iran on **3870.6** at 1822, OM with a harangue in Farsi (Persian), some music in the local style, further talk then rousing martial music. This clandestine identifies as 'Seda-ye Hazb-e Komunist-e Iran' and is on the air from 1730 to 1900.

Voice of the Fedaii on **4165.7** at 1835, martial music, talk in Farsi and announcements. Operated by the Iranian People's Fedaii Guerrillas, Voice of the Fedaii identifies as 'Seda-ye Fedaii', signing on with an anthem followed by the Internationale.


## NOW HEAR THESE

Radio Neuva Cajamarca, Neuva Cajamarca, Peru on **5800.4**, OM with a harangue in Spanish followed by some trumpet rendered folk music in typical local style with songs. This one reportedly signs off any time from 0215 to 0300.

The schedule and power are unknown at the time of writing.

Xinjiang PBS, Urumqi, China on **2560** at 2204, OM with a talk in Uigher. The Home Service in Uigher is on this channel from 0930 to 1600 and from 2200 to 0130, the power being 1.5kW.

## NOW LOG THESE

Emisora Nacional Angola, Luanda on **3375.6** at 1941, OM with a talk in Portuguese. The current schedule of this one is unknown. 

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depth mm x width mm	ad space	1 issue	3 issues	6 issues	12 issues
61 x 90	1/8 page	£91.00	£86.00	£82.00	£73.00
128 x 90 or 61 x 186	1/4 page	£160.00	£150.00	£145.00	£125.00
128 x 186 or 263 x 90	1/2 page	£305.00	£290.00	£275.00	£245.00
263 x 186	1 page	£590.00	£560.00	£530.00	£475.00
263 x 394	double page	£1140.00	£1070.00	£1020.00	£910.00

COLOUR AD RATES		colour rates exclude cost of separations	series rates for consecutive insertions		
depth mm x width mm	ad space	1 issue	3 issues	6 issues	12 issues
128 x 186 or 263 x 90	1/2 page	£420.00	£395.00	£375.00	£335.00
297 x 210	1 page	£810.00	£760.00	£730.00	£650.00

SPECIAL POSITIONS	Covers:	Outside back cover 20% extra, inside covers 10% extra
	Bleed	10% extra [Bleed area = 307 x 220]
	Facing Matter:	15% extra

DEADLINES		*Dates affected by public holidays			
issue	colour & mono proof ad	mono no proof and small ad	mono artwork	on sale thurs	
Sept 87	16 Jul 87	22 Jul 87	24 Jul 87	13 Aug 87	
Oct 87	13 Aug 87	19 Aug 87	21 Aug 87	10 Sept 87	
Nov 87	10 Sep 87	16 Sep 87	18 Sep 87	8 Oct 87	
Dec 87	15 Oct 87	21 Oct 87	23 Oct 87	12 Nov 87	

CONDITIONS & INFORMATION		
<p><b>SERIES RATES</b> Series rates also apply when larger or additional space to that initially booked is taken. An ad of at least the minimum space must appear in consecutive issues to qualify for series rates. Previous copy will automatically be repeated if no further copy is received. A 'hold ad' is acceptable for maintaining your series rate contract. This will automatically be inserted if no further copy is received. Display Ad and Small Ad series rate contracts are not interchangeable.</p>	<p>If series rate contract is cancelled, the advertiser will be liable to pay the unearned series discount already taken.</p> <p><b>COPY</b> Except for County Guides copy may be changed monthly. No additional charges for typesetting or illustrations (except for colour separations). For illustrations just send photograph or artwork. Colour Ad rates do not include the cost of separations.</p>	<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>





## £1 BAKERS DOZEN PACKS

Price per pack is £1.00. \* Order 12 you may choose another free. Items marked (sh) are not new but guaranteed ok.

- 1-5 13 amp ring main junction boxes
- 2-5 13 amp ring main spur boxes
- 5-3 flush electrical switches
- 7-4in flex line switches with neons
- 8-2 80 watt brass cased elements
- 9-2 mains transformers with 6V 1A secondaries
- 10-2 mains transformers with 12V ½ A secondaries
- 11-1 extension speaker cabinet for 6½" speaker
- 12-5 octal bases for relays or valves
- 13-12 glass reed switches
- 14-4 OCP 70 photo transistors
- 16-4 tape heads, 2 record, 2 erase
- 17-1 ultrasonic transmitter and 1 ditto receiver
- 18-2 15000 mfd computer grade electrolytics
- 19-2 light dependent resistors
- 20-5 different micro switches
- 21-2 mains interference suppressors
- 22-2 25 watt crossover units 2 way
- 23-1 40 watt 3 way crossover unit
- 28-1 6 digit counter mains voltage
- 30-2 Nicad battery chargers
- 31-1 key switch with key
- 32-2 humidity switches
- 34-96 x 1 metre lengths colour-coded connecting wires
- 36-2 air spaced 2 gang tuning condensers
- 37-2 solid dielectric 2 gang tuning condensers
- 38-10 compression trimmers
- 41-6 Rocker Switches 10 amp mains SPST
- 43-5 Rocker Switches 10 amp SPDT Centre Off
- 44-4 Rocker Switches 10 amp DPDT
- 45-1 24 hour time switch mains operated (s.h.)
- 46-1 6 hour clock timeswitch
- 48-2 6V operated reed switch relays
- 49-10 neon valves - make good night lights
- 50-2 x 12V OC or 24V AC, 4 CO relays
- 51-1 x 12V 2C 0 very sensitive relay
- 52-1 12V 4C relay
- 55-1 locking mechanism with 2 keys
- 56- Miniature Uniselect with circuit for electric jigsaw
- 57-5 Dolls' House switches
- 60-5 ferrite rods 4" x 5/16" diameter aeriels
- 61-4 ferrite slab aeriels with L & M wave coils
- 62-4 200 ohm earpieces
- 63-1 Mullard thyristor trigger module
- 64-10 assorted knobs ¼ spindles
- 65-5 different thermostats, mainly bi metal
- 66- Magnetic brake - stops rotation instantly
- 67- Low pressure 3 level switch
- 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
- 73-4 3 watt wire wound pots 50 ohm
- 77-1 time reminder adjustable 1-60 mins
- 78-5 5 amp stud rectifiers 400V
- 85-1 mains shaded pole motor ¼" stack - ¼ shaft
- 86-2 5" ali fan blades fit ¼" shaft
- 87-2 3" plastic fan blades fit ¼" shaft
- 88- Mains motor suitable for above blades
- 89-1 mains motor with gearbox 1 rev per 24 hours
- 91-2 mains motors with gearbox 16 rpm
- 93-4 11 pin moulded bases for relays
- 94-5 B7G valve bases
- 95-4 skirted B9A valve bases
- 96-1 thermostat for fridge
- 98-1 motorised stud switch (s.h.)
- 101-1 2½ hours delay switch
- 103-1 6V mains power supply unit
- 104-1 4½V mains power supply unit
- 105-1 5 pin flex plug and panel socket
- 107-1 5" speaker size radio cabinet with handle
- 109-10 ¼" spindle type volume controls
- 110-10 slider type volume controls
- 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.b. with 2 amp full wave and 17 other recs
- 122-10 mtrs twin screened flex white p.v.c. outer
- 132-2 plastic boxes with windows, ideal for interrupted beam switch etc
- 155-3 varicap push button tuners with knobs
- 188-1 plastic box, sloping metal front, 16 x 95mm, average depth 45mm
- 241-1 car door speaker (very flat) 6½" 15 ohm made for Radiomobile
- 243-2 speakers 6" x 4" 15 ohm 5 watt made for Radiomobile
- 262-2 mains transformer 9V ½ A secondary split primary so OK also for 115V
- 267-1 mains transformers 15V 1A secondary p.c.b. mounting
- 330-2 6V 0.6V mains transformer .3a p.c.b. mounting
- 350-40 double pole leaf switches
- 365-1 7uf 660V 50hz metal cased condenser
- 453-2 2¼ in 60 ohm loudspeakers
- 454-2 2¼ in 8 ohm loudspeakers
- 463-1 mains operated relay with 2 sets c/o contacts
- 464-2 packets resin filler/sealer with cures
- 465-3 5A round 3 pin plugs will fit item 193
- 466-4 7 segment i.e.d. displays
- 470-4 pc boards for stripping, lots of valuable parts
- 480-1 3A double pole magnetic trip, saves repairing fuses
- 498-4 1000uf 25V axial electrolytic capacitors
- 504-1 Audax PM 8" speaker 15 ohm 5 watt rating
- 515-100 4BA 1½" cheesehead plated screws and 100 4BA nuts
- 541-1 pair stereo tape head as in cassette recorder/players
- 546-1 bridge rectifier 600V international rectifier ref 3SB100
- 548-2 battery operated relays (3-6v) each with 5A c/o contacts 2 pairs
- 553-2 lithium 3V batteries (everlasting shelf life)

## 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).....£3.95
- Cord terminating with B.T. plug 3 metres.....£1
- Kit for converting old entry terminal box to new B.T. master socket, complete with 4 core cable, cable clips and 2 B.T. extension sockets.....£11.50
- 100 mtrs 4 core telephone cable.....£8.50

## COMPACT FLOPPY DISC DRIVE EME-101

The EME-101 drives a 3" disc of the new standard which despite its small size provides a capacity of 500k per disc, which is equivalent to the 3½" and 5½" discs. We supply the Operators Manual and other information showing how to use this with popular computers: BBC, Spectrum, Amstrad etc. All at a special snip price of £27.50 including post and VAT. Data available separately £2, refundable if you purchase the drive.

## MULLARD UNILEX AMPLIFIERS

We are probably the only firm in the country with these now in stock. Although only four watts per channel, these give superb reproduction. We now offer the 4 Mullard modules - i.e. Mains power unit (EP9002) Pre amp module (EP9001) and two amplifier modules (EP9000) all for £6.00 plus £2 postage. For prices of modules bought separately see TWO POUNDERS.

## CAR STARTER/CHARGER KIT

Flat Battery? Don't worry you will start your car in a few minutes with this unit - 250 watt transformer, 20 amp rectifiers, case and all parts with data and case £17.50 post £2.

## THIS MONTH'S SNIP

is a 2½ kW tangential heater, metal box to contain it and 3 level switch to control it. Special price £7.50 post paid.



## 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

Ex-Electricity Board. Guaranteed 12 months.

## 12 volt MOTORS BY SMITHS

Made for use in cars, etc. these are very powerful and easily reversible. Size 3½" long by 3" dia. They have a good length of ¼" spindle - 1/10 hp £3.45 1/8 hp £5.75 1/6 hp £7.50



## SOUND TO LIGHT UNIT



Complete kit of parts for 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 two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" 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.

## 9" MONITOR

Ideal to work with computer or video camera uses Philips black and white tube ref M24/306W. Which tube is implosion and X-Ray radiation protected. VDU is brand new and has a time base and EHT circuitry. Requires only a 16V dc supply to set it going. It's made up in a lacquered metal framework but has open sides so should be cased. The VDU comes complete with circuit diagram and has been line tested and has our six months guarantee. Offered at a lot less than some firms are asking for the tube alone, only £16 plus £3 post.

## LIGHT BOX

This when completed measures approximately 15" x 14". The light source is the Philips fluorescent 'W' tube. Above the light a sheet of fibreglass and through this should be sufficient light to enable you to follow the circuit on fibreglass PCBs. Price for the complete kit, that is the box, choke, starter, tube and switch, and fibreglass is £5 plus £2 post, order ref 5P69.

## TANGENTIAL HEATERS

We again have very good stocks of these quiet running instant heat units. They require only a simple case, or could easily be fitted into the bottom of a kitchen unit or book case etc. At present we have stocks of 1.2kw, 2kw, 2.5kw, and 3kw. Prices are £5 each for the first 3, and £6.95 for the 3k. Add post £1.50 per heater if not collecting.

CONTROL SWITCH enabling full heat, half heat or cold blow, with connection diagram. 50p for 2kw, 75p for 3kw.

## FANS & BLOWERS

5" £5 + £1.25 post. 6" £6 + £1.50 post  
4" x 4" Muffin equipment cooling fan 115V £2.00  
4" x 4" Muffin equipment cooling fan 230/240V £5.00  
9" Extractor or blower 115V supplied with 230 to 115V adaptor £9.50 + £2 post.  
All above are ex computers but guaranteed 12 months.  
10" x 3" Tangential Blower. New. Very quiet - supplied with 230 to 115V adaptor on use two in series to give long blow £2.00 + £1.50 post or £4.00 + £2.00 post for two

## TELEPHONE LEAD

3 mtrs long terminating one end with new BT, flat plug and the other end with 4 correctly coloured coded wires to fit to phone or appliance. Replaces the lead on old phone making it suitable for new BT socket. Price £1 ref BD552 or 3 for £2 ref 2P164.

## POWERFUL IONISER

Generates approx. 10 times more IONS than the ETI and similar circuits. Will refresh your home, office, shop, work room etc. Makes you feel better and work harder - a complete mains operated kit, case included. £9.50 + £2 P&P.

## J & N BULL ELECTRICAL

Dept. R.E., 250 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QT  
MAIL ORDER TERMS: Cash, P.D. 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 or 203500.

## NEW ITEMS

Some of the many described in our current list which you will receive with your parcel.

## £2 POUNDERS\*

- 2P120 - 1 combined clock work switch and thermostat for boiler control
- 2P122 - 1 30a rotary switch, surface mounting with pointer knob
- 2P123 - 1 25a rotary switch, surface mounting, cover engraved, high medium low and off
- 2P124 - 1 28kv 001 mfd block condenser
- 2P127 - 1 30a bridge rectifier assembly on heat sinks
- 2P129 - 1 10rpm motor 115V so supplied with adaptor for 230V
- 2P131 - 1 Crozet motor 230V fits the Crozet gearbox
- 2P132 - 1 ceiling heat-stat for fire warning or protection
- 2P133 - 1 Circuit breaker 20a. Crabtree ref C50
- 2P134 - 1 9V 500mA psu, plugs into 13a socket
- 2P135 - 10m 10 conductor intercom cable
- 2P136 - 1 2½ kv element made for tangential blowers
- 2P137 - 1 Thermo couple, stainless steel tipped for measuring internal heat
- 2P138 - 1 Mains transformer 20V 0.20V 1A upright mounting
- 2P141 - 1 rechargeable battery D size (4 AH) solder tag ended
- 2P142 - 10m 4 pair intercom cable White PVC outer
- 2P144 - 1 mains operated relay with 4 x 8a c/o contacts
- 2P145 - 1 10,000uf 70V dc smoothing capacitor
- 2P146 - 1 7,800uf 150V dc smoothing capacitor
- 2P148 - 1 Technical information on 3" FOD refundable if you buy 1dd
- 2P149 - 5 diff battery operated model motors
- 2P150 - 1 PSU chassis with all components for 24V 2A d.c. unwired
- 2P151 - 1 Metal box 14½ x 14 x 4 with lid add £2.00 post
- 2P152 - 1 Motor start capacitor 80uf 250V
- 2P153 - 1 Two station intercom unused but line reject
- 2P154a - 1 Nicad charger - plug into 13a socket 5.2V 70UA output
- 2P154b - 1 Nicad charger - plug into 13a socket 6V 9VA output
- 2P155 - 1 Mains transformer giving 16, 17, 18 & 20V 60W
- 2P158 - 1 Oven thermostat with temp calibrated knob
- 2P159 - 1 9V 500ma cased with mains lead and output lead
- 2P160 - 1 13a plug adaptor fused takes 3 x 3a plugs
- 2P161 - 16" diagonal slide cutters
- 2P162 - 1 Stereo Matrix PCB mounting deemphasis K35
- 2P163 - 1 AC Working capacitor 12uf 660V AC or 1500V dc
- 2P164 - 3 Phone leads 3 mtrs long tags one end B.T. plug other end

## £3 POUNDERS\*

- 3P7 - 1 DC voltage, doubler or halver for 12V to 24V 12 to 6V 24 to 12V
- 3P8 - 1 24hr time switch Sangamo. new condition Guaranteed 1 year
- 3P9 - 1 12V 500mA psu plugs in 13a socket regulated
- 3P10 - 1 Mains transformer 50V 2A with 6.3 pilot light winding, upright mounting, fully shrouded plus £1 post
- 3P13 - 1 Noise filter to fit in mains lead of appliance up to 25a
- 3P15 - 1 waterproof case will take 150 watt transformer
- 3P16 - 1 signal box, 3 lamps on face plate of metal box size 5½ x 3½
- 3P17 - 1 choke and starter to work 8" fluorescent tube at 125V
- 3P18 - 1 22V 3a mains transformer with bridge rect fitted on top panel
- 3P20 - 1 0-5a ammeter 3½ ac/dc ex equipment
- 3P21 - 1 power factor correction condenser 35uf 350ac
- 3P22 - 1 200va - auto transformer 230 to 115V toroidal encapsulated £1.50 post
- 3P23 - 1 36V-0-36V tapped 20V 0.20V 100va
- 3P24 - 1 3" floppy disc for Amstrad etc
- 3P25 - 1 7" Electricians pliers

## £4 POUNDERS\*

- 4P12 - 50m low loss co-ax 75ohm + £1 post
- 4P13 - 3 Horstmann time and set switches 15amp
- 4P14 - 1 150w mains transformer "c" core 43V 3.5A secondary
- 4P15 - 1 powerful motor 2" stack fitted with gearbox final speed 60rpm mains operated, could operate door opener etc
- 4P17 - 1 Uniselector 3 pole 25V, 50V coil standard size
- 4P18 - 1 Volt meter with digital display (DIGIVISDR)
- 4P19 - 1 12V dc motor will fit to gearbox 4P20
- 4P20 - 1 Gear train giving speed reduction

## £5 POUNDERS\*

- 5P86 - 1 Transformer upright mounting 230/240V primary 2 x 100 1a secondary
- 5P88 - 1 Transformer in waterproof metal box 24V 5A add £2 post
- 5P89 - 1 4 bank heating element each 2kw ideal convector heater
- 5P90 - 1 18" long tangential blower with motor on one end
- 5P91 - 1 14" blower, motor in middle
- 5P92 - 10m Audio co-ax double screened 75ohm super low loss for TV
- 5P93 - 1 6" Alarm bell 24V dc or ac
- 5P94 - 1 Current transformer 14V out with 1a dc input
- 5P95 - 1 Vintage photo cell
- 5P97 - 1 Impedance matching transformer 0.4-5-8-160 ohm 100 add £1.50 post
- 5P98a - 1 0 90a ammeter for mounting outside control panel
- 5P98b - 1 0 180a ammeter for mounting outside control panel
- 5P99 - 1 Mains operated browser centrifugal output size app. 5" x 1½"
- 5P100 - 1 Mains splitter 45a switch 3 15a fused circuits
- 5P101 - 1 Model motor 1 rpm from 6V reversible

## £7 POUNDERS\*

- 7P1 - 1 Instant heat solder gun - mains with renewable tip and job light

## £8 POUNDERS\*

- 8P1 - 1 Charger transformer 10a upright mounting 230/240 primary 16v 10a secondary
- 8P2 - 1 6" undermode alarm bell suitable for a fire alarm or burglar alarm mains operated.
- 8P3 - 1 heat sink big powerful so ideal for power transmitter
- 8P5 - 1 ½ hp motor 900 rpm capacitor run
- 8P6 - 1 24hr time switch - 2 on/off 16a c/o contacts 3" x 3" x 1½"
- 8P7 - 1 Silent sentinel invisible ray kit
- 8P8 - 1 Papst fan 3½ x 3½ x 1½ 230V metal bodied

## £10 POUNDERS\*

- 10P13 - 1 reversible motor with gearbox 104 rpm Parvalux
- 10P14 - 1 100a time switch 1 on/off per 24hr extra triggers £1 per pair
- 10P15 - 1 Max demand meter 230 ac mains
- 10P16 - 1 powerful air mover 2 small type blowers with motor in middle
- 10P18 - 1 mains operated klaxon
- 10P19 - 1 12V alarm bell really loud, mains operated, in iron case + £5 post
- 10P22 - 1 sensitive volt meter relay
- 10P23 - 1 fruit machine heart 3 fruit wheels each stepper motor operated add £3 post
- 10P24 - 1 big panel meter face size 4½ x 2½ 200uA movement scaled 1.0
- 10P26 - 1 "Secretary" phone auto-dialer complete untested sold as such
- 10P29 - 1 12V engine cooling fan
- 10P30 - 1 instrument psu on pcb has 4 outputs .12V/.5V 6A/12V .5A/5V .5A
- 10P31 - 1 7 day time switch 16a c/o contacts sep switches for each day
- 10P32 - 1 68 rpm 1/6th hp motor reversible

## £15 POUNDERS\*

- 15P1 - 1 kit for 115V hi fi amp
- 15P2 - 1 kit for psu to supply one or two 15P1 amps
- 15P3 - 1 time switch battery or mains operated - 16a c/o contacts. 7 day programmable has 36hr reserve

## £25 POUNDERS\*

- 25P1 - 1 1500 PSI hydraulic pump 24V dc motor, made for operating aircraft undercarriage etc.

**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.**

## ELMASET INSTRUMENT CASE

300x133x217mm deep £10.00 ea (£2.20)

## REGULATORS

LM317T Plastic T0220 variable £1  
LM317 Metal £2.20  
7812 Metal 12V 1A £1.00  
7805/12/15/24 plastic 50p 100 + 27p  
7905/12/15/24 plastic 50p 100 - 27p  
CA3085 T099 Variable regulator £1  
LM338 5A variable £5

## COMPUTER ICS

68008 Processor Ex-Equip £5  
27256-30 ex-eqpt £2.50  
2764-30 USED £2  
2716-45 USED £2 100+ £1.50  
1702 EPROM ex equip £5.00  
2732-45 USED £2 100+ £1.50  
2114 EX EQPT 60p 4116 EX EQPT 70p  
6264LP158K static ram £2.80  
6116-3 (TC5517AP) £1.50  
4416 RAM £3.50

## SURFACE MOUNTED TRANSISTORS

BCW30 BCW31 BCW72 NTA70 1s2836 min 50/typc 100/£2.50

## POWER TRANSISTORS

2N3055H RCA House numbered 5/£2  
2SC1520 sim BF259 3/£1 100/£22  
TIP141, 142, £1 ea, TIP112, 125, 42B 2/£1  
TIP35B £1.30 TIP35C £1.50  
SE9302 100V 10A DARL SIM TIP121 2/£1  
2N3055 Ex eqpt tested 4/£1  
Plastic 3055 or 2955 equiv 50p 100/£35  
2N3773 NPN 25A 160V £1.80 10/£16

## QUARTZ HALOGEN LAMPS

A1/216 24v 150w £2.25  
H1 12v 55w (car spot) £1.50

## MISCELLANEOUS

D.I.L. Switches 10 Way £1 8 Way 80p. 4/5/6 Way 50p  
180 Volt 1 watt ZENERS ALSO 12V 20/£1  
Miniature co-axial cable RG316U £0.50/metre  
Olivetti logos calculator keyboard (27) key plus 12 Digit  
fluorescent display on driver board (ie calculator less case,  
transformer and printer) £1.30  
Plastic Equipment case 9x6x1.25" with front and rear  
panels containing PCB with eeprom 2764 -30 and ICS 7417  
LS30 LS32 LS74 LS367 LM311 7805 Reg, 9 way D plug, push  
button switch, din socket. £1.90  
VNIOLM 60V 1/2 5ohm TO-92 mosfet 4/£1. 100/£20  
MIN GLASS NEONS 10/£1  
RELAY 5v 2 pole changeover looks like RS 355-741 marked  
STC 47WBO5T 2/£1  
OMRON RELAY 3.6volt coil 2p c/o contacts marked  
G4D-287P-BT2 2/£1  
MINIATURE CO-AX FREE PLUG RS 456-071 2/£1  
MINIATURE CO-AX FREE SKT RS 456-273 2/£1.50  
STRAIN GAUGES 40 ohm Foil type polyester backed balco  
grid alloy £1.50 ea 10+ £1  
DIL REED RELAY 2 POLE n/o CONTACTS £1

Zettler 24v 2p c/o relay 30x20x12mm sim. RS 348-649  
£1.50 100+ £1  
ELECTRET MICROPHONE INSERT £0.90  
Linear Hall effect IC Micro Switch no 613 SS4 sim RS  
304-267 £2.50 100+ £1.50  
Hall Effect IC UGS3040 + MAGNET £1.00  
OSCILLOSCOPE PROBE SWITCHED X1X10 £10  
CHEAP PHONO PLUGS 100/£2 1000/£18  
1 pole 12 way rotary switch 4/£1  
AUDIO ICS LM380 LM386 £1 ea  
555 Timer 5/£1 741 Op AMP 5/£1  
COAX PLUGS nice ones 4/£1  
4 x 4 MEMBRANE KEYBOARD £1.50  
15,000uF 40V SPRAGUE 36D £2.50 (£1.25)  
INDUCTOR 20uH 1.5A 5/£1  
NEWBT PLUG + LEAD £1.50

1.25" PANEL FUSEHOLDERS 5/£1  
CHROMED HINGES 14.5x1" OPEN £1 ea  
TOK KEY SWITCH 2 POLE 3 KEYS ideal for car/home  
alarms. £3  
12v 1.2W small wire ended 1 amps fit AUDI VW TR7 SAAB  
VOLVO 10/£1  
12V MES LAMPS 10/£1  
STEREO CASSETTE HEAD £2  
MONO CASS. HEAD £1 ERASE HEAD 50p  
THERMAL CUT OUTS 50 77 85 120C £1 ea  
THERMAL FUSE 121C 240V 15A 5/£1  
TRANSISTOR MOUNTING PADS TO-5/TO-18 £3/1000  
TO-3 TRANSISTOR COVERS 10/£1  
STICK ON CABINET FEET 30/£1  
PCB PINS FIT 0.1" VERO 200/£1  
TO-220 micas + bushes 10/50p 100/£2  
TO-3 micas + bushes 20/£1  
Kynar wire wrapping wire 20z £1  
PTFE min screen cable 10m/£1  
Large heat shrink sleeving pack £2  
CERAMIC FILTERS 6M/9M/10.7M 50p 100/£20  
TOKIN MAINS RFI FILTER 250V 15A £3  
IEC chassis plug rfi filter 10A £3  
Potentiometers short spindles values 2k5 10k 25k 1M 2M5  
new value 5/£1  
500k lin 500k log 4/£1  
40Khz ULTRASONIC TRANSDUCERS EX-EQPT NO  
DATA £1/pr  
PLESSEY INVERTER TRANSFORMER 11.5-0-11.5V to  
240V 200VA £6 (£3)  
Large Qty Available 240 to 115v step down transformers  
1kVA £13 carr £3

## DIODES & RECTIFIERS

1N4148 100/£1.50  
1N4004/SD4 1A 300V 100/£3  
1N5401 3A 100V 10/£1  
BA158 1A 400V fast recovery 100/£3  
BA159 1A 1000V fast recovery 100/£4  
120v 35A stud 65p  
12FLO 12A 200V small stud 4/£1.50 100/£25  
BY127 1200V 1.2A 10/£1  
BY254 800v 3A 8/£1  
BY255 1300v 3A 6/£1  
6A 100V Similar MR751 4/£1  
VM88 800mA 100VDIL B/REC. 5/£1  
1A 800v bridge rectifier 4/£1  
4A 100V bridge 3/£1  
6A 100v bridge 50p  
10A 200v bridge £1.50  
25A 200v bridge £2 ea 10/£18  
25A 400v bridge £2.50 10/£22

## SCRs

2P4M equiv C106D 3/£1 100/£20  
MCR71-6 10A 600v SCR £1  
35A 600v stud £2  
TICV106D .8A 400v SCR 3/£1  
MEU21 Prog. unijunction 3/£1

## TRIACS

NEC Triac AC08F 600V TO 220 5/£2 100/£30  
NEC Triac 150L Tab TO220 6A 400V 2/£1  
ACOV8FGM 800mA 400V T092 TRAC 3/£1  
Diacs 4/£1  
TXAL225 8A 400V 5mA gate 2/£1 100/£35  
TRAL 2230D 30A 400V isolated stud £4 each

## CONNECTORS

Centronics 36way IDC plug £4 10+ £3.50  
Centronics 36way IDC skt £4  
Centronics 36way plug (solder type) £40  
USED Centronics 36W plug & socket £3  
'D' 9-way £1; 15-way £1.50; 25-way £2  
37-way £2; 50-way £3.50; covers 50p ea

## WIRE WOUND RESISTORS

W21 or Sim 2.5W 10 of one value £1  
R10 0R15 0R22 2R0 4R7 5R0 5R6 8R2 10R 12R 15R 18R 20R  
22R 27R 33R 36R 47R 56R 62R 91R 100R 120R 180R 390R  
430R 560R 680R 820R 910R 1K15 1K2 1K5 1K8 2K4 2K7 3K3  
3K0 5K0 10K R05 (50 milli-ohm) 1% 3W 4 for £1  
W22 or Sim 6W 7 of one value £1  
R47 R62 1R0 1R5 1R8 3R3 6R8 9R1 10R 12R 20R 24R 27R 33R  
51R 56R 62R 68R 100R 120R 180R 220R 270R 390R 560R  
620R 910R 1K0 1K2 1K5 1K8 2K7 3K3 3K9 4K7 8K2 10K 15K

16K 20K  
W23 or Sim 9W 6 of one value £1  
R22 R47 1R0 1R1 15R 56R 62R 68R 100R 120R 180R 220R 300R  
390R 680R 1K0 1K5 5K1 10K  
W24 or Sim 12W 4 of one value £1  
R50 1R0 2R0 6R8 9R1 10R 18R 22R 27R 56R 68R 75R 82R 100R  
150R 180R 200R 220R 270R 400R 620R 6K8 8K2 1K0 10K 15K

## PHOTO DEVICES

Slotted opto-switch OPCOA OPB815 £1.30  
2N5777 50p only  
TIL81 T018 Photo transistor £1  
TIL38 Infra red LED 5/£1  
OPI2252 Opto isolator 50p  
Photo diode 50p 6/£2  
MEL12 (Photo darlington base n/c) 50p  
RPY58A LDR 50p ORP12 LDR 70p  
LEDs RED 3mm or 5mm 12/£1 100/£6  
GREEN or YELLOW 3 or 5mm 10/£1 100/£6.50  
FLASHING RED OR GREEN LED 5mm 50p 100/£35

## SUB MIN PRESETS HORIZONTAL

1K 4K7 10K 22K 47K 1M 10M 15/£1 100/£5

## MULTI

## TURN PRESETS

10R 20R 100R 200R 250R 500R 50p  
2K 5K 10K 22K 50K 100K 200K 2K2 2K5 47K 500K 2M2

## IC SOCKETS

6-pin 15/£1 8-pin 12/£1; 14-pin 10/£1.00; 18/20-pin 7/£1;  
22/24/28 pin 4/£1 40 pin 30p

## TRIMMER CAPACITORS 5/50p

Grey 1.5 to 6.5pF Grey larger type 2 to 25pF purple 3pF to  
50pF  
Transistors 2N4427 60p  
Feed Thru Ceramic Caps 1000pF 10/£1

## SOLID STATE RELAYS NEW 10A 250v AC

Zero voltage switching £2.50  
Control voltage 8-28v DC £18  
40A 250V AC Solid State relays £18

## POLYESTER/POLYCARB CAPS

1n/3n3/5n6/8n2/10n 1% 63v 10mm 100/£6  
10n/15n/22n/33/47n/68n 10mm rad 100/£3.50  
1uF 250V Mullard/Siemens AX 10/£1 100/£8  
100N 250V radial 10mm 100/£3  
2u2 160v rad 22mm 100/£10  
470n 250v AC X rated rad 4/£1  
33n/47n 250v AC X rated rad 15mm 10/£1.00  
1u 600V Mixed dielectric 50p ea  
Paper cap. 1uF 700V ideal for electronic ignition £1.00

## BEAD

## THERMISTORS

GLASS BEAD NTC Res @ 20°C 80p  
250R 1K2 50K 220K 1M4

## BEAD TANTALUM CAPS

8 25V 47u 3V 12/£1 100/£6  
2u2 20V 8/£1 100/£8

## MONOLITHIC CERAMIC CAPS

10n 50V 2.5mm 100/£4.50  
100n 50v 2.5mm or 5mm 100/£6  
100N 50V axial Shortleads 100/£3  
10N 50V 100/£4 1000/£35  
100N 50V dil package 0.3" rad 100/£10  
10N 50V dil package 0.3" rad £4/100 £35/1k

## STEPPER MOTOR 4 PHASE 2 9v WINDINGS

£3.50 10/£30

# KEYTRONICS

MAIL ORDER ONLY

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TELEPHONE: 0279 505543

ELECTRONIC COMPONENTS BOUGHT FOR CASH

MIN CASH ORDER £3.00 OFFICIAL ORDERS WELCOME  
UNIVERSITIES COLLEGES SCHOOLS GOVT DEPARTMENTS  
MIN. ACCOUNT ORDER £10.00

P&P AS SHOWN IN BRACKETS (HEAVY ITEMS)  
65p OTHERWISE (LIGHT ITEMS)

ADD 15% VAT TO TOTAL

