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# Radio & Electronics

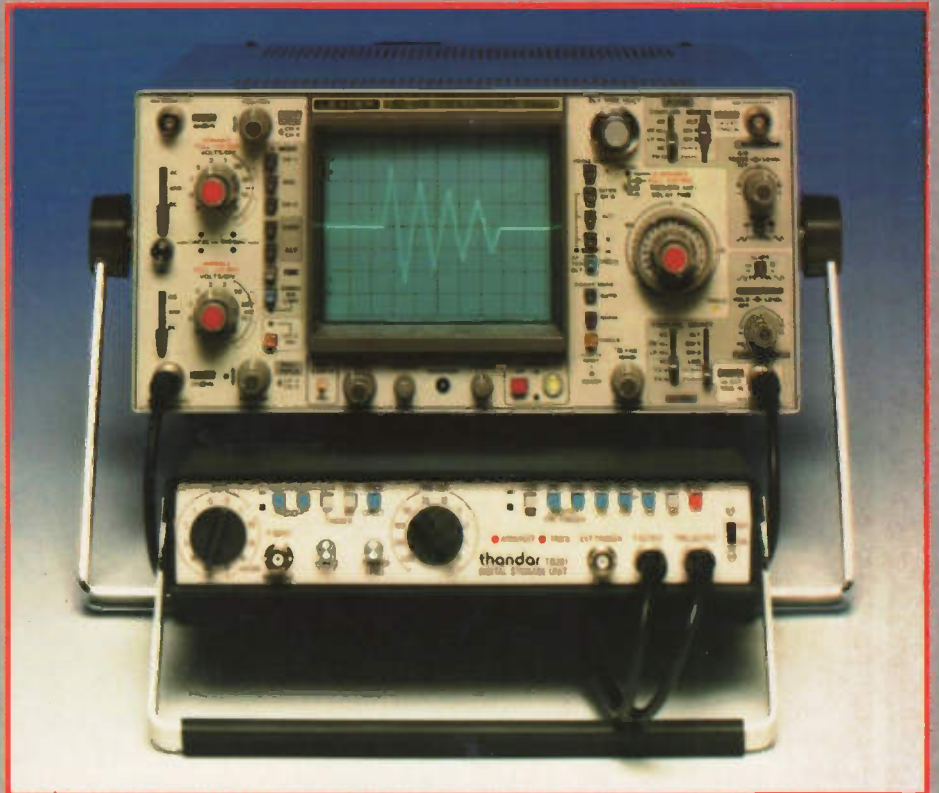
The communications and electronics magazine **World**

**CONSTRUCTION:**  
A DXER'S  
TONE CONTROL

**RADIO MODEM:**  
ASCII DATA  
TRANSMISSION

**SATCOMMS:**  
THE LOW-DOWN  
ON ASTRID

**RX REVIEW:**  
CHECK OUT  
YAESU'S FRG-8800



**CB CONVERSIONS:**  
FINAL INSTALMENT

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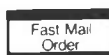
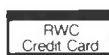
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## Safety in the shack

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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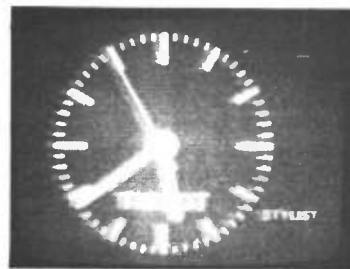
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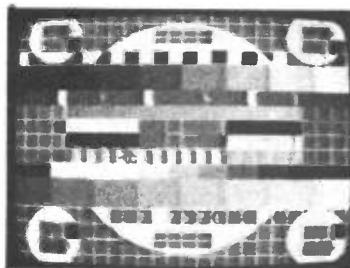
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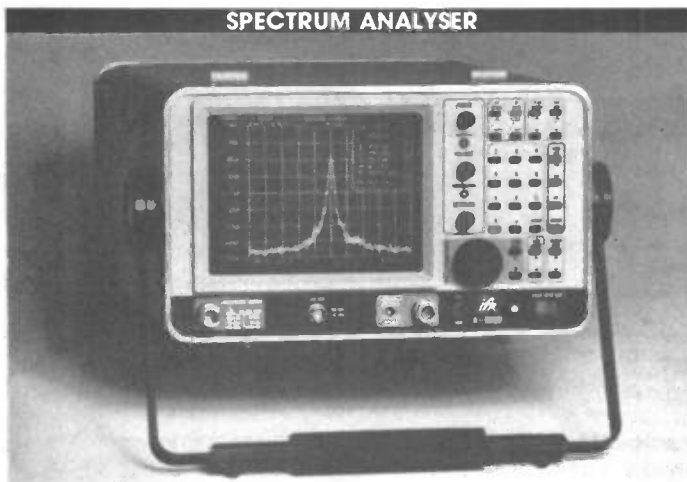


From Russia with love - p55

# 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



Fieldtech Heathrow claims that the latest RF spectrum analyser from IFR is the most advanced, low cost portable spectrum analyser available today. Designated the IFR A-8000, the instrument has a frequency coverage of 10kHz to 2.6GHz and incorporates many features to provide both ease of operation and optimum performance.

The A-8000 is micro-processor-controlled and

offers the user a menu-driven mode. The analyser's master menu is accessed simply by depressing the 'menu' key; branch menus and particular functions are further accessed by entry of a single, menu-displayed digit. All special functions of the A-8000 are selected from the menus, which can be displayed concurrently with graticule and trace information for uninterrupted viewing of

analyser parameters.

A digitised vertical raster scan (VRS) CRT system is used as the display for the A-8000. This system, along with the menu 'window' permits the operator to view most analyser parameters simultaneously while monitoring an active or stored trace, or while changing analyser functions.

RF frequencies may be entered manually via the front panel numeric keyboard for immediate centre frequency selection or by use of a frequency slewing knob for convenient analyser operation. The absolute rate of the frequency slewing knob is automatically programmed for the scan width selected to enable smooth control of the analyser's centre frequency.

The microprocessor system automatically selects and optimises resolution bandwidth, sweep rate and the frequency slewing rate. The operator can uncouple the automatic optimisations when non-standard settings are required, then at the

touch of a button the analyser will resume the programmed optimised positions. When video filters are activated, the sweep rate is compensated to prevent an uncalibrated condition.

The A-8000's compact size and rugged construction, coupled with its internal rechargeable battery pack (optional) and standard provisions for external dc make the analyser highly suitable for remote field applications where no ac power source is available.

Several options are available for configuring the analyser's capabilities to suit particular user requirements. An internal tracking generator; a sensitive  $2\mu\text{V}$  receiver with band select filters; a selectable 50/75 ohm input; a quasi-peak detector; an IEEE-488 interface and RS232 interface.

*Fieldtech Heathrow Ltd,  
Huntavia House,  
420 Bath Road,  
Longford,  
Middlesex UB7 0LL.*

## LOW COST DMM

New from Alpha Electronics is the Metex 3800, featuring a single, easy to use, 30 position rotary switch for both function and range. The measurement method is dual slope integration with the A/D converter using CMOS technology for autozero, polarity

selection and overrange. All ranges are fully protected with high surge voltage protection to 3kV and an input impedance of greater than 10Mohms. Model 3800 is the ideal instrument for use in the field, laboratory and workshop or for hobby and DIY applications.

A large 0.5 inch 1999 count liquid crystal display clearly indicates dc voltage from 100 microvolts to 1000V in five ranges to a basic accuracy of 0.5% of reading, while five ac voltage ranges go to 700V at a basic accuracy of 0.8% of reading. Both alternating and direct current is measured from 0.1 microamp to 20A in six ranges with fuse protection, a basic dc accuracy of 0.5% of reading and ac at 1.0% of reading.

Powered by a single 9 volt battery with automatic 'low' indication, this latest value for money DMM from Alpha is fully guaranteed and comes

ready for work with an operation manual, battery, test leads, spare fuse and a sturdy storage/carrying case.

*Alpha Electronics Ltd,  
Unit 5,  
Linstock Trading Estate,  
Wigan Road,  
Atherton M29 0QA  
Tel: (0942) 873434.*

## SSB MEASUREMENT

An SSB/AF analyser option, CMT-B10, is now available from Rohde & Schwarz for the radio communication tester CMT, a test set meeting all the requirements of radio-telephone measurements on FM and AM transceivers. This option has been integrated in the CMT concept such that the wide frequency and dynamic measurement range in conjunction with the available measurement capabilities and generator functions can also be fully utilised in the

new measurement applications.

In SSB transmitter tests it allows measurement of the suppressed carrier, wanted sideband and intermodulation products, while in receiver tests selective measurement of all AF spectral components (at AF output of transceiver) is possible.

As an AF analyser, the option CMT-B10 also measures internal (demodulated) or externally applied signals. It determines the spectral components of harmonic distortion at any AF frequencies, features selective modulation measurement (with multi-tone modulation, sub-audio or pilot-tone modulation) and selective AF level measurement (detection of interfering products).

All measurements can be selected manually or, with suitable CMT configuration, via IEC/IEEE bus or an auto-run control program. If



remotely controlled by a process controller with graphics capability, the CMT in conjunction with the CMT-B10 option provides clear and informative results of SSB measurements.

*Rohde & Schwarz,  
Mühldorfstrasse 15,  
D-8000 München 80,  
München,  
West Germany.*

### DIGITAL STORAGE

Thandar Electronics have recently announced the introduction of a portable low power digital storage unit.

Designated the TD201, it has been designed, developed and manufactured at Thandar's St Ives operation and will offer the ideal complement to an ordinary real-time oscilloscope.

The TD201 offers sensitivity down to 5mV and the real-time bandwidth is >200kHz. Operating modes are real-time, refresh, roll and single shot with selectable pre-trigger of 0%, 50% or 100% internal and external triggering. Pen plot and hold facilities are also provided.

The maximum sampling rate of 200kHz permits fast transients to be captured whilst the minimum sampling rate enables events lasting more than 1 hour to be acquired. Data is stored in a 1K memory and can be retained for up to 4 years when batteries are fitted.

The TD201 will operate from disposable or rechargeable cells or from an optional ac adaptor, which also serves as a charge when rechargeable

cells are used. The TD201 is priced at £195.00 + VAT.

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

### PROFESSIONAL DMM

A high quality digital multimeter, the Metex M3650, offers a large autozeroing LCD with the unusual addition of transistor hFE testing and frequency measurement ranges.

Available from Crotech Instruments Limited and designed for use in electronic servicing, laboratory, electrical and DIY applications, the M3650 has a clearly laid out front-panel with a large 30-position range selector switch.

All ranges are fully protected and autozero is accomplished without short circuit. Surge protection is provided from 1.5 to 3kV.

The meter offers fsd measurements of voltage up to 750V ac, 1000V dc, dc/ac current up to 20A, resistance from 200 ohms to 20Mohms, LED/audible continuity testing, transistor hFE, capacitance from 2000pF to 20µF and frequencies up to 200kHz.

A CMOS dual-slope ADC is utilised for the autozero, polarity selection and over-range indication functions and the 3½-digit '1999' LCD has a range of annunciators including a low battery indication and shows the units selected. The operating temperature range is from 0

to +40°C and the M3650 measures 90 × 176 × 36mm.

*Crotech Instruments Ltd,  
2 Stephenson Road,  
St Ives,  
Huntingdon,  
Cambs PE17 4WJ.*

### PAL STARTER KIT

First steps to programmable logic designs are made simpler by a new PAL (TM) starter kit (TIBPAL-START) jointly launched by Personal CAD Systems, Stag Electronic Designs and Texas Instruments. It is available from Online Distribution at £75.

In the kit are four IMPACT PAL (TM) devices from Texas Instruments; CUPL (TM) programming support from p-CAD; and programming information from Stag. New programmable logic users will find enough documentation in this kit for successful completion of a first-time design.

Five floppy discs (in IBM-PC format) supplied in the kit contain a full introduction to programmable logic and the p-CAD CUPL (TM) development language.

Disc 1 holds a user guide to the kit, plus information on the technology. The other four discs carry the CUPL (TM) suite of programs for configuring logic designs, plus the library information for the PAL devices in the kit. With CUPL, the PLD functions can be specified using state machine, truth tables or high level descriptions. Four powerful minimisation algorithms help the designer optimise the use of the functions in a particular IMPACT PAL.

Texas Instruments say their IMPACT PALs offer the fastest operation in the industry, with 12ns max propagation delay; 10ns clock-to-output time and a 62MHz max output register frequency.

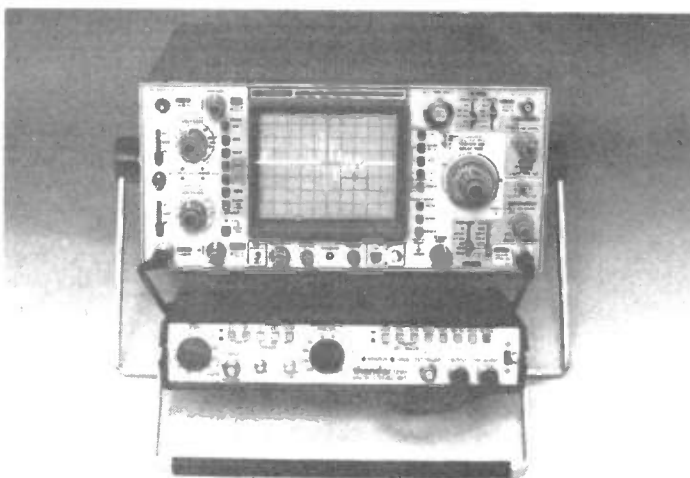
Each of the four devices in the kit, 16L8, 16R4, 16R6 and 16R8, can replace up to 10 TTL packages.

Stag markets a number of device programmers which are compatible with the CUPL development approach. Details of Stag equipment which can be used are included in the kit. For those who do not own programming equipment, Stag offers a free programming service for buyers of the starter kit.

Online Distribution, a subsidiary of Electrocomponents Group plc, offers a specialist service in electronic component distribution by providing a broad product range covering semiconductors, passives, electromechanical products, cables and connectors from a small group of leading manufacturers.

*Online Distribution Ltd,  
Melbourne House,  
Kingsway,  
Bedford MK42 9AZ.  
Tel: (0234) 217915.*

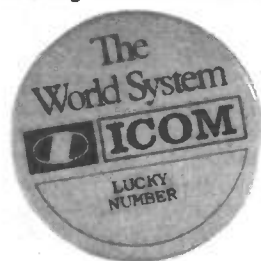
*Don't miss all the latest information on new products each month in these columns - take out a subscription using the form on page 15*



# Thanet Electronics is dead LONG LIVE ICOM (UK) LTD.

As from the 16th march 1987 Thanet Electronics Ltd have been trading under the new banner of ICOM (UK) LTD.

Nothing else has changed, still top quality ICOM equipment and service from one of the UK's leading Amateur radio importers.



To celebrate our name change we are offering to those persons who selected the following badge numbers at N.E.C. this year a gift from the ICOM range. To claim your prize just send your winning badge to ICOM (UK) LTD and we will send you the fantastic ICOM Micro 2, 2 metre handportable. Naturally this does exclude those persons who persons who already claimed their prize at the N.E.C. The numbers are 1271/2751/3200

This summer ICOM (UK) LTD will be one of the sponsors for Richard Branson's Transatlantic Balloon Challenge. They will be using ICOM communication equipment.



## IC-275E/475E 25 Watt 2 metre/70cm. Multimode Transceivers.

### Tech Talk from ICOM: THE EXCITEMENT OF SATELLITE COMMUNICATIONS

An ever increasing number of radio amateurs are joining the excitement of Phase 111 - type satellite communications. This new medium combines the communications range of the 20 and 80 metre bands with the line-of-sight reliability of 2 metres. Its equivalent to a totally new band, and a vast technical background is not necessary for enjoying the action.

ICOM is able to help you enjoy the fascinating new capabilities of OSCAR and future amateur satellites. Its all mode 2 metre and 70cm base transceivers bring the operating conveniences of low band units to the VHF and UHF amateur bands. They can be used for local FM operations via repeaters or for SSB/CW communications via Phase 111 satellites. The IC-1271E all mode 23cm transceiver is in a class of its own, providing mode L satellite uplink capability (Mode L: 1269MHz uplink, 436 downlink) (Mode U: 435 uplink, 145 downlink).

Satellite relayed signals are somewhat weak in nature and the IC-275E's low noise/high sensitivity receiver gives the highest performance for hearing everyone regardless of their uplink performance. The noise blanker prevents pulse type electrical interference from masking desired DX signals, the selectable AGC can follow fast fades associated with spin modulation. There are also the 99 mode memories which can be used for inter-mixed FM repeater and SSB/CW operators. When the IC-275E is equipped with the optional mast mounted AG25 GaAsFET pre-amp, it becomes a satellite operations dream come true.

ICOM's IC-475E 70cms transceiver has a continuously front panel adjustable power output to allow for daily signal variations. This overcomes the practice of overloading a satellites on-board receiver. The IC-475E also includes 99 all mode memories for the ultimate in operation flexibility.

Using the ICOM CT16 satellite communications interface these base stations will track together via the ICOM CI-V system. If you are interested in joining today's most excitement era of amateur communications, ie, OSCAR and future Phase 111 satellites, ICOM is the logical choice for top performance equipment.



## ICOM 70cm Promotion

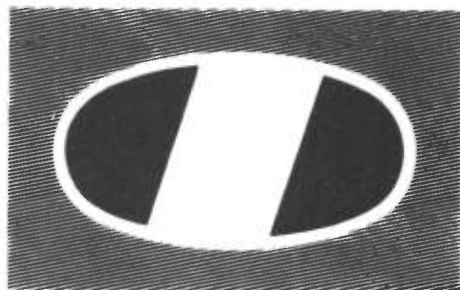
Due to our new range of equipment we are able to offer the following equipment only while stocks last.

- ICOM IC-471E 25 watt Multimode Base Station ..... £650.00
- ICOM IC-471H 75 watt Multimode Base Station ..... £759.00
- ICOM IC-47E 25 watt FM Mobile ..... £349.00
- ICOM IC-U12 12 Channel 450-460 MHz

Handportable, uses existing ICOM handheld accessories, details on how to get onto 70cms provided.

Supplied as radio body only ..... £115.00





# ICOM

## THE HOTTEST ITEMS THIS SUMMER

### VHF/UHF FM Handportables

If you want a handheld with exceptional features quality built to last and a wide variety of interchangeable accessories, take a look at the ICOM range of FM transceivers, all ICOM handportables come with a nicad battery pack, AC wall charger, flexible antenna and wrist strap.

### Micro 2E/4E

These new micro-sized 2 metre and 70 centimetre handportables give the performance and reliability you've come to expect from ICOM.

Measuring only 148 x 50 x 30 the Micro fits in your pocket as easily as a cassette tape. The Micro 2E/4E features an up/down tuning system for quick frequency adjustments, 10 programmable memories, a top panel LCD readout, up to 2.5 watts of output (optional).

### IC-2E 2 metre Thumbwheel Handportable

This popular handheld from ICOM is still available. For those amateurs who require a straightforward and effective FM transceiver the IC-2E takes some beating. Frequency selection is by means of thumbwheel switches (with 5KHz up switch) simplex or duplex facility. Power output is 1.5 watts or low 150 milliwatts (2.5 watts possible with BP5A battery pack).

### IC-02E/04E 2 metre and 70cm Keypad Handportable

These direct entry CPU controlled handhelds utilise a 16 button keypad allowing easy access to frequencies, memories and scan functions. Ten memories store frequency and offset, these handhelds have an LCD readout and power output is 2.5 watts or low 0.5 watt. 5 watts is possible with the IC-BP7 battery pack or external 13.8v DC.

### IC-12E 23cm Handportable

Similar in design and style to the 02E/04E this 1296Mhz handheld utilises ICOM's experience in GHz technology, gained by the excellent IC-1271E base station. Power output is 1 watt from the standard BP3 nicad pack, external 13.8v DC powering is available to the top panel jack. With the growing number of repeaters on 23cm, the IC-12E makes it an ideal band for rag chew contacts.

ALSO AVAILABLE FOR ICOM HANDPORTABLES ARE A LARGE RANGE OF OPTIONAL EXTRAS INCLUDING A VARIETY OF RECHARGEABLE NICAD POWER PACKS, DRY CELL BATTERY PACKS, DESK CHARGERS, HEADSET AND BOOM MIC, LEATHERETTE CASES AND MOBILE MOUNTING BRACKETS.



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*This is strictly a helpline for obtaining information about or ordering ICOM equipment. We regret this service cannot be used by dealers or for repair enquiries and parts orders. Thank you.*

You can get what you want just by picking up the telephone. Our mail order department offers you free same day despatch whenever possible, instant credit, interest free H.P., Barclaycard and Access facility, 24 hour answerphone service.



## Datapost



**ICOM (UK) LIMITED**  
DeptREW Sea Street,  
Herne Bay, Kent CT6 8LD.  
Tel: 0227 363859.

# PRODUCT NEWS

## MODEM ENHANCED



Racal-Milgo's UK designed and built Alpha modem family has been upgraded and enhanced. The new Alpha Plus series now features an extensive list of powerful options which allow customers to tailor a modem to meet their particular needs.

Facilities not required immediately can be added simply and quickly later. Alternatively, for users needing no-frills communications, an economical non-upgradeable version is also available.

Upgrade options include network management from Racal-Milgo's CMS range with full monitoring, control and testing; integral line access to allow dial back-up

in the event of leased line failure; modem sharing to split one modem between up to four users; multiport built-in four port multiplexing for maximum utilisation of communications resources.

Standard features include Racal-Milgo 'Fastran' rapid line equalisation, point to point or multidrop operation and a choice of CCITT V29/V27 modulation or the superior 4 by 4 scheme which offers improved performance.

*Racal-Milgo Ltd,  
Landata House,  
Station Road,  
Hook,  
Hampshire RG27 9JF.*

## BROADCAST MONITORS

Vistek Electronics' latest grade 1 broadcast colour monitors (GM7100 series) combine high reliability with low cost and ease of maintenance. Common electronics using easily accessible plug PCBs for both the 14 inch and 20 inch models not only speeds servicing but also minimises spares stockholding.

Self-converging in-line tubes with fine pitch phosphor dots ensure a stable, accurately reproduced picture with all primary and secondary controls accessible on the front panel.

The monitors are ruggedly built, using the latest integrated circuit techniques to minimise component counts, reducing heat dissipation and ventilation requirements.

Consuming typically only 75 watts, the monitors are particularly suitable for use in OB vans and other restricted-ventilation environments.

*Vistek Electronics Ltd,  
Unit C, Wessex Road,  
Bourne End, Bucks SL8 5DT.  
Tel: (06285) 31221.*

## MONITOR REDUCTIONS

Panasonic recently reduced its prices on monochrome monitors. Hero Electronics' new price list reflects these reductions. An example of the prices Hero will now offer in ten off quantities is £95 for a 5 inch open frame monitor and £100 for a 9 inch.

Panasonic monitors incorporate direct etched non-glare CRTs, and high quality

deflection yokes for easy setting up and excellent raster geometry. The tube and PCB are mounted on a well-engineered rugged chassis.

Hero stocks monochrome monitors, chassis and kits from 5 to 15 inches. Most sizes have composite and separate TTL versions.

*Hero Electronics Ltd,  
Dunstable Street,  
Amphill,  
Beds MK45 2JS.  
Tel: (0525) 405015.*

## BREADBOARD KIT

Users of many types of popular microcomputers now have the opportunity to develop their own custom interface boards with a new breadboard kit, the K2613, from Electronic and Computer Workshop Ltd.

Designed to operate with the K series of motherboards and plug-in interface daughterboards, the K2613 gives a versatile environment with which to develop new board functions. It contains 8-bit address decoding and has tracking to suit popular DIL packages with 80cm<sup>2</sup> of free space for building, testing and debugging a design. Power supply tracks are included and the board has provision for address selection. It is fitted with the standard indirect edge connector to fit the motherboard. Components can be mounted on both sides either directly to the copper tracks or with a through-hole mounting approach.

Motherboards are now available for most popular microcomputers including the BBC 'B' and Master series, the Sinclair ZX-81 and Spectrum range, the Commodore 64/128, the Amstrad CPC464, 664 and 6128 and the MSX series. A version for the IBM-PC will be announced in the near future.

ECW offers the versatile K2613 breadboard kit at an all-in mail order price of £34.16, including post/packing and VAT.

*Electronic and Computer  
Workshop Ltd,  
Unit 1,  
Cromwell Centre,*

*Stepfield,  
Witham,  
Essex CM8 3TH.  
Tel: (0376) 517413.*

## CADD SOFTWARE

Robotechnic Ltd recently announced the launch of its newest computer aided drafting and design software package, Generic 3.0. It offers full featured CAD facilities, such as powerful editing functions and high resolution capability, at the price of £99.95.

Developed in response to market demand, Generic 3.0 looks set to follow the success of its predecessor, Generic 2.0, which sold over 80,000 copies world-wide in less than 1 year.

Supporting all the functionality of Generic 2.0, Generic 3.0's main feature is the addition of graphics drivers which have been included to allow high resolution 1280 x 800 pixel displays.

Additional features include a facility called 'UNERASE', which allows the user to edit previous drawing modifications; the 'ZOOM' facility, which enables immediate zooming to a named viewpoint; the facility to display 10 different line thicknesses over the provision of 256 colours and layers available from the palette.

Menu driven Generic 3.0 allows drawn objects to be moved, copied, erased, broken and, if required again, stored in a user created library for later use. Such stored objects can be retrieved from the menu, then rotated, scaled or stretched as required.

The manual includes a high proportion of diagrams and illustrations. A tutorial section has also been added.

The basic hardware required for Generic CADD 3.0 is an IBM XT/AT or compatible, with 384K RAM using DOS 2.0 or later, two floppy disc drives or one floppy and a hard disc, plus a graphics card providing EGA or CGA facilities.

*Robotechnic Ltd,  
19 Queen Street,  
Mayfair,  
London W1X 7PJ.  
Tel: 01-499 9746.*



## 8-BIT HCMOS MICRO

Now available from RR Electronics of Bedford is the new Motorola MC68HC11, an 8-bit HCMOS advanced microcontroller with sophisticated on-chip peripheral functions.

The core of the MC68HC11 has a powerful instruction set that is completely compatible with the MC6801 family. Features include an 8-channel A/D converter, 40 I/O lines, 16-bit timer, 256 bytes of RAM, 512 bytes of EEPROM, serial communications interface, and serial peripheral interface. An evaluation board M68HC11EVB is available to assist design-in.

*RR Electronics Ltd,  
St Martins Way,  
Cambridge Road,  
Bedford MK42 0LF.  
Tel: (0234) 47211.*

## CMOS EPROMs

Now available from Online Distribution of Bedford are two new EPROMs by Texas Instruments. They feature CMOS technology, and are claimed to be faster than their NMOS equivalents, while drawing less power.

These new devices, a 256K and a 128K EPROM, have a low power requirement in both the standby and active modes: 1.4mW and 220mW

respectively. They also improve system reliability with their low operating temperature.

TI's HVCMOS devices offer latch-up immunity well beyond any current or voltage transients possible at PC board level: up to 250mA on inputs and outputs over the full temperature range. The EPROMs are available with  $\pm 5\%$  or  $\pm 10\%$  power supply variation tolerance.

The 256K device has up to 170ns access time: the 128K version offers up to 150ns. This speed, as well as their single 5V power supply operation, makes them well suited to use with high performance

166-bit and 32-bit micro-processors.

The ICs are pin compatible with their NMOS counterparts and have similar uses, for example as micro-processor-based systems.

Because of their low power, CMOS EPROMs are suitable for portable battery-operated equipment.

Both EPROMs use the 'Fast Program' algorithm, with typical programming times of 66 seconds for the 128K and 132 seconds for the 256K device.

*Online Distribution Ltd,  
Melbourne House,  
Kingsway, Bedford.  
Tel: (0234) 217915.*

## BENCH PSUs

A new, low cost range of regulated dc bench power supplies is now available from Flight Electronics. One-off retail prices are claimed to be typically 15 per cent lower than competitive equipment with comparable specifications.

The range begins with single variable output models and progresses to dual and quadruple output types. Fully floating outputs and push-button selection of ranges are featured on all units. Models can be supplied with traditional analogue meters or 3½-digit LED/LCD displays.

The multi-output types may be used with the outputs linked in series or parallel, effectively doubling voltage or current levels. Fine and coarse controls are provided along with overload and short-circuit protection. LEDs display constant voltage and current. Leads and a manual are included.

Multiple output units in the range have a dual tracking facility, and normally independent outputs are synchronised and set by 'master' voltage/current controls. This is useful, for example, when negative and positive voltages are set at matching levels.

Ripple noise is only 1mV RMS. Single output models are available with ranges 0 to 18V (0 to 1 or 3A), 0 to 30V (0 to 2, 3 or 6A) and 0 to 60V (0 to 3A). Dual output ranges are 0 to 18V (0 to 5A) and 0 to 30V (0 to 2

or 3A). Quad output ranges are the same as dual with an additional pair of fixed outputs, 5V/1A and 5V/3A.

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

## 1kW POWER SUPPLY

Advance Power Supplies has introduced the P1000, a 1000W switched-mode power supply which has up to five outputs.

The P1000 features a main

output of 5V at 150A and a range of auxiliary outputs, including 5V or 12V at 15A; 24V at 8A; and 48V at 5A. The ac operating range is 88-132V or 176-264V, which is user selectable by a link pin. Frequency range is 47-440Hz and the inrush current is less than 30A peak.

Other features include constant current protection as standard and a hold-up facility whereby all outputs will stay within regulation for at least 30ms after the nominal line voltage (110/220V) is removed.

The P1000 also has over-

temperature protection and all the outputs have terminals for remote sensing with a maximum total cable drop for each of 0.5V.

An optional signals package is available which offers a range of facilities including 'All Outputs Up', 'Early Temperature Warning', 'Remote Margin Switching on Main Output', and 'Power Fail'.

*Advance Power Supplies,  
Raynham Road,  
Bishop's Stortford,  
Hertfordshire  
CM23 5PF.  
Tel: (0279) 55155.*

## POWERFLEX

New from Advance Power Supplies is the PB350, the latest model in the company's range of Powerflex multi-output power supplies, which, offering 350W, is powered from a 24V dc source.

The Powerflex range is

based upon modular output cards and a motherboard concept, which permits rapid assembly of any combination of up to five outputs. Major design features include power trading and the use of magnetic amplifier and soft switching techniques to

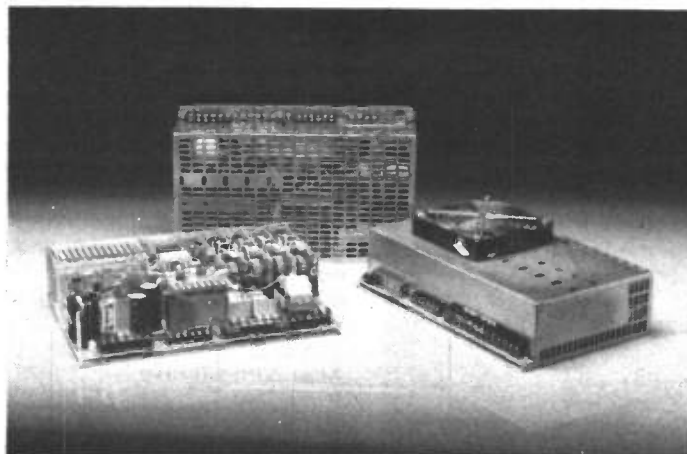
ensure high reliability. Regulated auxiliary outputs will function without the necessity for any minimum load on the main output and without any interaction between outputs.

Available as an option is a signals board that offers 'all outputs up', 'power fail', and 'remote shutdown' facilities. All output boards have an LED indicator to show the presence of an output voltage.

The noise present on the input to the PB350 meets BTR 2511 requirements.

The PB350 is suitable for a wide range of applications including telecommunications and offshore environments.

*Advance Power Supplies Ltd,  
Raynham Road,  
Bishop's Stortford,  
Herts CM23 5PF.  
Tel: (0279) 55155.*



## PRODUCT NEWS

### SWITCH RANGE



Three types of switch are available from Rendar. The range includes momentary action push-button switches, miniature slide switches and miniature toggle switches. All the switches are supplied with a rugged thermoplastic body.

Momentary action push-button switches have terminals and contacts made of gold flashed beryllium copper. The single-pole model has make or break contacts. The double-pole model offers two different switching

actions. Coloured button caps are available as accessories for quick and easy identification.

Applications for these push-button switches include electronic instrumentation, low voltage circuit switching, counting circuits and impulse contacts applications.

The miniature slide switch is a double-pole changeover slide switch. Both printed circuit board and panel-mounted versions are available with wiping action contacts. The contacts are made of gold-plated beryllium copper and the external pin terminals are gold-plated phosphor bronze.

Rendar's miniature toggle switch has a straight red lever. It is a single-pole changeover switch with silver-plated beryllium copper terminals and solid silver alloy contacts.

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

### A, D CONVERTER

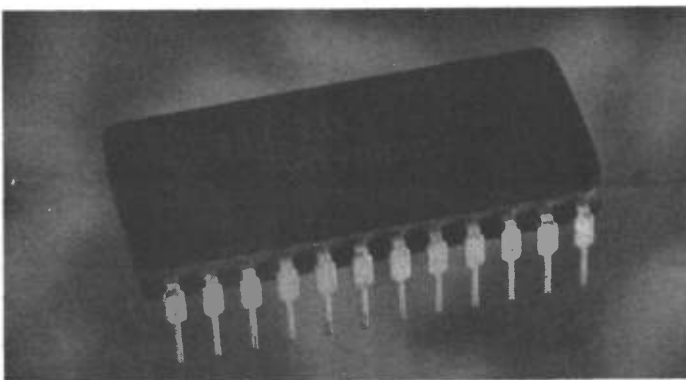
Now available from RR Electronics is the Motorola MC10319 high speed 8-bit parallel flash A/D converter. Applications include video display and radar processing, high speed instrumentation and TV broadcast encoding.

The device uses an internal Grey code structure to exclude large output errors on fast-slewing input signals. Three-state TTL outputs allow direct drive of a data bus or common I/O memory.

The MC10319 contains 256 parallel comparators across a precision input reference

network. The comparator outputs are fed to latches and then to an encoder network, to produce an 8-bit data byte plus an overrange bit. The data is latched and converted to 3-state LS-TTL outputs. The overrange bit is always active to allow for either sensing of the overrange condition or ease of interconnecting a pair of devices to produce a 9-bit A/D converter.

*RR Electronics Ltd,  
St Martin's Way,  
Cambridge Road,  
Bedford MK42 0LF.  
Tel: (0234) 47211.*



### DIN SOCKETS

Watts International has announced a comprehensive range of DIN sockets, manufactured by Emuden of Japan.

The five and eight-way sockets are available in panel and PCB-mounting versions. The PCB types have fixing holes, providing additional mechanical strength and signal integrity. Fixing may be with self-tapping screws or nuts and bolts. Many body types are available including a clip-in unit, and versions with polarisation spigots for accurate panel alignment and easy ganging. A three-in-one unit is available, simplifying the ganging capability.

Audio and data links such as stereo and keyboard/monitor connections are among the typical applications for the range. Solderability is enhanced using tinned contacts.

The insulation resistance is at least 100Mohms at 500V dc.



Contact resistance is 10mohms or less at 1mA. Dielectric strength is 500V ac for one minute.

*Watts International  
Components Ltd,  
Suite 6,  
Wyvern House,  
Bognor Regis,  
West Sussex.  
Tel: (0243) 868322.*

### ANSLEY CONNECTORS

Two new types of Thomas & Betts Ansley connectors are now available from Online Distribution. Both connectors are part of the 622 series, which is an improved replacement for the 609 series. Their one-piece design is claimed to cut installation time by up to two-thirds.

Ansley male connectors mate with female socket transition connectors. Used mainly for in-line cable splice and 'T' tap applications, they are available with optional mounting ears for I/O applications, and optional retainer/ejector latches for easy disconnection.

They are offered in 10-64 positions.

Ansley card edge connectors are a high-performance flat cable interface for double-sided PCBs. There are various mounting options, and the connector is available in 10-60 positions. There are three versions: full mounting ears, half mounting ears and no mounting ears.

*Online Distribution  
Limited,  
Melbourne House,  
Kingsway,  
Bedford.  
Tel: (0234) 217915.*

### FLANGE TERMINATION

The availability of a family of flange terminations with standard power ratings of up to 250W has been announced by Anglia Microwaves Limited.

Operating over a frequency range from dc to 4GHz, the Florida RF Labs' 32-100X series may be used with input power levels as high as 800W, to special order. The series is designed to meet or exceed MIL-STD-5400 and power ratings are true from -55 to +100°C.

Characteristic impedance is 50 ohms and the terminations are constructed on a beryllium oxide substrate with a Nichrome resistance film.

Flange material is nickel-plated copper while tabs are manufactured from gold-plated beryllium copper.

Maximum VSWR ranges are from 1.2:1 to 1.4:1, depending on the version. A custom service is offered to meet specific power and performance requirements.

*Anglia Microwaves Limited,  
Radford Business Centre,  
Radford Way,  
Billericay,  
Essex CM12 0BZ.  
Tel: (0277) 630000.*

## SOUND SYSTEMS



Thorn EMI Ferguson Ltd is strengthening its audio range, starting with two new portable machines: the radio cassette recorder RC02 and its big brother, the RCD02, with built-in compact disc player.

Both products are aimed at older, more discerning teenagers and students or at adults looking for a second sound system. The RCD02 will appeal to the growing market of compact disc purchasers as the price of software continues to decrease.

The RCD02 is a truly portable sound system which can be played indoors or outdoors. It incorporates a high quality compact disc player with repeat facility which can be programmed to play up to 30 tracks in any order. There are ten watts RMS power; twin-cassette decks; a five-band graphic equaliser; three-band tuner (long, short and stereo FM); sockets for 12V dc input, extension loudspeakers, microphones; CD output and headphones; LED indicators for power, record, output level, high speed dub-

bing, tuning and stereo FM; normal/CR02/metal tape switching; ac bias/ac erase, and mains/battery/car battery operation.

This high specification machine is priced at around £299.99.

The RC02 has detachable two-way speakers; twin-cassettes for tape-to-tape recording/editing/continuous play and high speed dubbing; a five-band graphic equaliser; four-band tuner (long, medium, short and stereo FM); four watts RMS power; mains or battery operation; headphone, five pin DIN, external microphone and phono input sockets; LED indicators for tuning/FM stereo/high speed dubbing and recording; built-in condenser microphone and ac bias/ac erase. It retails for around £89.99.

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

## SONY SHORT WAVES

Sony's range of short wave receivers has been boosted by the introduction of three new models.

At the top of the new range is the ICF PRO80, styled like a walkie-talkie and complementary to the Sony AIR 7, with most of the facilities of the ICF2001D. It offers 115kHz - 223MHz continuous coverage, 40 memories, 10 key tuning and six-way scan tuning. It has an auto/manual squelch control. The ICF PRO80 retails at £349.95.

The ICF7600DA is a 15 band receiver, FM/MW/LW/SW x 12, with LCD frequency readouts, dial pointer and band indicator, and 15 station presets. It has a clock and timer. The ICF7600DA is a sister to the popular ICF7600D, but offers the option of analogue tuning for those who prefer a dial. It is priced at £199.95 and will be available from September.

The WA8800 is a multi-use short wave radio cassette with a 10 band tuner (FM/MW, 8 x SW) with auto-reverse stereo cassette deck and LCD alarm clock, with two speakers built in. It costs £159.95.

*Sony (UK) Ltd,  
Sony House,  
South Street,*



*Staines,  
Middlesex.  
Tel: (0784) 67371.*

module performs a single electronic function and, although some are more complex than others, each has a specific purpose corresponding to one of the basic circuit blocks used in electronic systems today. Through understanding each function, a novice can construct complex electronic systems without the need to understand the circuit theory in detail.

The approach brings the realms of electronics within the grasp of all pupils, obviating the need to study individual components and their characteristics, which has in the past been a stumbling block for electronic teaching. Furthermore, it is more in line with the requirements of most examination syllabuses in which electronics plays a part.

The range comprises 24 different function boards providing as many different cir-

cuit functions, which vary from simple logic gates up to a Z80 control board with 16 pre-programmed functions. Other modules to be introduced in the future will be an analogue-to-digital converter, EPROM programmer, stepper motor driver and dual liquid crystal display.

*Cirkit Distribution Ltd,  
Park Lane,  
Broxbourne,  
Herts EN10 7NQ.  
Tel: (0992) 444111.*

## ELECTRONICS EDUCATION

The Education Division of Cirkit has acquired exclusive rights to distribute the Godiva range of modular printed circuit boards for use in primary and secondary schools by pupils in CDT, Science, Maths and Computer Studies.

The boards have been designed, developed and tested by the Coventry

Education Authority Microelectronics Centre over a period of four years, during which time they have been used extensively within the Coventry TVEI programme.

The principle of Godiva boards is to promote a systems approach to electronics, encouraging students to analyse, investigate and develop solutions to electronic control problems. Each

**Don't forget to mention *Radio & Electronics World* when contacting any of the addresses on these pages.**

# NEWS DESK

## Satellite update

Over the next few years the world's major satellite earth stations will be engaged in an updating programme to convert to the IDR (Intermediate Data Rate) system of operation, for which special modems are required to carry the digitised traffic.

British Telecom International has started the conversion by using the new Marconi modems, which initially will be used for experimental transmissions with COMSAT in the USA.

The modems were designed by Marconi Communication Systems and are an extension of the company's range of IBS (International Business Services) and SMS (Satellite Multi-services System) digital equipment for INTELSAT and EUTELSAT business services, which are already in operation world-wide.

The IDR modems, which have been delivered to British Telecom International, will be operational shortly. They are equipped for 2.048mbit/sec data rate and have a self-contained 3/4 rate VITERBI FEC CODEC.

## Olympus 1 progress

The Space and Communications Division of British Aerospace has successfully completed the assembly and integration of the multi-purpose Olympus 1 satellite, the world's largest and most powerful civil three-axis stabilised communications satellite.

A specially chartered Belfast transport aircraft took the satellite from Stansted to Pasadena, California, where it will start its solar simulation tests in early June in NASA's Jet Propulsion Laboratory. The tests are designed to prove that the thermal design

electrical efficiency is further enhanced by use of a three-stage depressed collector, giving over 50% total efficiency across the wide, 2GHz operating bandwidth.

The M-type osmium-coated, barium-impregnated tungsten cathode used has a demonstrated potential lifetime and stability compatible with projected satellite mission durations of 10 to 15 years.

Integral pole piece con-

struction improves the magnetic alignment precision, minimising beam interception and RF losses, and also improves the thermal transfer from the helix to the cooling baseplate, allowing a wide margin of safety for the thermal behaviour of the TWT even at saturation power levels (50W minimum guaranteed).

The rugged, all-metal and ceramic construction has demonstrated many times the robustness necessary to withstand the rigours of satellite launch and orbital insertion. The individually potted, high voltage feedthroughs allow the TWT to operate even at critical pressure without incident.

This new tube is the first member of a new family of medium power (25-50W) space TWTs for the coming generation of telecom and direct-TV satellites.

Thomson-CSF can be contacted on (44 256) 29 155.

## Election trail

Journalists covering the general election in June were able to benefit from the cellular mobile voice and data communications offered by the Vodafone network and its value added network services.

One particular example was at ITN, where using a com-

ination of specially adapted Vodafones and transportable data packages designed by Racal-Vodata, its reporters on the election trail were able to send up-to-the-minute reports back to base, extending the newsroom computer system for use out in the field.

The equipment used by ITN comprised transportable Series Ten Vodafones (manufactured by Panasonic) and a transportable data package of a specially designed modem, terminal and printer, allowing the journalist to transmit or receive data on the move via the Vodafone Mobile Access Conversion Service (VMACS). No special cellular modem equipment was required at ITN headquarters. To access the newsroom computer the reporter just had to dial the PSTN number of the system, prefixed by 971, the gateway access code.

With this system, hard copy quotations as made by the politicians could be sent to the editors at ITN and then via the data link, without the risk of misunderstanding words spoken over a telephone. On election day itself the system was used for forwarding results, quotations and other information to the editors, ensuring close and precise coverage of the news items of the day.

## Showing off

The Personal Computer World Show, an annual event for personal computing for business and leisure, celebrates its 10th birthday this year, from 23rd to 27th September at Olympia.

This year's show promises to be the largest ever, with a host of newcomers, including a strong contingent from abroad, as well as many familiar faces.

Special attractions include the PC productivity business feature, spotlighting key business applications and offering free, impartial advice, plus the Atari and Commodore Villages. Visitors to Level 2's PC productivity area will also have the chance to win a spectacular Far Eastern holiday for two.

Business will again be emphasised this year. Last year, the show attracted



47,528 business, trade and professional visitors, out of a total attendance of 66,030.

The top 20 UK entertainment software suppliers will be exhibiting at the show and a major US games supplier has chosen the event to launch in Europe. Among the perennial exhibitors are Acorn, Amstrad, Olivetti, Philips, Psion, Spectrum Group, Ocean Software, Prism Leisure Corporation, Victor, Comart and Mirrorsoft.

Occupying the largest floor space is Atari, with its own 'village' of 30 satellite stands, this year including unusual applications such as a satellite weather receiving system and a full recording studio. The Atari Village is expected to be as great an attraction this year as last, and Commodore has also decided to set up a village.

Tickets for the Personal Computer World Show are available through Keith Prowse ticket agencies (tel: 01-741 9999) priced at £3 for the public, with discounts for groups of 10 or more to £2.50.

As in the past, the first two days of the exhibition are devoted to business and trade visitors, with the show's National Hall opening up to the public from Friday 25th onwards. Opening times are 10.00 to 19.00 from Wednesday 23rd to Saturday 26th September and from 10.00 to 17.00 on Sunday 27th September.

### Computer insurance

A new insurance policy for users of small business systems - minis, micros and PCs - which covers software as well as hardware, has been launched by Cornhill Insurance.

Called Computer Cover, it has been developed for all types of small business computers, including the new generation of low-cost PCs. In addition to providing cover for most risk to all elements of a system, it also covers consequential loss due to disruption of business.

Specifically it insures against accident, malicious causes, fire, storm, water damage and theft. Also covered is the cost of breakdowns excluded by maintenance agreements, for example, those caused by power

failure and operator error.

Damage and breakdown cover includes the cost of any necessary temporary repair, costs of fast permanent repair, as well as debris removal and consultants' fees. Software is covered automatically at any location or in transit.

The policy also covers the increased costs of working while a policy holder's system is out of action, such as additional staff, hired equipment, auditors' fees and charges and increased rental charges if the system is hired. In addition, it covers the costs of restoring lost data and the purchase of replacement programmes. These include the cost of labour, research and the collection of information.

An important benefit of the policy is that full cover is automatically extended to include additional equipment of a similar type provided the sum assured is adequate.

For more details contact Cornhill Insurance PLC, PO Box 10, 57 Ladymead, Guildford, Surrey GU1 1DB. Tel: (0483) 68161.

### European agreement

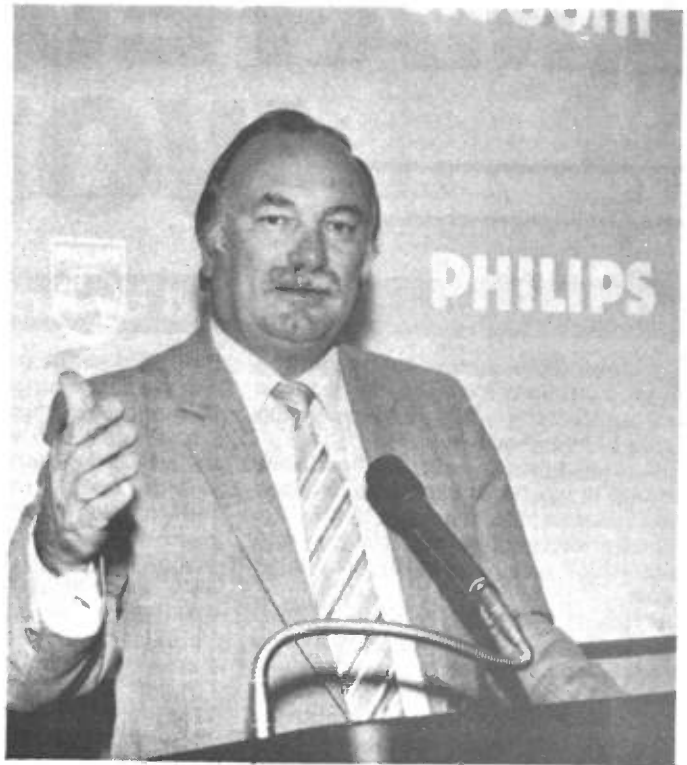
British Telecom is to play a major role in the development of a Pan-European digital cellular radio network. This follows an agreement made in Bonn in May between the United Kingdom, France, West Germany and Italy.

Mr Geoffrey Pattie, Minister for Information Technology, who has responsibility for telecommunications in the UK, met with his counterparts from France, West Germany and Italy to endorse a narrowband standard for the new network.

The four countries have now agreed to work towards a commercial service on the new network by 1991. This will allow customers to use their phones wherever they are in each of the four countries.

### Good connection

Last year, under the banner of 'Modems for Schools', central government subsidised the purchase of a modem by every school in the country, primarily to access electronic information services such as TTNS. At the same time, many



Philips Telecom's divisional director, Len Davis

local authorities purchased Connect C03, an efficient and cost-effective method of connecting micros to ICL mainframes, be it the smallest MS-DOS stand-alone or the largest multi-user UNIX system.

Metascybe have now released a version of the CC03 program, specially tailored to allow all popular micros (RML, Apricot, Amstrad, Torch, IBM, etc) to auto-dial the Connect C03 controller via the Dacom modem for schools and to perform interactive work or file transfer to or from the ICL mainframe.

The price of the software is £95 plus VAT. Further details can be obtained by contacting 01-253 1001.

### All change at Pye

Pye Telecom, one of the country's market leaders in mobile communications, changed its name to Philips Telecom on 22nd June. The change was announced at the company's annual sales conference, held in June.

The change was designed to help customers perceive the company's true relationship with the Philips group; they have direct access to the group's resources.

Philips Telecom intends to play a major part in the current revolution in mobile communications. Two new cellular radio products are due for launch later in the year and Philips' new private trunked radio systems technology (TN100) is already being introduced.

Also due for introduction later this year is the new nationwide private mobile radio service known as Band III, in which Philips Telecom - under its former name - has a major stake.

### Vodafone first

Racal-Vodafone recently announced that it is the first cellular telephone network operator to achieve 90 per cent coverage of the UK population, meeting its licence obligation to the Government two and a half years early. Nearly 3½ million calls a week are now being made on the Vodafone network - a third in the London area.

Over 50 million people live within the coverage area and, with over 4300 voice channels, Vodafone has the largest network capacity in the country. It is now possible to receive and make calls while travelling around Britain by road or rail.

# AMATEUR RADIO WORLD

Compiled by Arthur C Gee G2UK

**A** amateur radio seems to be getting good publicity from the media these days, particularly when it helps in the rescue of sea disasters.

The latest episode to hit the headlines was that in which British radio amateur Brian Tutt was able to initiate the rescue of two German yachtsmen from the yacht 'Faiia' which was sinking off Ascension Island.

Mr Tutt, of Herne Bay, had been in QSO with amateurs in South Africa and America and, on tuning around the band after finishing with them, he came across the distress call from the yacht. He contacted the local coastguard and informed them, saying at the same time that he believed there was a Ministry of Defense radio station on Ascension Island, so there were likely to be direct channels of communication available with the island.

As a result, a message was sent to Ascension Island and an RAF Hercules was scrambled to search for the yachtsmen. They were found adrift in a dinghy, exhausted but otherwise in perfectly good shape.

## Emergency communications

From the RSGB News Broadcast for 5th April last we learn that Raynet was asked to supply emergency communications in Northumberland on 27th March. Due to exceptionally low atmospheric pressure, large quantities of carbon monoxide and carbon dioxide gas was being released into the surrounding air from old mine workings in the Seaton Sluice area. Raynet groups were requested to assist in providing mobile communications for British Coal scientific officers, the Fire Service, Mine Rescue, the Police, CEPO and the Gas Board.

In Norfolk on the same day, Raynet groups were involved in a flood alert from 1500hrs to 2100hrs.

## Mast allowed

It is interesting to note from the *Eastern Daily Press* for 7th April that a North Norfolk radio amateur who is directly involved in Raynet won the right to install a bigger aerial in his garden. Despite objections from 15 neighbours, the local council development committee gave the go-ahead as the aerial was needed 'to improve local radio contact in emergencies'.

## Potential radar problem

From the *Westlink Report* for January 23rd we learn that a new US Air Force surveillance and tracking radar system, called 'Over Horizon Backscatter' or OTH-B, could spell problems for the radio amateur. Similar in operation to the Russian Woodpecker which gave such trouble to the amateur bands some time ago, it is in the planning stage for installation in the Modoc National Forest, on the west coast of the USA. The transmitter will be near Buffalo Flats, Oregon, the receiver in the Rim Rock area and the operational centre at Mountain Home Air Force Base, Idaho. A full-time OTH-B is already operational in Maine and plans have been announced for a third, south-looking system. The purpose of these systems is to detect, track and give early warning of aircraft approaching North America.

The potential problem for radio amateurs comes from the way in which these systems operate. Whilst conventional radar systems use line-of-sight microwave frequencies, the OTH-B systems project high levels of pulsed power towards the horizon. Through the use of sophisticated receivers and computers, the OTH-B system is capable of scanning an area of almost 1,800 nautical miles from its transmitter site. Pulsed multi-megawatt power can play havoc with HF communications.

While the US Air Force has said that it has no plans to operate these OTH-B systems on the amateur bands, their proximity and power levels may cause reception problems for amateurs residing anywhere near the transmitting sites. So far, however, only minor complaints have been voiced by radio amateurs who reside near the north-looking OTH-B radar systems operating in Maine.

## Solar sunspot cycle

The last time we had a guess in this column at when the next sunspot minimum would occur was in January last, when we quoted that an American forecast gave July 1987 as the most likely date. It seems we – or rather they – weren't all that far out! The latest solar cycle activity predictions suggest that the 'minimum' has definitely been passed and we are now into Cycle 22.

The forecasters are now beginning to predict the next 'maximum' as being mid-

1991! They even go so far as to predict a maximum sunspot number of 100 plus or minus 10! If this turns out to be correct, the Cycle 22 will be somewhat below average but will not be an unusually 'small' one.

## UoSAT team in Pakistan

Dr Martin Sweeting, director of the spacecraft engineering team at the University of Surrey recently returned from Pakistan, where he was supervising the setting up of two experimental UoSAT groundstations – one at the Punjab University in Lahore and the other at the Space and Upper Atmosphere Research Commission in Karachi. The stations will provide facilities for students to undertake projects associated with the two UoSAT spacecraft, and will be active on the UoSAT digital communications experiment using the amateur callsigns AP2PUL and AP2SUP. It is anticipated that radio amateurs at these stations will be active on the Japanese 'Fugi' FO-12 satellite before long.

Considerable traffic has already been passing between the UoSAT team in Pakistan and the University of Surrey via the DCE message titles, in addition to other DCE stations in the USA and Australia, thus demonstrating the use of 'store-and-forward' communications by satellite from remote areas.

## Ski expedition

A joint Russian/Canadian polar skiing expedition is being planned for next February. Leonid Labutin UA3CR, the well-known polar explorer and spacecraft authority, will be a member of the party of scientists making the trip to the North Pole. Communications will be via amateur radio satellites using both voice and data systems. Discussions have been held between Dr Martin Sweeting and the expedition organisers about carrying a UoSAT-2 DCE station. It is hoped Leonid Labutin will attend the AMSAT-UK colloquium, which is being held at the University of Surrey from 18-19th July.

## 50 and 70MHz for Class B

From 1st June the 50 and 70MHz bands became available to Class B amateur radio licensees. The 50MHz band has been expanded to cover 50 and 52MHz

and the 70MHz band has been expanded to become 70 to 70.5MHz. The amateur service in the UK has primary status between 50 and 51MHz and secondary status between 51 and 52MHz. On 70MHz, the UK amateur service is limited to secondary service.

Power limits for 50MHz will remain unchanged, but may be reviewed in six month's time. Restrictions on the location of 50MHz stations have been removed, so both /A and /P operation is now allowed. Mobile operation on 50MHz is still prohibited, however. 50MHz antennas must not be at a height greater than 20 metres above ground level and must be horizontally polarised as at present, because of possible interference with TY in Europe.

### RSGB efforts

The June issue of *RadCom* has a special feature on the 50 and 70MHz bands. It gives the background to the RSGB's efforts to get these new facilities, what can be expected from these bands, a list of beacons and bandplans, a review of likely propagation conditions and ideas on how to get going on the bands with suggestions for aerials, receivers and transmitters.

The section on propagation makes

particularly interesting reading. For instance, 50MHz apparently behaves more like an HF band than a VHF one. Because of where it is in the radio spectrum, one would expect it to be a good band for inter-G or European QSOs by normal tropospheric propagation. But this is not so; it is worse than 144 and 70MHz in this respect. Its fading characteristics are quite different, too. Again ducting, caused by temperature inversions, does not affect 50MHz to the extent it does 144 and 430MHz, as 50MHz is not high enough in frequency for this to be a problem.

### Sporadic-E benefits

However, 50MHz benefits greatly from sporadic-E and auroral conditions. Sporadic-E may give openings for 50MHz for hours on end, instead of for a matter of minutes. Ionospheric propagation can also occur on 50MHz, although we may have to wait until we are further into the new solar cycle for this to happen. 70MHz is very popular with those who have tried it. Tropo propagation is excellent and more stable than other VHF bands and conditions are less noisy. It is less affected by obstacles in the signal path.

So, with this relaxation in the licensing regulations there should be a lot of new

interest, which will undoubtedly give a much needed stimulus to the use of these frequencies.

With the recent improved solar activity, the 10 metre band is coming to life once again for DX working. South America has been worked on low power CW and quite a lot of local European QSOs have been possible lately. So, it is worth watching.

### Launch hold-ups

The European Space Agency has suffered a further setback in its Ariane programme, with critical damage occurring to the V-19 launch vehicle third stage in a vacuum chamber handling accident. The V-20 third stage will now be brought forward to be tested and mated to the V-19 mission. AMSAT's Phase 3C spacecraft is due to be launched on the V-21 mission during 1987 but this mishap will undoubtedly postpone its launch until next year.

REW

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# ATV ON THE AIR

## Andy Emmerson G8PTH puts you in the picture

It's funny how no news comes in for months, then suddenly several letters arrive. As Richard G3WW says, people like reading about their activities but are too busy to write about themselves. Anyway, no problem this time, because several folk have taken time out to drop me a line.

From Uxbridge, Middlesex, Jim G2BML writes: 'Who says SSTV is dead? It's only hibernating!

'This shy, soporific, timorous creature does surface occasionally to be hunted. One such animal, the 'inva' came out of its hideaway recently, and the open season was from 16th to 20th March. I did not manage to locate the country of origin, but it appeared that the whole of Europe was calling 'CQ Inva Contest'.

'I managed to hook HA9SB, YU1NR, LZ1WN, IS0XR1, OK3CKW, HA5JI, HA1ZH, LZ1OW, YU1CS and YU1AA, but the others got away. They were 5B4CU, 9K2DZ, VU2DK, EA8AEU, SM5EEP, LZ1VF, IS0ATZ, N4MZL, FD1JMC, G4XIS, JA1HHL, EA8EV, W4SCJ, WA2FDL and EA3FTR.

'Being an 'OT' I only found out about the contest while browsing around on 14230, and I hope our next contest has as many entrants. Incidentally, HA1ZH had a total of 51 SSTV contacts when I contacted him'.

Paul G4TBQ lives in Burton-on-Trent and says: 'I have been active on SSTV for the past six months using a DRAE converter and JVC camera. More recently I have had a 48K Spectrum computer and the excellent G1FTU program for the text. Activity on 20 metres is very good, and now that 10 metres is more lively a good idea is to make contacts on 20 and then QSY to 10 where excellent QRM-free contacts can be exchanged. The next band is six metres, and I wonder if there are any SSTVers active there?

'My best DX to date is PY5BYE T77Q, with over 40 other stations having been worked'.

Now a letter from Greece, where Demetre Valaris SV1UY seems to be extremely active:

'I am writing to tell you a few things for your column. I have been a member of BATC for nearly a year now and am very pleased. I have built the G3WCY and G4ENA system (with three memories) and have had many fine video QSOs with BATC members on 20 metres. These were mostly with Dick G4RRX from Norwich, but also with G3WW, G4TUK, G4TBQ, G3INZ, G4PFG, G4UKL, GM3WIL, G4RVC and G0BDD.

'I am in touch nearly every night with DL1HBN and SP44KM. You see, signals are stronger from Germany over here

than the British. I have also worked with many other Europeans and my furthest SSTV contact up to now is WD0FNL in Minnesota.

'SSTV activity is rather low in Greece for the time being. I just know SV1OJ, SV1IY and SV9ADT/1; the first is working with an old Robot and the others with computers. I recently got the G1FTU Tx/Rx program and I am very impressed with it. I use it mainly for captions but I also use it for two-way 16 and 32 second pictures.

'I pinch pictures from Spectrum games such as Samantha Fox Strip Poker (hi hi) and transmit them in high-resolution mode for 32 seconds. I have worked in 32 with Bob SM6RKU, who is British, DL1HBN and SP4KM. The above program has a nice real-time writing facility from the keyboard.

'I wonder if any BATC members have had any success with the 16 or 32 seconds transmit and receive using the G4ENA/G3WCY system. Any info would be much appreciated. I am on the air most afternoons and would be glad to contact more BATC members.

'Next time I hope to tell you more news. Do you know the proper reporting format for SSTV - perhaps RSV? If so, what is the maximum for V?'

If anyone knows, please drop me a line or tell Demetre. He lives at 24 Grigoriou E' Str, GR 16231 Byron-Athens, Greece.

### BR buys BR

The enigmatic heading means that Bob Robson GW8AGI has enhanced his home studio with a camera suite bought from British Rail. At this year's Crick extravaganza Ted G6CTV brought along some redundant studio equipment from British Transport Films, all of which went to good homes. Ted also sold his colour camera, which will give him a dilemma as to what to spend the cash on - or perhaps it won't!

### To the wilds of Wales

A letter from Ron G4HSC advises that the G8LIR contest group is hoping to arrange a mini-expedition to the Welsh mountains this summer when, among other things, they hope to swap pictures with Continental stations on 70 and 24cm. Due to the sporadic nature of ATV activity between contests (who says?!), Ron wondered if it would make more sense to try and arrange skeds.

Fixing schedules is not especially easy as most ATVers seem to be rather disorganised folk - even getting a QSL for a DX contact is well nigh impossible. All the same, it might be worth writing to the ATV club secretaries in each country - only Germany and Switzerland have

ATV clubs and their 'top teams' speak only German (as we know from EATWG meetings). In other countries (Belgium, Holland and Austria) there are ATV managers who act on behalf of their national radio clubs. France has no ATV organisation yet, though it is hoped that an ATV club will be formed soon. Note that it is essential to enclose an international reply coupon if you expect a reply.

Failing any skeds, though, the best thing is to put out a call on two metres. As most folk will be aware, there are two calling frequencies for ATV, 144.75 FM and 144.17 SSB. The latter is widely used in France, where 144.75 is a repeater input frequency and generally avoided by ATVers. Usually calling on one of these frequencies produces results, especially on a Sunday morning, which is an activity time for many ATVers.

Anyway, we wish the group luck with their expedition in August and I hope they'll drop us a line if they have any success. Ron indicated that they hoped to make some DX contacts and wondered what the best DX records were. For ATV these don't seem to be written down normally anywhere, but to the best of my ten years' knowledge they are as follows:

### 70cm

Best DX from the UK: G4EGC Sheffield - DK3NZ FM44e (835km), October 1975. Best DX in Europe: EA1CR - F3YX (verified); EA1CR - Ryn Muntjewerff (SWL) in Beemster, Netherlands (not verified whether he was seeing EA1CR direct or a retransmission of F3YX's recording).

### 24cm

G3YGC Rugby and G8VBC Burton - F1EDM Le Havre, 23/1/83. G8PTH Northampton - PE1DWQ, 25/8/84.

No DX claims have been made from the Continent, though the Germans regularly work France, Holland and Austria.

### Repeater news

Perhaps the G8LIR group will be the first from Britain to see LX0ATV, a TV transponder and beacon co-sited with LX1GR at Rumelange in Luxemburg. The input frequency is 1252.5MHz FM and the output in on 70cm (434.25MHz vision and 439.75MHz sound). Between 2200 and 2400 local time it operates as a beacon, so this might be the best time to take a look for it. In charge of the device is Rob LX1CR. Thanks to Kris Partridge G8AUU for this info. It will be incorporated in the new edition of the *International Repeater Guide* which Kris helps compile.

In Bristol the GB3ZZ repeater received its licence on 30th April and was due to

be switched on ceremonially on 2nd June. Roger G4ZQF, who is chairman of the repeater group, says they are doing their best to get maximum local publicity for the event. He wants to pay a tribute to the BATC and the RSGB Repeater Management Group for helping get the licence so quickly and successfully.

The Brighton video repeater group has a clever gadget for a new development. This is a combined microphone and touch-tone keypad which is intended to control beam alignment and a remote-controlled camera at the repeater site. This sounds fascinating and I look forward to telling you more about it in future.

Moving north, the Dunstable Downs repeater, GB3TV, went high-power during the last week of May and now puts out the full legal ERP. The Rugby repeater, GB3RT, has been seen on test in manual

mode; it was rather weak at Northampton owing to the lie of the intervening land but good reports have been received elsewhere in the West Midlands.

At High Wycombe the GB3HV repeater is now on the air in beacon mode. It will be made fully operational once engineering tests are completed; so far the signs are good. Ian G4VTD, located near Croydon, is 55km from GB3HV but manages to get an excellent signal, so he considers the machine a considerable success.

He thanks Garry G4CRJ and all the others who have put in so much work on the project.

The repeater is used under manual control from time to time and so far Ian has seen Mike G6GIF, Chris G1FEF, Lewis G6HVQ, Mike G8LES and Garry G4CRJ through the box. All pictures were P3/P4 and in colour (except G1GIF).

### Tut, tut . . .

Just in case you didn't need about it in the papers, Britain's first satellite pirate has been brought to book. Raymond Starkey, of Huddersfield, recorded films received on his home satellite receiver and then rented and sold these to friends. He was prosecuted and fined £2,000, and in addition he had to pay £200 costs as well as having his dish and all his video recording apparatus confiscated.

The new owners are the Federation Against Copyright Theft, who are taking an active role in tracking down people who steal movies intended for cable stations and sell them for gain.

### Sign-off

That's it for this time – not much on 70cm, was there? Please send in your reports ready for our next three-monthly round-up, care of the Editor.

REW

One of the enjoyable things about writing this column is the excuses it gives to do things out of the ordinary. One of those is to visit the Japan Centre in London once a month to pick up my copy of *Five-O*.

The Japan Centre, in Brewer Street, is a sort of Japanese supermarket with paper shop, books, travel bureau, cafe and food store. It caters mainly for expatriate Japanese workers and visitors in London and, although not the only shop of its kind, it is certainly the best stocked. It sells a number of Japanese hi-fi, video and computer magazines and used to have CQ-JA, the monthly equivalent of *Amateur Radio*. There was not much call for this, however, and nowadays they only obtain radio magazines to order.

### Five-O magazine

*Five-O*, which I have on order, is one of the leading Japanese magazines for 900MHz personal radio. Of course it is nearly all in Japanese, but the pictures (and prices!) are universally understood. Actually, it is quite easy to get the gist of most articles and advertisements, especially as headings and titles are often in English (a fashionable language in Japan), and specifications for power, frequency and so on use the same watts, dB and MHz as we do.

*Five-O* is the code Japanese users key into their PRS sets for a general call (CQ), so now you understand the significance of the title!

This month, then, I thought we might take a look at some recent issues of *Five-O* and see what's happening on the personal radio scene in Japan. I said English (or American) is fashionable, and many of the advertisements have American automobiles and other motifs of American culture. One, however, has an Austin Mini, so I suppose we should feel flattered too.

# NETWORK

## 934

Andy Emmerson G9BUP

### Look, no tuning!

First of all we should outline the system used in Japan, as there are some differences between this and our British open channel system. The frequencies used are different; the Japanese have from 903 to 905MHz. Originally, these were split into 80 channels, one of which was reserved for data exchange. The Japanese personal radio service (PRS) is an automatic system, where you key in the five-digit call number of the person you want and then press the PTT switch briefly. If the rig belonging to the person you want is switched on and is on standby, the set will respond automatically and a spare channel will be found without any further action on your part. Your set will bleep and you can then speak.

### Secure calls

Calls are secure against unwanted break-in, and in a way the system works like selcall or cellular radio, except that no central base station is involved and there are no charges. Obviously, for your QSO to be successful the person you want must be within radio range and have his or her rig switched on.

A similar system is in use in Switzerland and was also proposed for Britain and other European countries. Whether it will ever happen now is quite another matter, though!

### Overcrowding

It was soon found that 80 channels (or more accurately, 79) were not enough, especially as there is no legal 27MHz operation in Japan any more. Accordingly, they found a way of squeezing in twice the number of channels, though two new-style channels (equivalent to one old-style slot) had to be kept for call set-up data transfer. Thus, the new rigs have 158 channels and the old 80-channel sets are being sold at up to 35 per cent discount.

There is less than perfect compatibility between the old and new systems and more than a little aggravation in some districts.

### Bells and whistles

Nearly all the sets are sold on the basis of female metres, and the glossy advertisement pages are full of beautiful colour pictures of foxy ladies obviously gaining ecstasy from their new rigs. None of the sets look like our Delta-1 but more like amateur rigs, car hi-fis or cellphones.

All have dozens of function keys for all the smart features. Some have large keypads and liquid crystal displays, while others go in for the incredibly slim-line look with minute soft-touch keys, intended for nimble oriental fingers, no doubt.

Most sets are mobiles but there are also some hand-helds as well as base-station adaptors for the mobiles, which incorporate a power supply and speaker in a smart housing. Power is 5 watts on all models, just as over here.

All the well-known manufacturers are represented: Yaesu, NEC, Panasonic, Clarion, Icom and so on. The names they give to the sets are a little strange to our ears—you have fairly sensible names like City-Call, Persona 5 and GT-5, but then there are the less likely Action 55 Go-go, the Air-Pit, Pasox and Pasocall.

## NETWORK 934

### Paso-everything

Paso occurs in many other combinations, such as the Pasotopia, and after a while the penny (or yen) drops. It's the way the Japanese say personal radio (pasonal radio)!

The choice of language in the advertisements is a little strange, too. Icom has a beautifully posed shot of their GT-5 surrounded by a hi-tech phone, an MSX computer and tins of Swiss lager. The caption is 'My communication booth'. Yaesu are advertising their FRG-965 scanner receiver as 'Non-fiction radio', and so it goes on. It makes a refreshing change, anyway.

### Prices and accessories

The cost of these all-singing, all-dancing rigs is not unreasonably high to our way of thinking, though I have no idea what the average Japanese earns in relation to us. Here, in any case, are some current prices to give you an idea.

#### New all feature rigs:

Icom GT-5, £382; Yaesu Action 55, £360; Panasonic Air-Pit, £319; NEC Sky-Bird, £361.

#### Discounted 80-channel rigs:

Clarion JC-9, £230; Sharp hand-held, £170.

#### Antennas:

0dB base ground-plane, £19; 7dB mobile collinear, £42; 7dB base collinear, £55.

The magazine itself costs just under £2 in Japan, but because of air freight and other charges it is £5.50 over here.

### Activity

Apart from technical articles and reviews, much of the magazine is given up to on-air news, as it is clear that personal radio is a very sociable pastime in Japan. PRS is widely used by truckers and by social clubs, who take the rigs on outings and use a single call number. This number is then shared by everyone and enables several people to chat at once.

The names of some of these clubs are amazing. . . All Pacific Musen Club, Star

Saucy ads from the pages of Five-O

Dust Tokyo Members, Free Wave, Personal Club On and Off, Club Lovely's and Sexy Club. One wonders what all these names really mean!

As well as your personal call number you can also adopt a callsign or a nickname for your DX contacts: callsigns are in the JPR series, eg JPR8UY and JPR1CFZ, while 'handles' noted include North Fox, QR Boy, City Hunter and Gundan. No doubt someone can explain all this to me!

QSL cards and rubber stamps with your call numbers or letters are the 'in' thing, as are large stickers with your call numbers to put on the rear of your car (so you can receive calls on the move). No doubt they pass time in traffic jams, nattering on PRS.

### Back to normality

I hope you enjoyed our little trip to the mysterious Orient – it would be interesting if that sort of thing ever caught on over here! As I said above, there have been proposals for a similar PRS system in Europe, possibly between 933 and 934MHz.

One or two keen folk have got hold of European specification sets for experimentation over here, and demonstrations have been given of this fascinating system. I have two myself and find that one is now spare; if anyone wishes to take it off my hands please give me a call on (0604) 844130 or drop me a line, care of the Editor. The same applies to your activity news – I haven't had much lately! See you again next month. **REW**

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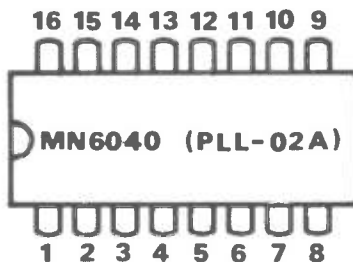
# CB CONVERSIONS

## Part Two

How to modify the Binatone Route 66 rig for 10 metre amateur operation  
by Roger Alban GW3SPA

The converted CB had been working in my shack for a few days when the squelch of the set was suddenly lifted and the receiver sprung to life with some strange phrases such as 'Keep the pedal to the metal, have a good day today and a better day tomorrow', which obviously did not belong to amateur radio. The interfering signal remained irrespective of the channel selected. A glance out of the front window revealed a car parked

Fig 6 PLL02 pin connections



IC-4 Pin No	MN6040 (PLL-02A)
1	Vdd
2	Signal frequency input
3	Reference frequency input
4	Reference divider ratio exchange
5	Phase detector output
6	Lock detector output
7	P8 Programmable counter preset input
8	P7 Programmable counter preset input
9	P6 Programmable counter preset input
10	P5 Programmable counter preset input
11	P4 Programmable counter preset input
12	P3 Programmable counter preset input
13	P2 Programmable counter preset input
14	P1 Programmable counter preset input
15	P0 Programmable counter preset input
16	Ground

across the road with the driver engaged in a conversation on his radio telephone. Further investigations revealed that the driver was operating a CB rig on channel 4, 27.63125MHz.

The first mixer of the modified CB rig was being injected with a fixed signal which was producing an IF frequency of 10.695MHz. On receive the only fixed frequency within the set is the PLL loop down-mixer crystal oscillator, operating on 38.325MHz. If this frequency is being injected into the receiver first mixer the resulting receiver frequency will be 38.325 minus 10.695 which equals 27.63MHz, only 1.25kHz away from channel 4. An important lesson has been learnt here. When modifying CB rigs always ensure that any changes in internal oscillator frequencies will not, if they find their way into the receiver first or second mixer, cause problems.

How do we overcome this? Additional screening was placed around the oscillator circuit and the supply feed to the oscillator was de-coupled to minimise stray radiation, but in the end this did not solve the problem. The only remaining possibility was to change the frequency of the down-mixer crystal oscillator and compensate by changing the value of the divide by N counter in the PLL chip. This is accomplished by changing the logic on the programme lines of the PLL chip.

An examination of the circuit diagram in Figure 2 and the pin functions of Figure 5 revealed that programme line P7, pin 8 is permanently connected to the PLL chip supply voltage, ie at logic level 1, and that programme line P8, pin 7 is permanently connected to ground, logic level 0. It is therefore possible to alter these two programme lines to give different divide by N values. It would be more involved to alter the programme code of the channel select switch (see later) and therefore it was decided to experiment with the two programme lines, P7 and P8.

### Change of programme code

Programme lines P7 and P8 can be modified by cutting the printed circuit track to programme lines P7 and P8, which are pins 7 and 8 of IC4.

The first experiment conducted was to

put P7 and P8 at logic level 0, that is to earth pins 7 and 8 of IC4. On channel 30 the divide by N number will be 69, see Figure 7a. Under lock condition,  $F_{in}$  on pin 2 will be  $69 \times 10\text{kHz} = 690\text{kHz}$ . Therefore, the difference on frequency between the VCO and down-mixer crystal oscillator frequency will only be 690kHz. I felt that Q of the output tuned circuit of the down-mixer was not sufficient to prevent the PLL chip being controlled by an unclear signal at  $F_{in}$  which could confuse the loop operation.

Fig 7a Truth table for programme code with P7 and P8 at logic level 0

	Channel select switch								Fixed	
	P0	P1	P2	P3	P4	P5	P6	P7		P8
	$2^0$	$2^1$	$2^2$	$2^3$	$2^4$	$2^5$	$2^6$	$2^7$	$2^8$	
	1	2	4	8	16	32	64	128	256	
Logic code	1	0	1	0	0	0	1	0	0	
Binary value to give divide by N number	1		4				64			= 1-4-64=69

Fig 7b Truth table for programme code with P7 and P8 at logic level 1

	Channel select switch								Fixed	
	P0	P1	P2	P3	P4	P5	P6	P7		P8
	$2^0$	$2^1$	$2^2$	$2^3$	$2^4$	$2^5$	$2^6$	$2^7$	$2^8$	
	1	2	4	8	16	32	64	128	256	
Logic code	1	0	1	0	0	0	1	1	1	
Binary value to give divide by N number	1		4				64	128	256	= 453

Fig 7c Truth table for programme code with P7 at logic level 0 and P8 at logic level 1

	Channel select switch								Fixed	
	P0	P1	P2	P3	P4	P5	P6	P7		P8
	$2^0$	$2^1$	$2^2$	$2^3$	$2^4$	$2^5$	$2^6$	$2^7$	$2^8$	
	1	2	4	8	16	32	64	128	256	
Logic code	1	0	1	0	0	0	1	0	1	
Binary value to give divide by N number	1		4				64		256	= 325

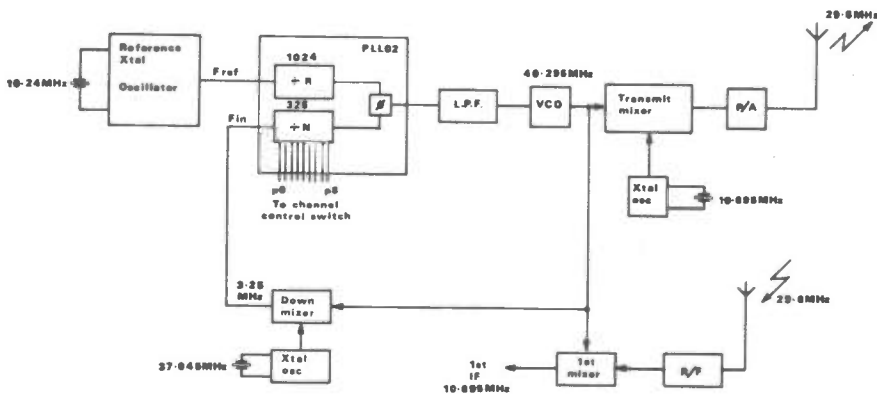


Fig 8 Block diagram of final modified rig operating on channel 30

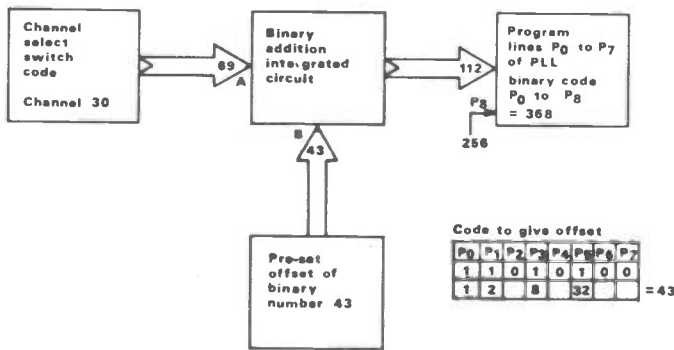


Fig 9 Changing the binary value of the channel select switch by using binary addition

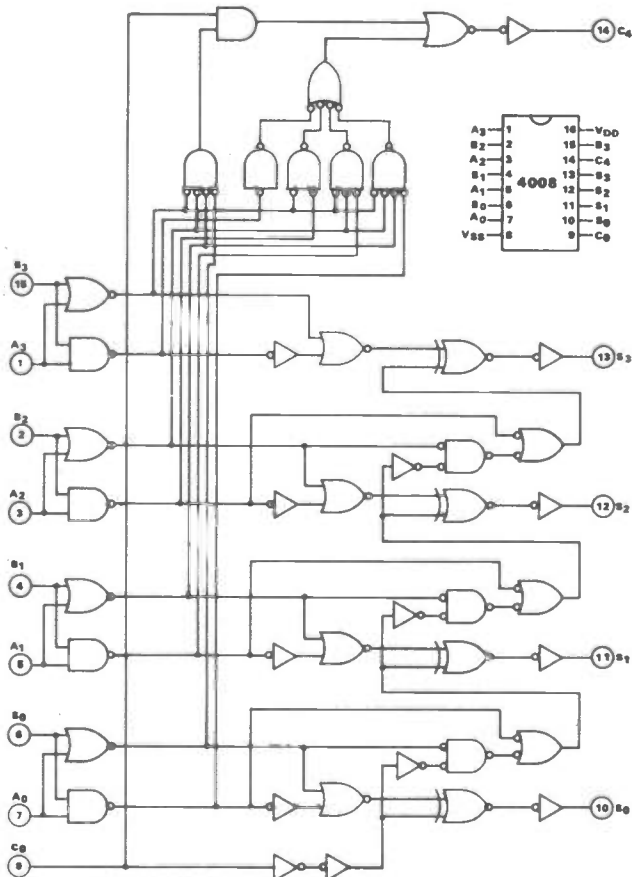


Fig 10 The circuit configuration and pin out functions of the 4008 integrated circuit

The second experiment was to put P7 and P8 at logic level 1, that is to connect pins 7 and 8 at the supply voltage to IC4. The resulting divide by N number for channel 30 will be 453 (Figure 7b), resulting in an  $F_{in}$  frequency of  $453 \times 10\text{kHz} = 4.53\text{MHz}$ . The VCO frequency for channel 30 will remain at 40.295MHz and therefore the frequency of the down-mixer crystal oscillator will be  $40.295 - 4.53 = 35.765\text{MHz}$ . Any possible receiver interference problem will occur on  $35.765 - 10.695 = 25.07\text{MHz}$ ; a frequency well away from public use and the likelihood of local interference. I did not favour this as a solution because the frequency of  $F_{in}$  is approaching the upper frequency limits of the PLL02 chip.

The third experiment involved putting P7 at logic level 0 and P8 at logic level 1. The resulting divide by N number for channel 30 will be 325 (Figure 7c). The corresponding value of  $F_{in}$  will be 3.25MHz, well within the operating characteristics of the PLL02 chip. The frequency of the down-mixer oscillator will be  $40.295 - 3.25 = 37.045\text{MHz}$ . The receiver interfering frequency will be  $37.045 - 10.695 = 26.35\text{MHz}$ . Again away from any frequency likely to be used locally. The alignment procedures are identical to that described earlier. The other corresponding channels will remain with an offset of 10kHz between channels because the divide by R network and reference frequency remain unchanged, so that the divide by N value changes by a factor of 1 between each consecutive channel. A block diagram of the final modified rig is shown in Figure 8.

### Binary addition

For those of you born in the Northern Hemisphere, who consider spending £5.50 on a single crystal to convert a CB rig to the 10 metre FM band expensive, then a possible solution would be to use binary addition on the programme lines to the PLL chip.

Let us consider the unmodified rig operating on channel 30, the block diagram of which is shown in Figure 1. From earlier discussions, for the set to operate on 29.6MHz the VCO needs to operate at a frequency of 40.295MHz. The down-mixer oscillator will continue to operate at 36.61625MHz. I strongly recommend that the additional circuit shown in Figure 4 should be constructed, as I experienced problems in ensuring that the crystal oscillator shown in the circuit diagram of Figure 2 continued to operate. The resulting output from down-mixing will produce an  $F_{in}$  of 3.67875MHz, corresponding to a divide by N number of 3.67875MHz divided by 10kHz which equals 367.875.

Ha! We have a problem. It is not possible to have a divide by N number which is not a whole number. Therefore, if we make the divide by N number equal to 368, this will produce an  $F_{in}$  of 3.68MHz. The VCO will be operating on 36.61625 +

$3.68 = 40.29625\text{MHz}$ , which will produce an operating frequency of  $40.29625 + 10.695$ , which equals  $29.60125\text{MHz}$ ,  $1.25\text{kHz}$  higher than the required frequency. This can be partially corrected by adjusting the trimming of the down-mixer crystal oscillator.

The main problem confronting the constructor is how he can achieve a programme code of 368 for channel 30 and still maintain the required operating channel switch codes to maintain an offset of  $10\text{kHz}$  between consecutive channels. First, we must examine how the binary number is obtained in the original unmodified set. For example, on channel 30, in Table 1, the channel change switch provides binary 69 to the PLL integrated circuit programme lines P0 to P6, that is P0, P2, and P6 at logic level 1. Programme line P7 is permanently connected to the positive supply and is therefore at logic level 1, and programme line P8 is grounded to give logic level 0. Therefore, P7 contributes 128 to the programme code binary number to give an overall programme code of 69 plus 128, which equals 197, the divide by N number required.

For the modified rig operating on channel 30 (Figure 8), we require a divide by N number of 325 which is achieved when the programme code is 325 binary. To obtain this higher binary number it is necessary to put P7 at logic level 0 and make P8 logic level 1. The binary code now available to the programme lines will be 69 plus 256 which equals 325, only 43 short of the required binary number of 368. We need to find some device that can be inserted between the channel change switch and the inputs of the PLL chip, to permanently increase the channel switch codes by 43 irrespective of the channel selected. The device to use is called a binary adder.

Figure 8 shows the use of a binary adder integrated circuit. The programme code generated by the channel switch is fed directly into the binary adder on input line A. The fixed binary code of 43 which is to be added to the channel switch code is entered into the binary adder on input lines B. The binary adder adds together the binary inputs on lines A and B and presents the addition onto the input lines, which are directly connected to the programme lines P0 through to P7 of the PLL integrated circuit. On channel 30 the binary code from the channel switch, which is 69, is added to the fixed binary code of 43 to produce a binary code of 112. This is presented to the programme lines P0 to P7 of the PLL integrated circuit. Programme line P8 is now permanently at logic level 1 and therefore the overall binary code presented to the programme lines of the PLL integrated circuit will be 112 plus 256, which equals 368, the required binary number for channel 30.

The binary adder integrated circuit selected for the job is the Motorola 4008, which is a four bit binary full adder with

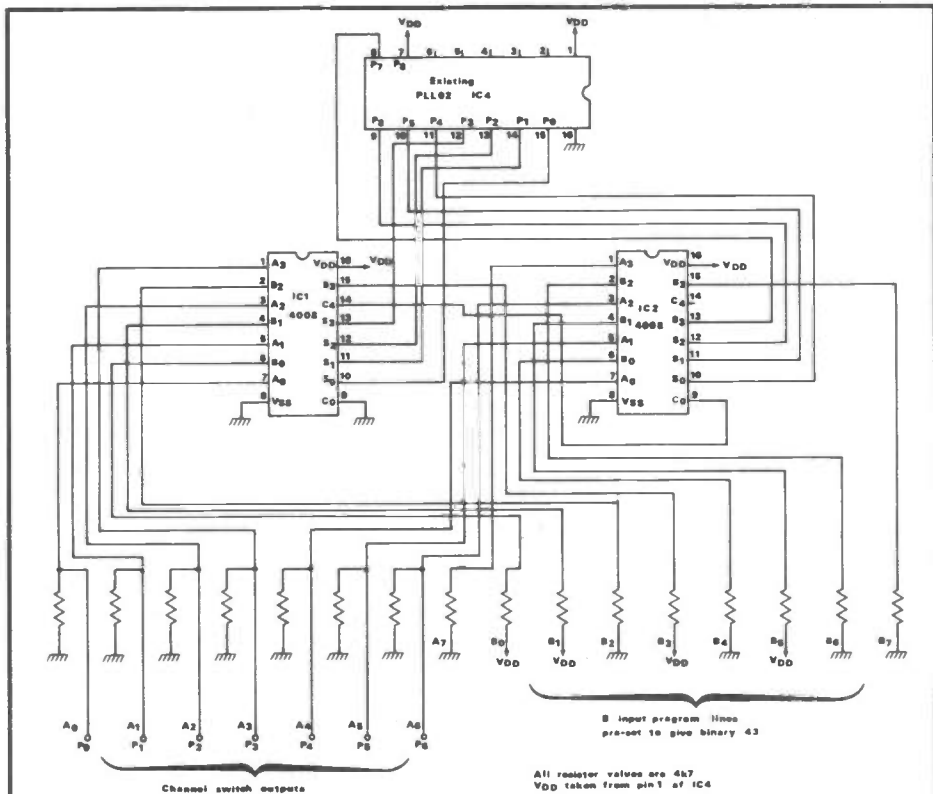


Fig 11 The full binary adder circuit interposed between the channel switch and the PLL IC

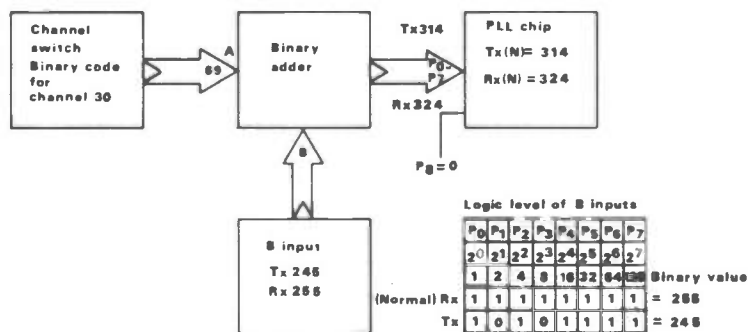


Fig 12 Using binary addition to achieve frequency shift for repeater working

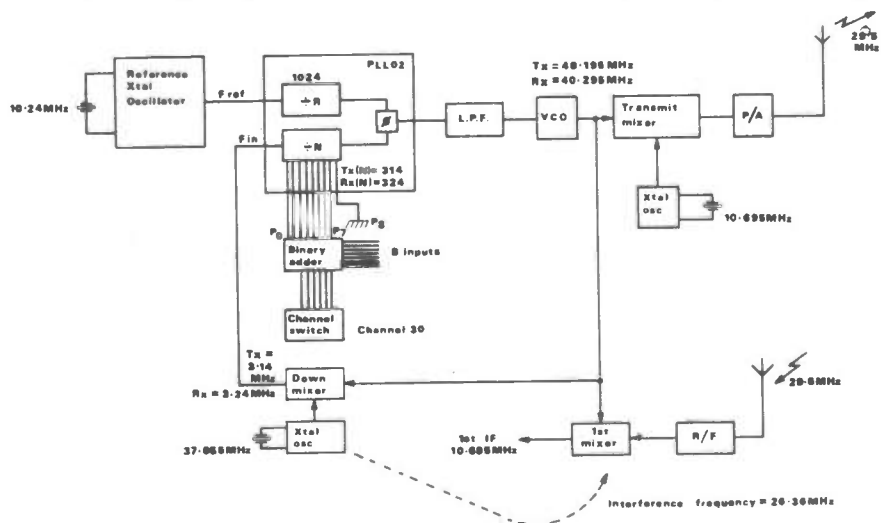


Fig 13 Block diagram of modified rig tuned to channel 30, incorporating frequency shift for repeater working

# CB CONVERSIONS

	P0	P1	P2	P3	P4	P5	P6	P7	P8	Binary value
	2 <sup>0</sup>	2 <sup>1</sup>	2 <sup>2</sup>	2 <sup>3</sup>	2 <sup>4</sup>	2 <sup>5</sup>	2 <sup>6</sup>	2 <sup>7</sup>	2 <sup>8</sup>	
	1	2	4	8	16	32	64	128	256	511
(1)	0	0	1	0	0	0	1	0	1	324
(2)	0	0	1	1	1	0	0	0	1	284
(3)	0	0	1	0	1	1	1	1	0	244
(4)	0	0	1	1	0	0	1	1	0	204
(5)	0	0	1	0	0	1	0	1	0	164

PPL02 programme line truth table channel 30

	B0	B1	B2	B3	B4	B5	B6	B7	Binary value
	2 <sup>0</sup>	2 <sup>1</sup>	2 <sup>2</sup>	2 <sup>3</sup>	2 <sup>4</sup>	2 <sup>5</sup>	2 <sup>6</sup>	2 <sup>7</sup>	
	1	2	4	8	16	32	64	128	255
(1)	1	1	1	1	1	1	1	1	255
(2)	1	1	1	0	1	0	1	1	215
(3)	1	1	1	1	0	1	0	1	175
(4)	1	1	1	0	0	0	0	1	135
(5)	1	1	1	1	0	0	1	0	95

B input truth table

Band	Frequency range		
	Chan 1	Chan 30	Chan 40
(1)	29.31MHz	29.60MHz	29.70MHz
(2)	28.91MHz	29.20MHz	29.30MHz
(3)	28.51MHz	28.80MHz	28.90MHz
(4)	28.11MHz	28.40MHz	28.50MHz
(5)	27.51MHz	28.00MHz	28.10MHz

Table 2 Truth table for the programme codes for the PLL02 chip and the B inputs

two four bit data inputs, A0 to A3, and B0 to B3, a carry input C0 four sum outputs, S0 to S3, and a carry output C4. The 4008 incorporates full look ahead across 4 bits to generate the carry output C4. This minimises the necessity for extensive look ahead and carry cascading circuits. The circuit configuration and pin out functions are shown in Figure 10.

To achieve full binary addition, two 4008 ICs will be required. The full circuit diagram of the binary adder circuit is shown in Figure 11. The input programme lines for both IC1 and IC2 are grounded through 4.7kohm resistors to ensure that their outputs are at logic level 0 when not being used. The logic outputs of the channel change switch are connected to A0 through to A3 of IC1 and A0 through to

A2 of IC2. A3 of IC2 is not used and is grounded via a 4.7kohm resistor.

The B inputs for both binary adder ICs are fed via a 4.7kohm resistor to either VDD or ground to achieve the binary value of 43. The carry output of IC1 is connected to the carry input of IC2 to achieve full carry over between the two binary adder integrated circuits. The carry input of IC1 is not used and is grounded to ensure that noise cannot trigger the input to give an incorrect output code. The carry output of IC2 is not used and pin 14 is left open circuit.

At a VDD of approximately 10V each, 4008 consumes about 1.4 milliamps and therefore it is acceptable to use the same voltage rail which feeds the PLL chip IC4.

## Construction

The two binary adder integrated circuits, IC1 and IC2, are mounted on a small piece of Veroboard. It is wise to use an IC holder and complete the soldering before inserting the two ICs to avoid damaging them, as we are dealing with CMOS logic. The resistors are also mounted on Veroboard and ribbon cable is used to interconnect to the set printed circuit board. If difficulty is experienced putting the set on frequency because the down-mixer crystal oscillator will not shift sufficiently in frequency, it is worth trying again with the divide by N number reduced by 1. This can be achieved by removing VDD from B0 and connecting it to ground. Remember that the VCO will also require to be set up as previously described.

When the final tuning has been accomplished the Veroboard is insulated with PVC tape to ensure that it does not come into contact with the other components in the set.

## Providing repeater shift

Having now experienced the 'delights' of binary addition, it is possible to make use of this technique to provide additional facilities. For example, when the sunspot cycle becomes favourable for DX working on 10 metres, working through the repeaters of other countries can be very enjoyable. To achieve this facility within the modified set we need to ensure that the transmit frequency is 100kHz below the receive frequency. It is therefore necessary to change the value of the divide by N number between transmit and receive. The only other way of achieving the same result is to keep the same divide by N number between transmit and receive and use another crystal in the down-mixer oscillator which is a more expensive way of providing this facility.

With the transmitter operating 100kHz below the receiver frequency the divide by N number on receive will be higher than that on transmit. If we make the B inputs to the binary adder all at logic level 1 (Figure 12), the resulting binary number will be 255. On channel 30 the binary number produced by the channel change switch will be 69, which is fed to

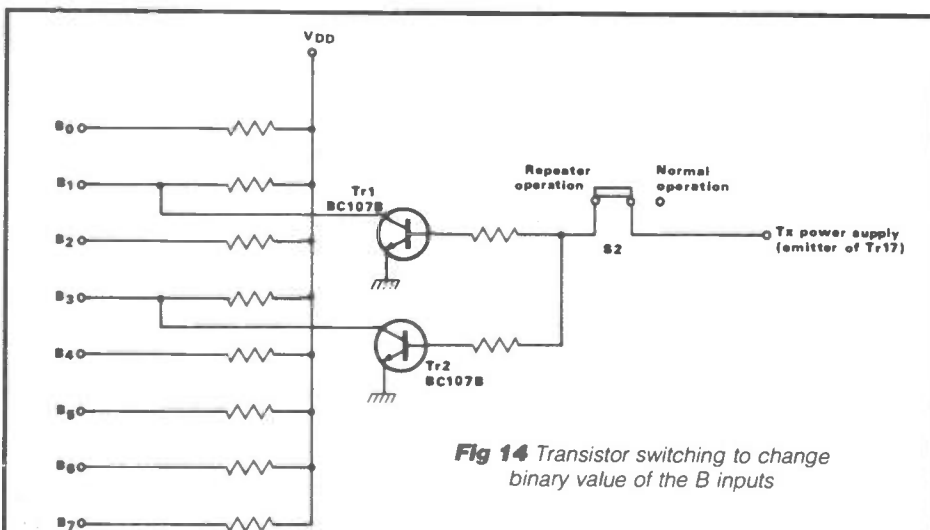


Fig 14 Transistor switching to change binary value of the B inputs

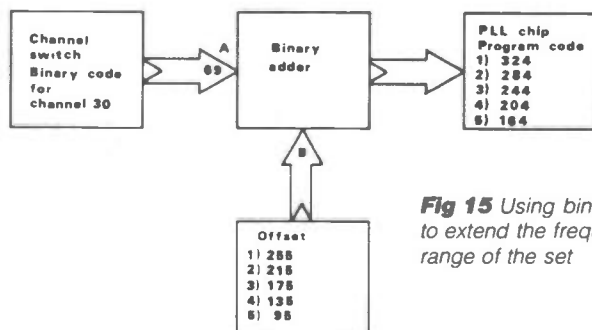


Fig 15 Using binary addition to extend the frequency range of the set



the A inputs of the binary adder. The binary adder output will be 69 plus 255 which equals 324. Therefore, the resulting divide by N number will be 324. The frequency of  $F_{in}$  will be  $324 \times 10\text{kHz}$  which equals 3.24MHz.

From previous examples, we know that the VCO will be operating at 40.295MHz on channel 30 and therefore the frequency of the down-mixer crystal oscillator will be  $40.297\text{MHz} - 3.24\text{MHz}$ , which equals 37.055MHz. If this frequency should find its way into the receiver first mixer, the interfering frequency will be  $37.055\text{MHz} - 10.695\text{MHz}$  which equals 26.36MHz, this frequency being well away from any possible locally generated transmissions. On transmit the frequency must be 100kHz below the receive frequency and therefore on channel 30 will be operating at 29.5MHz. The VCO requires to operate at a frequency of  $29.6\text{MHz} - 10.695\text{MHz}$  which equals 40.195MHz. The frequency of  $F_{in}$  will be  $40.195\text{MHz} - 37.055\text{MHz}$  which equals 3.14MHz.

The required divide by N number to produce a frequency of 10kHz to the input of the phase detector to maintain the loop in a locked condition will be 3.14MHz divided by 10kHz, which equals 314. The binary number on the inputs of the programme lines will be 314.

Figure 13 shows the block diagram of the modified rig giving the frequency relationships existing within the rig. On transmit the output of the binary adder will be 324. The binary value of the B inputs to achieve this value will be 314 - 69 which equals 245. To achieve a binary value of 245 we require to make all the B inputs at logic level 1, with the exception of P1 and P3 which are placed at logic level 0 (Figure 12). Therefore, to obtain the 100kHz frequency shift, we only need to change the logic level of two of the B inputs from logic level 1 to 0.

We can use the same circuit configuration of Figure 11 with the exception that all the B inputs are held at logic level 1 by connecting all the resistors to VDD. On transmit we require to ground the inputs of P1 and P3 which can be achieved using transistors, as shown in Figure 14. On transmit the bases of Tr1 and Tr2 are connected to the transmit voltage rail, which causes Tr1 and Tr2 to conduct heavily and ground P1 and P3. The front panel switch to select PA or CB, S2, can be used to select repeater operation as shown in Figure 14. The two transistors were mounted on the same piece of Veroboard containing the binary adder ICs. The base current of the two transistors is limited by 4.7kohm resistors and the trigger voltage is taken from the emitter of Tr17, the transistor regulator and switch to supply the transmitter when the mic button is pressed.

## The frequency range

Binary addition can again be used, this time to extend the frequency range of

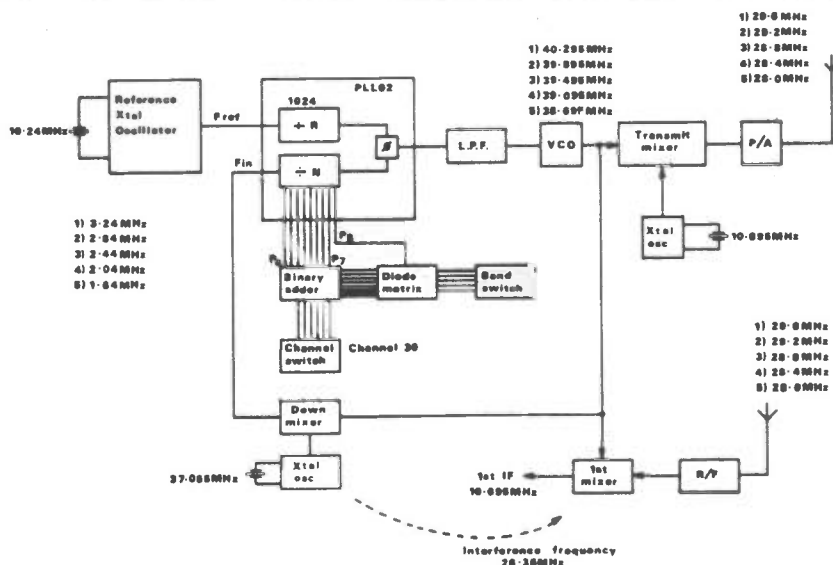


Fig 16 Block diagram of the modified rig tuned to channel 30, which will tune over 5 bands to cover from 27.51MHz to 29.7MHz

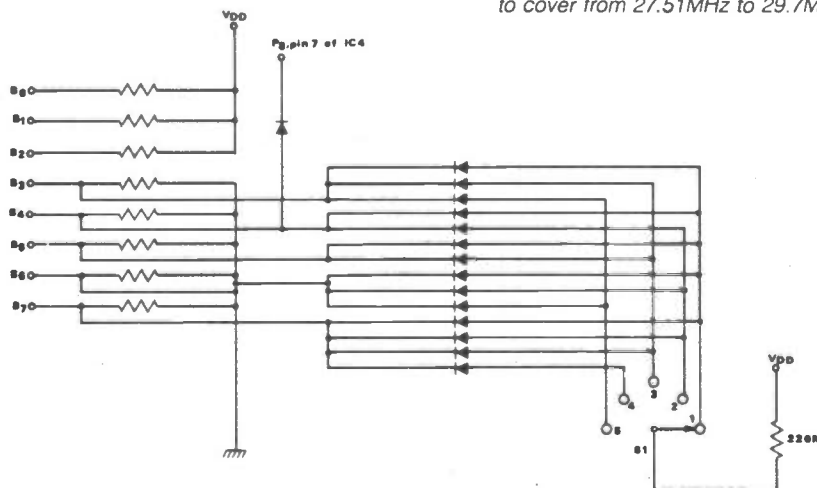


Fig 17 Diode switching to achieve the required binary code for the B inputs of the binary adder

the set. For example, the set may be used as an exciter to obtain operation on the 2 metre band. If this is the case, the set must be capable of operating over a bandwidth of 2MHz between 28MHz to 30MHz.

Let us assume that on Band 1 channel 30 will remain the calling frequency of 26.6MHz, and that we will adopt the two 4008s approach with all the B inputs at logic level 1. From Table 2, the binary value with B0 to B7 all set at logic level 1 will be 255. The output of the binary adder (Figure 15) will result in a binary value of  $68 + 255$  which equals 324.  $F_{in}$  will be  $324 \times 10\text{kHz}$ , which equals 3.24MHz. On channel 30, the VCO will be operating at a frequency of 29.6MHz plus 10.695MHz, which equals 48.295MHz. The down-mixer crystal oscillator must operate at a frequency of  $40.295\text{MHz} - 3.24\text{MHz}$ , which equals 37.055MHz, the same frequency as in the previous example.

To obtain complete coverage of the amateur ten metre band, you will observe from Table 2 that on Band 2 at channel 30 the operating frequency of the set will be 29.2MHz, a drop of 40kHz from channel 30

on Band 1. From Figure 17 the VCO will be operating at a frequency of 29.2MHz plus 10.695MHz, which equals 39.895MHz.  $F_{in}$  will be  $39.895\text{MHz} - 37.055\text{MHz}$ , which equals 2.84MHz. The resulting divide by N number will be 2.84MHz divided by 10kHz, which equals 284, also corresponding to the binary number appearing on the input programme lines to the PLL chip. From Figure 15 the B binary code required will be  $284 - 69$ , which equals 215. The truth table is given in Table 2. The same calculation exercise is continued for the remaining 3 bands.

The output of the binary adder is connected to programme lines P0 through to P7. It will be noted from Table 2 that programme line P8 does not remain at logic level 1 throughout the 5 bands, and therefore cannot be permanently connected to VDD. However, a close examination of the B inputs of the binary adder reveal that B4 has a similar bit pattern per band as for P8, and therefore there is nothing stopping one connecting B4 directly to P8.

The next remaining problem is how we obtain the various logic codes on the B

# CB CONVERSIONS

input to the binary adder for each individual band. Again, a close examination of the inputs reveals that B0, B1 and B2 always remain at logic level 1 and therefore can be permanently connected to VDD. However, B2 through to B7 change state from one band to another. In the previous example we used transistor switching to achieve the change in logic levels, but this would prove unsuitable in this situation. The answer to the problem is to put the B inputs B3 through to B7 at logic level 0 through 4.7kohms resistors to ground and use diode switching as a means of changing the logic level of the individual B inputs.

## Diode switching

Figure 17 shows the arrangement of diode switching. The band switch S1 connects VDD via a diode to prevent back feeding to the various B inputs, as shown by the truth table for the B inputs in Table 2. This method uses only 14 switching diodes, with B4 connected to P8 via an additional switching diode. The diode matrix was constructed on a separate piece of Veroboard and then wired to the band switch which is mounted on the front panel of the set, and also wired to the Veroboard contain-

ing the two binary adder ICs. The B inputs B0, B1 and B2 are connected to VDD via 4.7kohm resistors, while the remaining B inputs are connected to ground via similar resistors.

The VCO in this set is operating at a frequency of around 40MHz and therefore with the existing values of tuned L and C is capable of operating over a frequency range of 2MHz, whereas in other sets with a VCO operating at around 17MHz the ratio of the tuned L and C in the VCO circuit will have to be adjusted to increase the VCO to operate over a bandwidth of 2MHz.

## Conclusions

The Binatone Route 66 transceiver model 01/8538 is relatively easy to convert for use on the 10 metre band. However, there are a number of pitfalls to be avoided.

The PLL02 PLL chip is not capable of operating at a frequency of  $F_{in}$  greater than approximately 4.5MHz, although the programme codes with a reference oscillator operating at 10.24MHz will permit an  $F_{in}$  with all programme lines at logic level 1 of 5.11MHz.

Secondly, to avoid any possible interference from the UK Citizens Band, the down-mixer crystal oscillator must be

selected to avoid the receiver first mixer mixing these unwanted frequencies. Therefore, avoid a down-mixer crystal oscillator frequency varying from 38MHz up to 38.7MHz.

Thirdly, before completing the frequency alignment of the set, ensure that the reference oscillator is operating at 10.24MHz. If not, adjust the trimmer VC2. Also, check on transmit that the transmitter crystal oscillator is oscillating at 10.695MHz; again if not adjust trimmer VC1.

The modified set with the down-mixer oscillator operating on 37.045MHz has been working in the shack for the past three months without any problem and works well on local nets. Unfortunately, the sunspot activity is not very good and no opportunity has arisen to try working any DX stations. The Binatone transceiver is probably one of the cheapest sets to convert to 10 metres, approximately £2.00 if you use binary crystal and £5.50 if the down-mixer crystal is changed.

I hope that this article will have kindled your interest in 10 metres and will not only assist you to modify the Binatone rig but any CB rig containing the versatile PLL02 phase locked loop integrated circuit. **REW**

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AUGUST 1987

In the last two issues of *Data File* we have looked at the basic details and practical applications of the LM10, a unique bipolar linear IC that is produced by the National Semiconductor Corporation and houses a high performance op-amp plus a precision 200mV band-gap voltage reference and a 2-input buffer amplifier in a single 8-pin TO5 package. To help refresh the reader's memory, *Figure 1* shows the functional diagram and pin notations of the LM10.

In this month's edition of 'The File' we continue the LM10 applications theme by looking at a wide variety of voltage, current and resistance-sensitive fault indicator circuits with audible or visual outputs.

### On/off voltage indicators

*Figures 2 to 9* show a variety of 'on/off-type' fault indicator circuits in which the output is normally low (off) but goes high (on) in the presence of a fault condition. In each of these circuits the op-amp section of the LM10 is used as a simple voltage comparator with its output feeding to either an LED indicator or a low power audible warning device via a suitable current-limiting (up to 20mA) resistor.

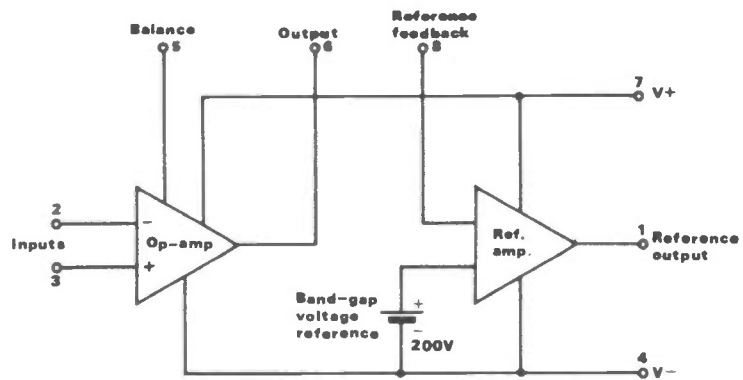
In the *Figure 2* over-voltage indicator circuit the test voltage is fed to the non-inverting input terminal of the op-amp, and an internally-generated reference voltage is fed to the non-inverting input terminal to preset the circuit's trigger voltage value ( $V_{trig}$ ). This reference voltage is derived via the internal 200mV band-gap voltage and via the reference amplifier, which has its gain determined by the ratios of  $R_1$  and  $R_2$  and can be given any value in the range 200mV to 40V. When the input test voltage is below the designed trigger value, the op-amp output is low and the LED/alarm is off; when the input exceeds the trigger value, the op-amp output switches high and activates the LED/alarm.

*Figure 3* shows an under-voltage indicating version of the above circuit, in which the output goes high when the input falls below a preset trigger voltage value. Here, the op-amp input terminal connections are simply transposed, so that the input is fed to the inverting terminal and the reference is fed to the non-inverting pin.

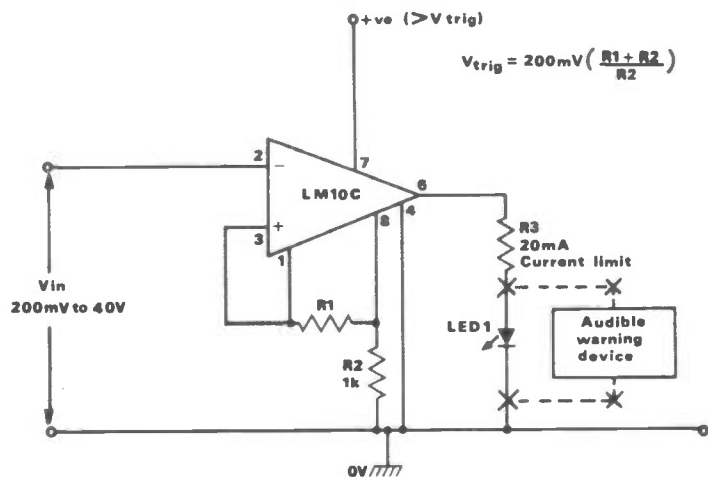
Note that both of the *Figure 2* and *3* circuits offer the advantage of a very high input impedance, but must have supply voltage values that are greater than the desired trigger voltage values.

*Figures 4* and *5* show alternative voltage-indicating designs that do not suffer from the above-mentioned snag of supply voltage restriction, and can operate from any supplies in the 2.5 to 40 volts range. Here, the internal buffer amplifier is set to give unity gain and thus generates a fixed 200mV reference voltage that is fed to one input terminal

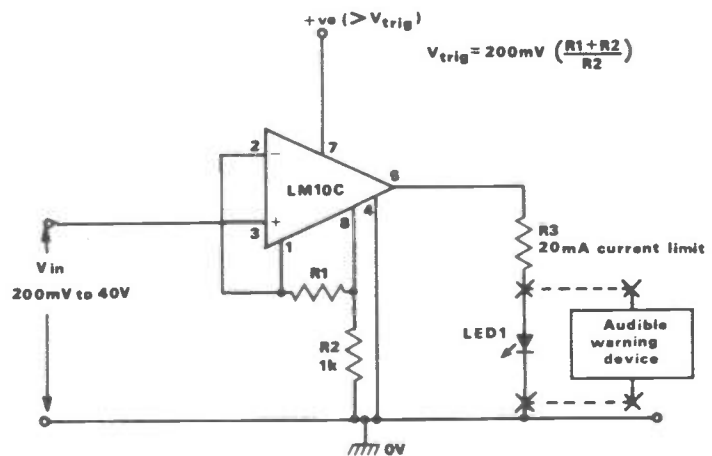
## Ray Marston presents a further selection of LM10 application circuits



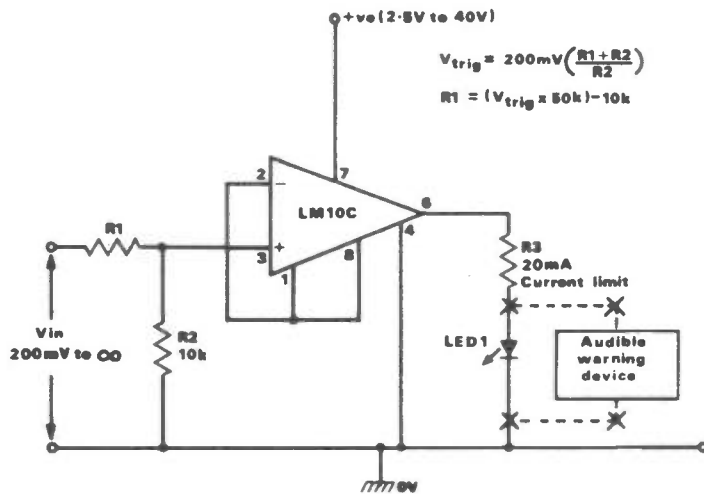
**Fig 1** Functional diagram of the LM10



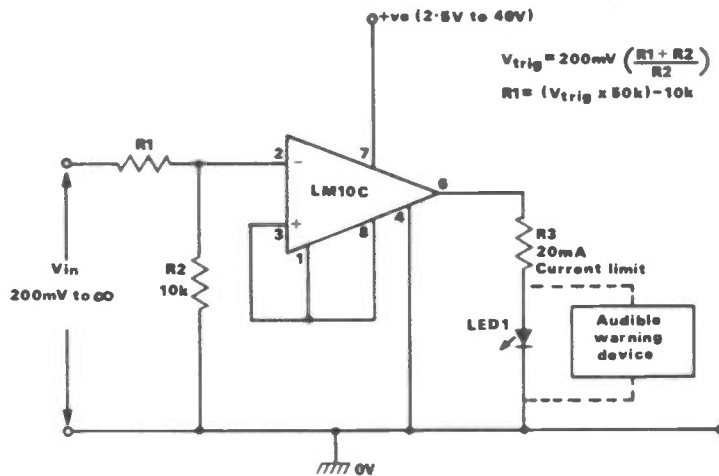
**Fig 2** Precision over-voltage indicator



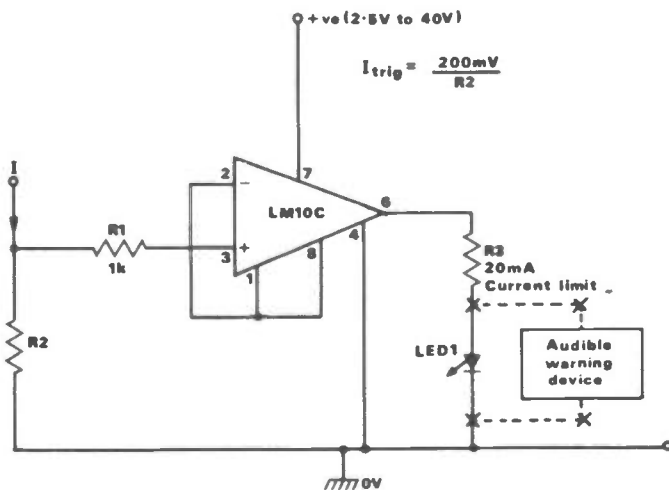
**Fig 3** Precision under-voltage indicator



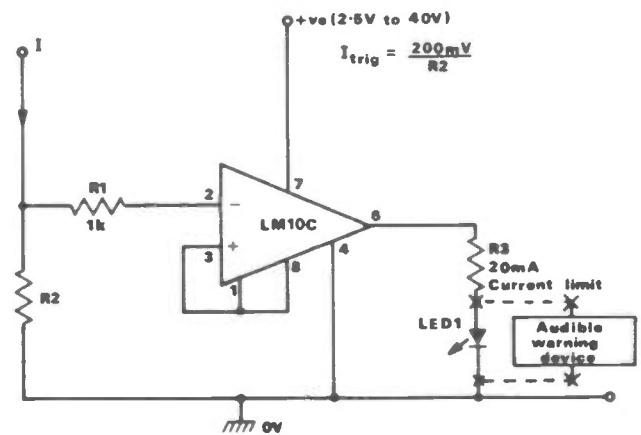
**Fig 4** Alternative over-voltage indicator



**Fig 5** Alternative under-voltage indicator



**Fig 6** Precision over-current indicator



**Fig 7** Precision under-current indicator

of the op-amp, and the test voltage is fed to the other input terminal via the R1-R2 potential divider, which thus determines the circuit's trigger voltage value.

In the *Figure 4* design the input test voltage is coupled to the op-amp's non-inverting input terminal, so this circuit acts as an over-voltage indicator. In the *Figure 5* design the input is fed to the inverting terminal, so this circuit acts as an under-voltage indicator. Note that both of these circuits have a basic input resistance sensitivity (equal to the sum of the R1 and R2 values) of 50k/volt. Thus, if the circuit is required to trigger at 12 volts, R1 needs a value of  $12 \times 50k$  minus 10k, equalling 590k.

### On/off current indicators

The *Figure 4* or *5* circuit can be given a maximum trigger voltage sensitivity of 200mV by simply reducing the R1 values to zero. Note in this case that the circuit will trigger when a current of 20µA is passed through R2, since 200mV is developed across R2 under this condition. These modified circuits can thus be used as current-sensitive indicators or switches.

*Figures 6* and *7* show practical examples of such circuits. In each case, the R2 value is selected to give the required trigger current sensitivity (ie 1 ohm for 200mA sensitivity, 10 ohms for 20mA, etc). Note that R1 is used simply as a 'safety' resistor, to limit op-amp input overload currents to a safe value.

### On/off 'R' indicators

*Figures 8* and *9* show precision circuits that can be triggered by variations in the value of R1, which would normally take the form of a resistive transducer such as an LDR (light-dependent resistor) or a thermistor, thus enabling the circuits to be triggered via either light or temperature. In such cases the LDR should take the form of a cadmium sulphide photocell, and the thermistor should be a simple ntc (negative temperature coefficient) type, each with a resistance value

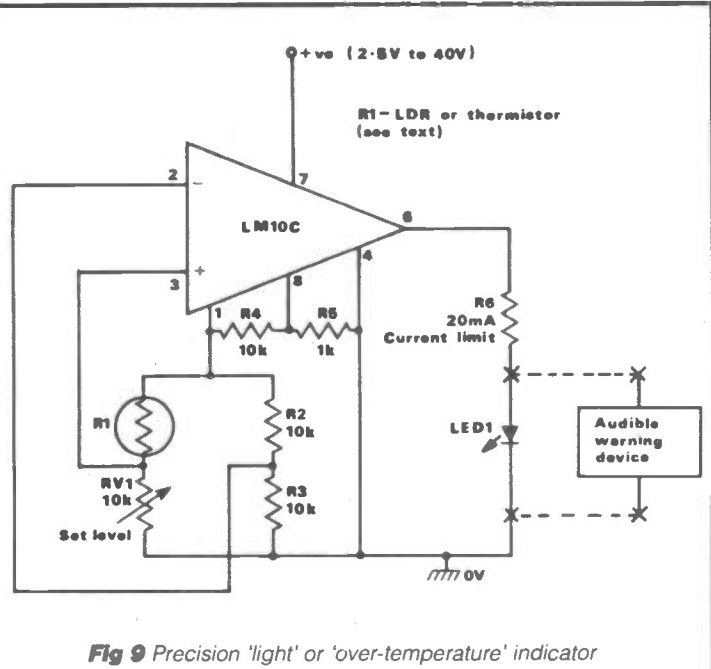
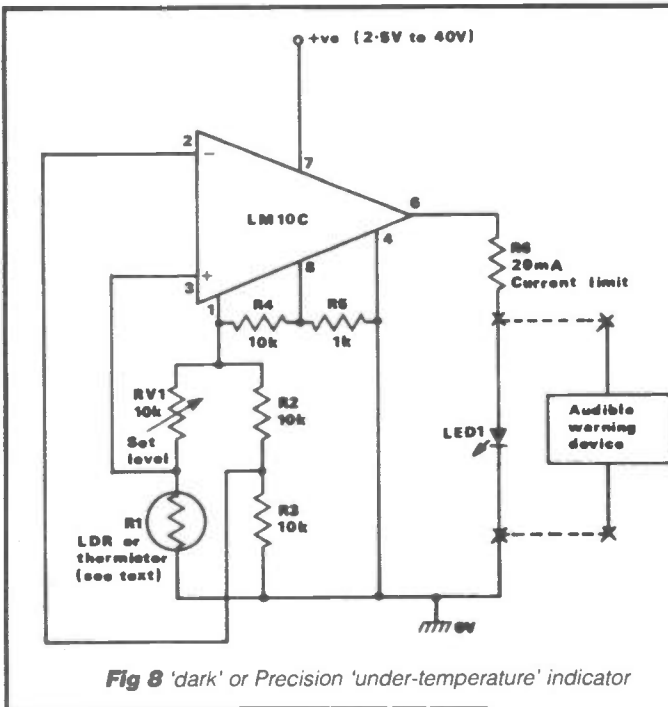


Fig 8 'dark' or Precision 'under-temperature' indicator

Fig 9 Precision 'light' or 'over-temperature' indicator

in the range 500R to 9k0 at the required trigger level.

In each of these circuits, the R1 resistive element forms part of a Wheatstone bridge (formed by R1-RV1-R2-R3) that is powered (via pin 1) from the LM10's voltage reference amplifier, and the output of the bridge is used to activate the comparator configured op-amp. The pin 1 voltage reference value is set at 2.2 volts by the relative values of R4-R5.

**Gated alarms**

A particularly useful application of the LM10 is as a low voltage (3 volts to 4.5 volts) gated astable multivibrator, and Figures 10 and 11 show how such a circuit can be made to act as either a gated LED flasher or as an audible alarm-tone generator.

The basic action of the gated astable was briefly described last month. In essence, it acts like a standard 'dual supply' op-amp astable, with R1 and R2 acting as a potential divider that sets the 'common' point of the R4-R5 divider and C1-R6 timing networks at half-supply volts. The circuit normally acts as a free-running square wave generator, but can be disabled (gated off) by preventing its pin 2 terminal from exceeding the pin 3 value via the gate input terminal.

Thus, the Figure 10 circuit is normally off (with its output locked high) but can be gated on by a high or logic 1 input, and the Figure 11 circuit is normally off (with its output locked low) but can be gated on by a low or logic 0 input.

Note that the circuit timing is controlled by the C1 and R6 values. If a circuit is to be used as an LED flasher, these components should be given values of

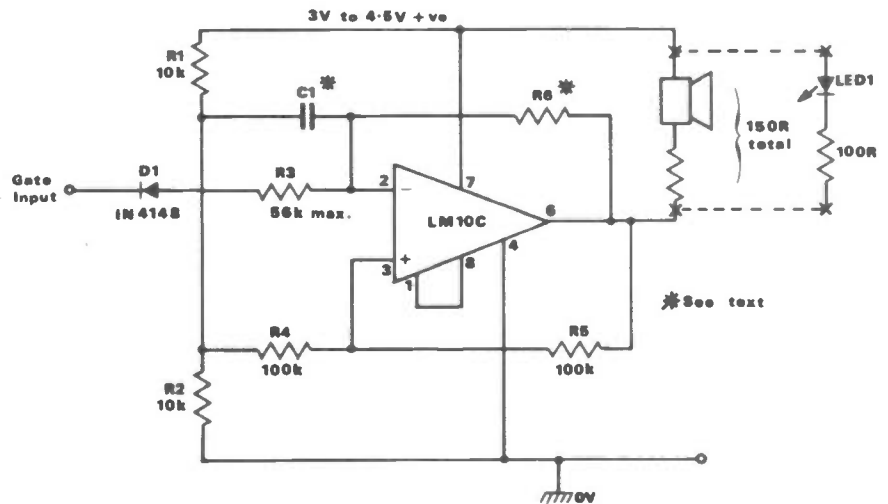


Fig 10 LED flasher or alarm-tone generator that is gated on by a high (logic 1) input

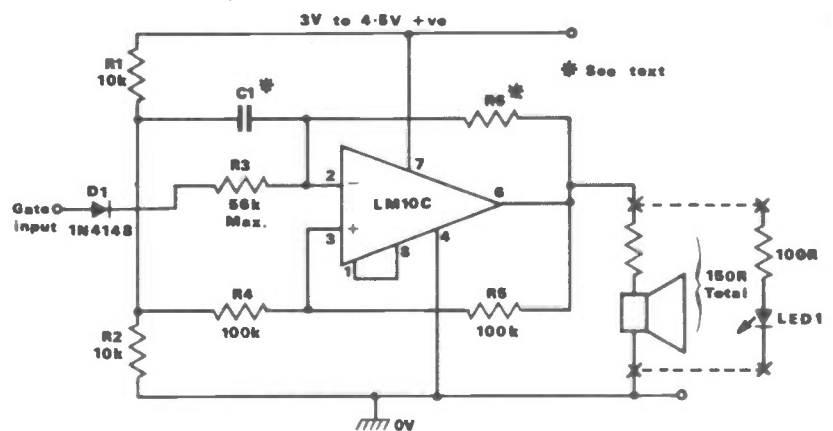
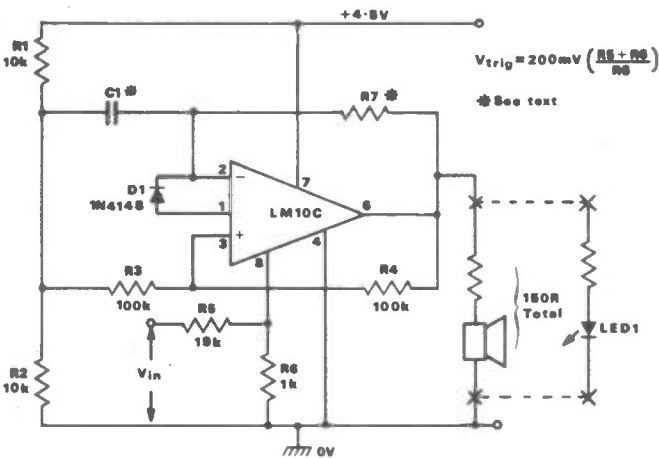
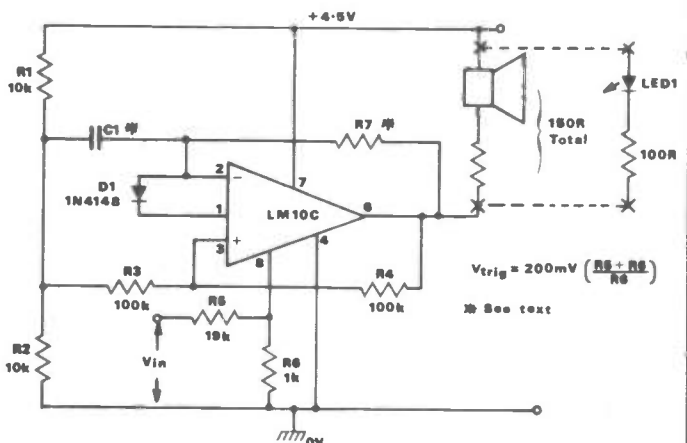


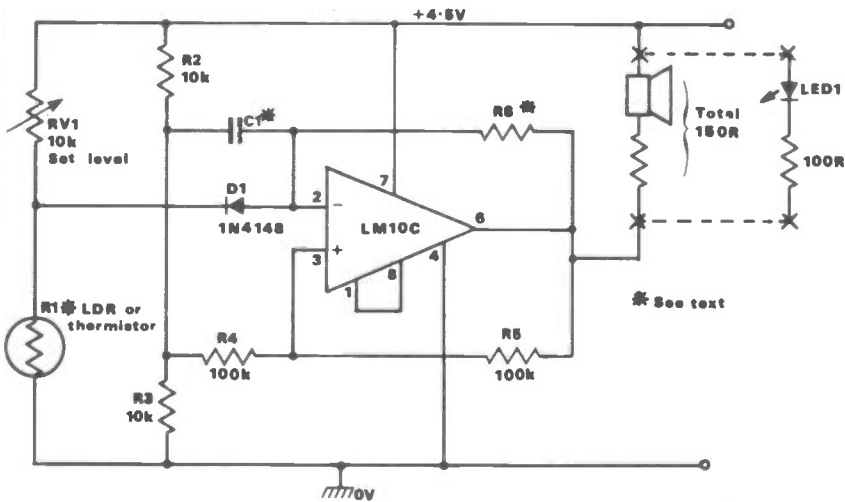
Fig 11 LED flasher or alarm-tone generator that is gated on by a low (logic 0) input



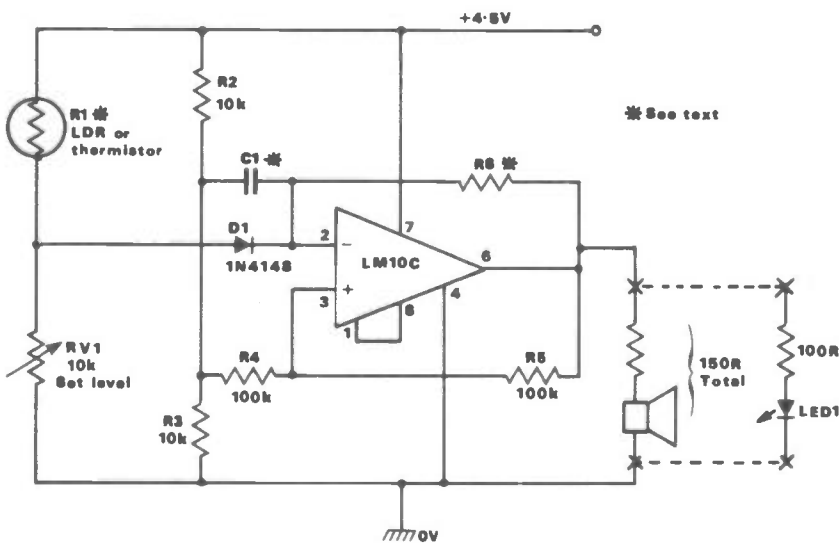
**Fig 12** Precision over-voltage alarm (triggers at 4V with  $R_5$  value shown)



**Fig 13** Precision under-voltage alarm (triggers at 4V with  $R_5$  value shown)



**Fig 14** 'Dark' or 'under-temperature' alarm



**Fig 15** 'Light' or 'over-temperature' alarm

220n and 1M0 respectively, to give a flash rate of 100 flashes/minute. If a circuit is to be used as a 400Hz alarm tone generator, the components should be given values of 10n and 68k respectively.

### Gated fault indicators

To conclude this month's edition of *Data File*, Figures 12 to 15 show how the basic Figure 10 and 11 gated astable circuits can be modified to act as 'fault condition' indicators that give either a flashing LED or a 400Hz monotone alarm signal output under the 'fault' condition.

In the Figure 12 over-voltage and Figure 13 under-voltage alarm circuits the LM10's internal reference amplifier is used as a precision voltage comparator, with its trigger voltage (equals 4 volts with the component values shown) determined by the relative values of  $R_5$  and  $R_6$ , and its output used to gate the astable via D1.

In the Figure 14 'dark' or 'under-temperature' and Figure 15 'light' or 'over-temperature' alarm circuits the astable is gated via D1 and the R1-RV1 potential divider, in which R1 takes the form of either a cadmium sulphide photocell or an ntc thermistor with a resistance value in the range 500R to 9k0 at the required trigger level.

Note in the Figure 12 to 15 circuits that the astable timing is controlled by the C1-R6 values. If a circuit is to be used to give a flashing LED output, these components should be given values of 220n and 1M0 respectively, to give a flash rate of 100 flashes per minute. If a circuit is to be used to give a 400Hz audible alarm tone output, the components should be given values of 10n and 68k respectively.

### Next month

Next month we will conclude our look at the LM10 by presenting a selection of practical remote amplifier and 2-wire transmitter circuits, etc.

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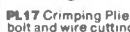
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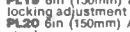
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# DXER'S TONE CONTROL

On the face of it, the tone controls fitted to many communications receivers are rather useless features. These are just simple 6dB per octave top-cut filters which would seem to be totally superfluous when one considers the effective audio attenuation rate provided by even low cost ceramic IF filters. With the IF filters giving an attenuation rate of what is likely to be over 40dB per octave above the cut-off frequency, and possibly in excess of 100dB per octave, what possible useful effect could a simple 6dB per octave tone control have?

## Lowering the tone

In use the story is a slightly different one, and under some operating conditions backing off the tone control to introduce some high frequency attenuation does seem to give improved results. The reason for this is a fairly straightforward one, hinging around the IF filters being optimised for a particular reception mode under the assumption that signals within the band are spaced at appropriate intervals. For example, SSB signals would ideally be spaced 3kHz or so apart, and with a typical SSB IF bandwidth of about 2.5kHz this would give minimal problems with adjacent channel interference. Under these conditions the tone control will have no useful effect on results and would be best set fully advanced so as to have no significant effect on the bandwidth of the system.

In reality, on the short wave amateur and broadcast bands at any rate, there is no proper channelling of stations and there is a lot of overcrowding. As a result of this there are often severe problems with adjacent channel interference with

one tending to be too close to the next. When looked at in terms of signals present within the passband of the receiver, this gives something like the signals depicted in *Figure 1a*. Here the solid lines represent an SSB signal showing its various constituent frequencies and their relative strengths at that particular instant in time. The broken lines represent frequency components from an SSB signal in the next channel, where inadequate channel spacing has been used.

These adjacent channel signals are just within the passband of the receiver, and are not subjected to any attenuation by the IF filters. They are therefore comparable in strength to the components in the wanted signal, and could in fact be much stronger if the wanted signal was a weak DX type. Although most of the interfering signal is removed by the receiver's IF filters, the few remaining components can be sufficient to render the wanted signal virtually unintelligible.

Although the theory states that a bandwidth of around 2.5 to 3kHz is needed to give intelligible speech, this is a generalisation which is not strictly accurate. The minimum bandwidth for understandable speech is very much dependent on the particular voice concerned and, to a lesser extent, on exactly who is doing the listening. By reducing the audio or IF bandwidth of the receiver it is obviously possible to cut off the interfering adjacent channel interference, but some of the wanted signal will also be lost, as in *Figure 1b*. In this example it is a reduction in bandwidth at the high frequency end of the spectrum which has been used to counter the interference, but in practice the interfer-

ing signal could just as easily be at the other side of the wanted signal. A reduction in the low frequency bandwidth would then be needed.

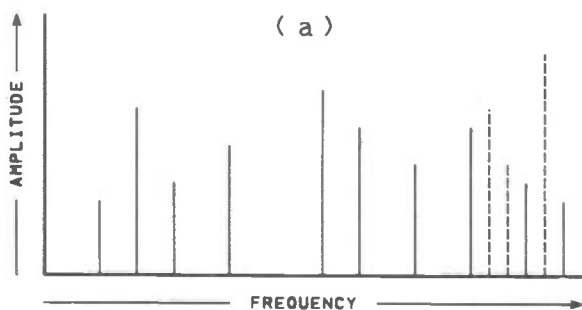
Just how effective (or otherwise) a reduction in bandwidth is in practice is something that will vary from one instance to another. In some cases there might be very strong co-channel signals falling just within the receiver's passband, and a small reduction in bandwidth will then dramatically reduce the interference while giving very little loss in the quality of the wanted signal. On the other hand, if a relatively weak signal is overlapping the wanted signal by a substantial amount, removing that signal could result in a relatively minor reduction in the interference level while rendering the wanted signal totally unintelligible.

It is also something that is dependent on the bandwidths of the receiver in its various reception modes. If it has very high slope filters with the bandwidths already erring on the narrow side, the ability to trim the bandwidth inwards is likely to be of little value. If the receiver has IF filters which give only a relatively modest slope at the skirts of the response, and the bandwidths are slightly on the wide side (which is generally the case with all but the most expensive of receivers), then the ability to reduce the bandwidth slightly can often give a large improvement in results.

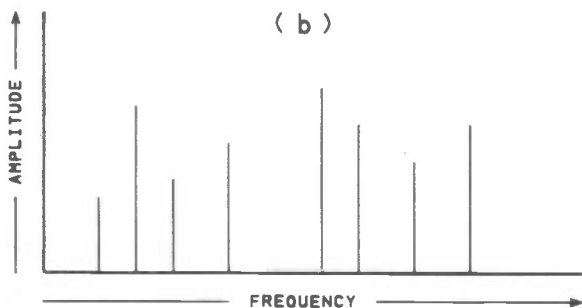
The tone controls fitted to some receivers can certainly give improved results under the right conditions, but the degree of improvement is relatively small due to the low attenuation rate of the filter. Also, it is normally only a treble cut filter that is included, whereas adjacent channel interference will provide signals at the low end of the audio band as often as it provides the all too familiar high frequency 'monkey chatter'.

The unit which forms the subject of this article was designed as a sort of super add-on tone control, and it has both variable highpass and lowpass filters. Both types are four stage (24dB per octave) filters, and they give substantially better performance than simple single stage types.

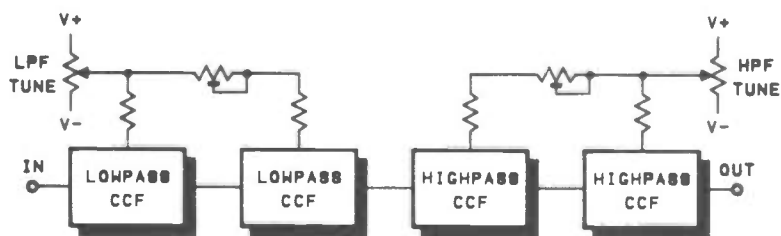
In use with both Trio QR-666 and Yaesu FRG8800 receivers the unit proved to be very effective, particularly on the



**Fig 1** Adjacent channel interference as in (a) can be removed by a reduction in audio bandwidth (b). This will reduce the audio output quality, but may give a perfectly intelligible output



**Fig 2** Block diagram for the DXer's tone control





# BY R A PENFOLD

amateur bands. The ability to trim the bandwidth at either end of the audio spectrum to obtain the best compromise between audio quality and lack of interference is an extremely useful one, and the 24dB per octave roll-off rate seems to be adequate to make the unit really effective. I would certainly rate this type of audio filter as more effective than a type having fixed cut-off frequencies for both the highpass and lowpass filters, even if the attenuation rate is far higher than the 24dB per octave of this unit. The ability to set the cut-off frequencies at the optimum figures for the prevailing conditions seems to be an important one.

## System operation

Simple single stage 6dB per octave filters having a variable cut-off frequency represent no real difficulty, and need consist of nothing more than one capacitor plus a potentiometer. Higher roll-off rates are more difficult, but 12dB per octave can be accommodated with the aid of a dual-gang potentiometer. An attenuation rate of 24dB would require a four-gang potentiometer and, due to the lack of availability of suitable components, an alternative to the normal C-R filters must be sought.

There are various possibilities, but the two main options are circuits based on either transconductance operational amplifiers such as the LM13600N or switched capacitor filters such as the MF10CN.

I tried circuits based on both types of filter and both can be made to give workable results. The final design is based on transconductance operational amplifiers, which overall seem to give a level of performance to match switched capacitor designs, but without any radio frequency interference problems and at a lower cost.

## Current-controlled resistance

Figure 2 shows the general make-up of the unit in block diagram form. A transconductance operational amplifier provides what is effectively a current-controlled resistance, and depending on the configuration used, this resistance can be part of an amplifier, a filter, an oscillator or various other types of circuit. This unit is based on four LM13600N dual transconductance amplifiers, giving a total of eight current controlled resistances with four being used in each tone control circuit. The LM13600N includes an output buffer stage for each transconductance amplifier and these four chips are therefore the only active devices needed in the circuit.

The basic set-up is to have two LM13600Ns configured as lowpass filters, followed by the other two which are operated as highpass filters. A potentiometer feeds the control inputs of

## PARTS LIST

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

R1,2,6,13,17,24,29,33,39,43,44	4k7 (11 off)
R3,4,8,11,15,16,20,22,26, 27,30,31,36,37,40,41	1k (16 off)
R5,7,9,10,14,18,19,21	22k (8 off)
R12	10k
R23	47k
R25	2k2
R28,32,35,38,42	100k (5 off)
R34	27k

### Potentiometers

VR1	100k sub-min hor preset
VR2,3	10k lin (2 off)
VR4	470k sub-min hor preset

### Capacitors

C1,7,13	100µ 10V radial elect (3 off)
C2	1µ 63V radial elect
C3,4,5,6	330p ceramic plate (4 off)
C8	47µ 16V radial elect
C9,10,11,12	In polyester layer (4 off)

### Semiconductors

IC1,2,3,4	LM13600N (4 off)
D1,2	1N4148 (2 off)

### Miscellaneous

JK1,2	3.5mm jack sockets (2 off)
S1	DPDT min toggle
S2	SPST min toggle
B1	9 volt (PP3 etc)

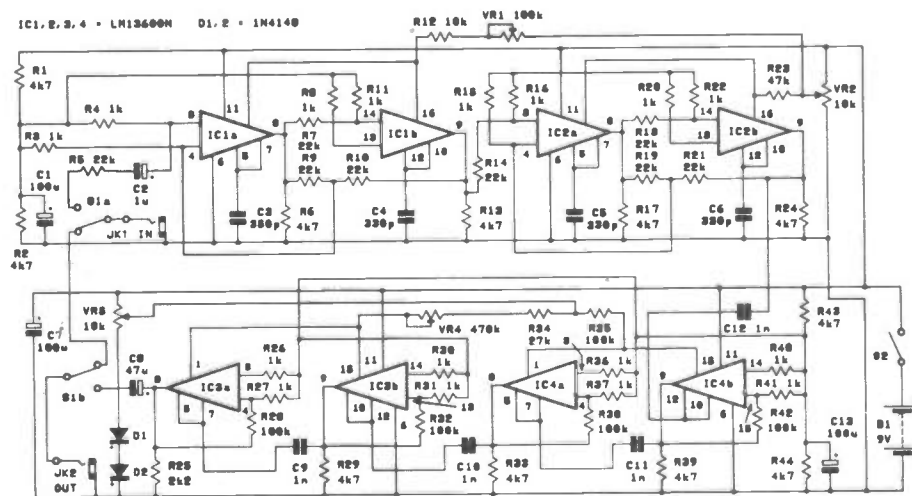
Case about 125 x 50 x 190mm  
Control knob (2 off)  
Printed circuit board  
16 pin DIL IC holder (4 off)  
Battery connector  
Wire, solder, fixings, etc

the lowpass via series resistors, and the current flow through the series resistors is dependent on the output voltage set using the potentiometer. In this way, a single potentiometer can be used to

control the cut-off frequency of all four filter stages. Essentially, the same arrangement is used to control the highpass filter stages.

There is a slight drawback with this

Fig 3 Full circuit diagram for the DXer's tone control



# DXER'S TONE CONTROL

method of control, in that there can be a significant mismatch in the cut-off frequencies of the four stages in each filter. This is one respect in which the use of transconductance operational amplifiers is less satisfactory than using switched capacitor filters. Matching between the two resistances in each LM13600N is actually quite good, but there can be a severe mismatch between the two chips in each filter chain. This can severely reduce the overall performance of each filter. The ultimate roll-off rate remains at 24dB per octave, but there is a very gradual roll-off over a fairly wide frequency range before the full attenuation rate is reached.

A simple way around the problem is to have one pair of filter stages fed from the potentiometer via a fixed resistor and the other pair fed via a preset resistance. The latter can then be adjusted to match the cut-off frequencies of the two filter pairs. The two halves of each filter might not actually track properly over a wide range of frequencies, but in practice this arrangement works quite well as they track accurately over the relatively narrow range of frequencies that are of most importance. For example, the lowpass filter only needs to track accurately over a frequency range of about 2 to 4kHz in order to give good results. Tracking outside this range is of little importance as the filter will not normally be used outside these limits.

## Circuit operation

The full circuit diagram for the DXer's tone control appears in Figure 3. IC1 and IC2 are used in the lowpass filter, and C3 to C6 are the discrete filter capacitors. These are each connected at the output of a current-controlled resistance, thus forming a simple 6dB per octave lowpass filter in conjunction with each of these resistances. The circuit includes feed-

back resistors, though, and the filters are used in what are really two second order state variable filters rather than four separate first order filters. The bandpass outputs of each filter (pin 8 of IC1 and IC2) are of no value in this application and are simply ignored.

The advantage of using this configuration is that it gives a reasonably flat response followed by a rapid introduction of the full 24dB per octave attenuation. There is a slight peak in the response just above the cut-off frequency, but this is typically only about +1dB at the peak and is of no practical consequence.

VR2 is the tuning control for the lowpass filter and VR1 is the preset potentiometer which is used to match the cut-off frequencies of the two pairs of filter stages. The filters require dual-balanced supply rails, but in this case they are powered from a single 9 volt battery supply with R1, R2 and C1 providing a centre tap on the supply rails for biasing purposes. The output buffer stages of the LM13600N are Darlington Pair emitter followers, and these require discrete load resistors R6, R13, R17 and R24.

The highpass filter is based on IC3 and IC4. C9 to C12 are the filter capacitors, and these couple the input signals to what would normally be considered the outputs of the transconductance amplifiers. However, in the highpass mode the amplifiers are providing a shunt resistance to earth and are not really operating as amplifiers at all.

The filter is comprised of four separate stages, giving a frequency response characteristic which is inferior to that of the lowpass filter but adequate results nevertheless. Again, a potential divider (R43 and R44) is used to provide a centre tap on the supply rails for biasing purposes. VR3 is the highpass tuning

control and VR4 enables matching of the cut-off frequencies. D1 and D2 prevent the filter from cutting off and blocking the signal with VR3 fully backed off.

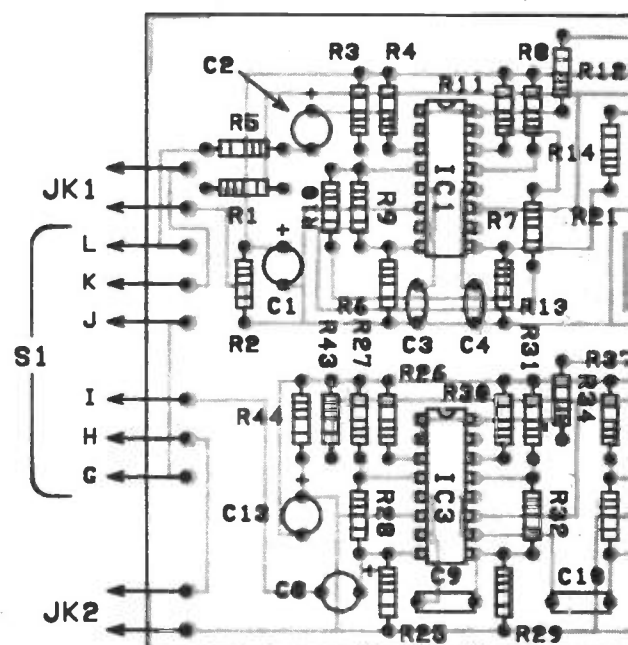
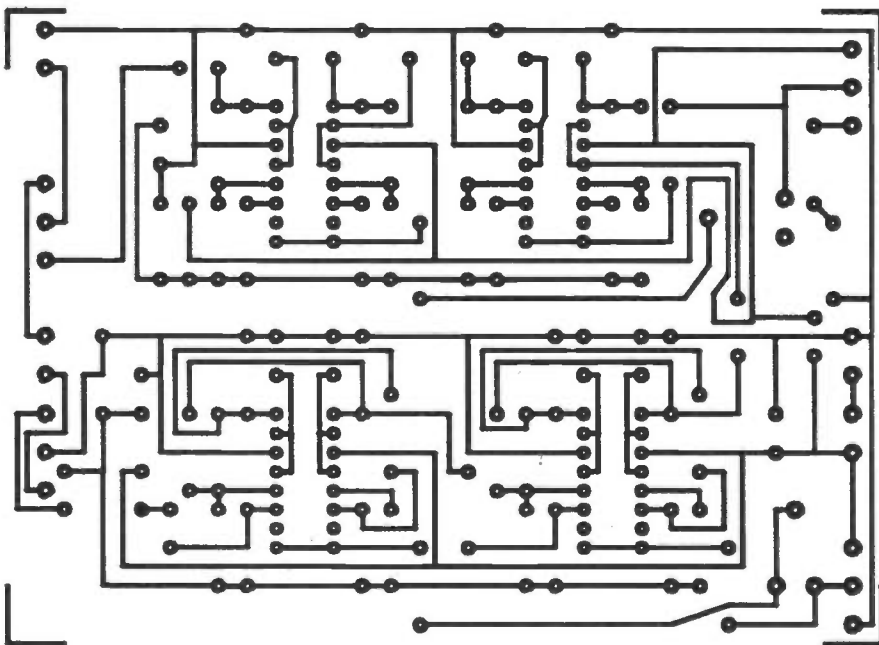
S1 enables the filter to be totally bypassed when it is not required. S2 is the on/off switch and the current consumption of the unit is about 12 milliamps. The output can drive most types of headphone or earphone, or an amplifier and loudspeaker combination can be fed from the output if loudspeaker operation is required.

Note that the LM13600N has 'diode bias' inputs which can be fed with a suitable bias current to give improved linearity, but these inputs are not normally used with filter circuits. These inputs (pins 2 and 15) are left unconnected in all the filter stages of this design. Also note that some suppliers now sell the LM13700N instead of the LM13600N. These two devices are virtually identical, and either type will operate in any stage of this circuit.

## Construction

Apart from the controls and sockets, all the components fit onto the printed circuit board, as detailed in Figure 4. Construction of the board should be quite easy provided that the correct components are used. In particular, the resistors must be miniature types and the capacitors must also be miniature (printed circuit mounting) types. In the case of C9 to C12 they should preferably be components with 7.5 millimetre (3.0 inch) lead spacing. It could be difficult to fit types having a different pitch into place properly, and there would be a real risk of damaging them in trying to do so.

Both preset potentiometers should be sub-miniature horizontal mounting types. The LM13600N is not a MOS device, but it is not a particularly cheap component either, and I would strongly



# DXER'S TONE CONTROL

recommend the use of 16 pin DIL sockets for all four integrated circuits. Be careful to fit the two diodes and the electrolytic capacitors with the correct polarity, and do not overlook the single link wire which fits just to the right of C12. Pins are fitted to the board at the points where it will eventually be wired up to the off-board components.

A plastic case having approximate outside dimensions of 125 by 50 by 190 millimetres will comfortably accommodate all the components, including the battery. A PP3 size battery can be used as the power source, but if the unit is likely to receive a great deal of use a higher capacity type will be more economic. Six HP7 size cells fitted in a plastic battery holder are suitable, and the connections to the holder are made via a standard PP3 style battery connector.

On the prototype the on/off switch and two tuning controls are mounted on the front panel, with the input socket, output socket and bypass switch being relegated to the rear panel. I used 3.5 millimetre jack sockets at the input and output, but these can obviously be any type of connector which fits in well with the particular equipment you are using. The on/off and bypass switches could be merged into a single control if desired. If this is done a switch having at least three poles will be required. The prototype filter is used as a permanent part of the author's receiving station and the bypass switch was only included to permit the unit to be switched out of circuit for comparison purposes. Some constructors may prefer to omit the bypass switch.

With all the components mounted in the case the unit is completed by adding the point-to-point wiring. This is mostly quite straightforward, but *Figure 5* (in conjunction with *Figure 4*) should help to clarify the wiring to S1 and the two tuning controls.

## Adjustment and use

The input of the filter connects to the headphone socket of the receiver via a twin-screened lead fitted with the appropriate plugs. The output of the unit can drive most types of headphone properly. With high impedance types parallel connection of the phones will probably give best results, but with low and medium impedance types series connection is preferable. With some low impedance types operation might be better with a resistor of about 47 ohms in value connected in series with the output. The unit can also drive a crystal earphone, but it will not work well with a low impedance magnetic type. It cannot be used with headphones that are intended for direct connection to loudspeaker outputs.

VR1 and VR4 must be given suitable settings before the unit is ready for use, and adjustment of these is much easier if an audio frequency signal generator and an oscilloscope or other form of signal level detector is available. Taking VR1 and the lowpass filter first, start with VR1 set for minimum resistance (set fully anticlockwise). Adjust VR2 to give around 2dB of attenuation at a frequency of about 3kHz, and then advance VR1 until it gives a further attenuation of about 2dB from the filter. A good response shape should then be provided by the filter.

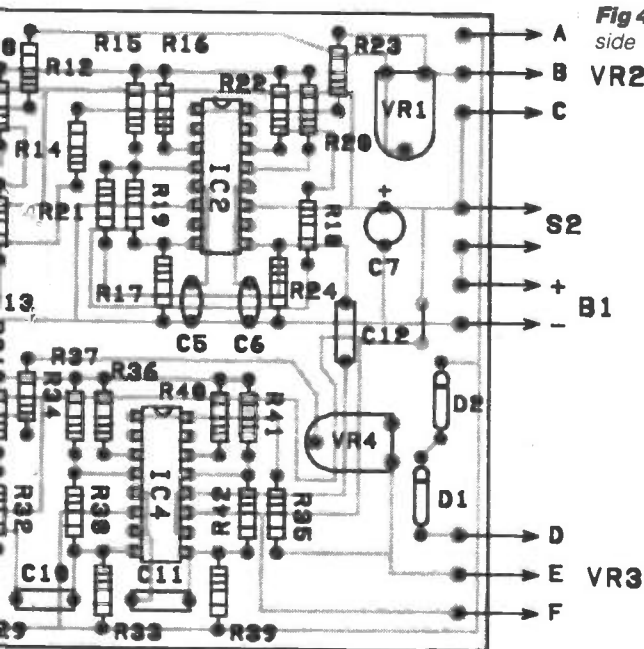
The highpass filter is adjusted in a similar fashion, but VR4 should be set for maximum resistance (fully clockwise) and VR3 should be set for around 2dB of attenuation at 300Hz. VR4 is then adjusted to give a further 2dB or so of attenuation.

In the absence of suitable test equipment, it is a matter of aligning the filters by ear, and this is most easily done with the aid of a noise signal. Most receivers will provide a good noise signal with the

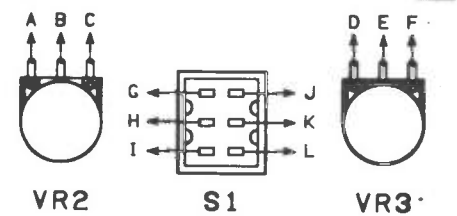


aerial disconnected and the volume well advanced, particularly if the set is tuned to a high frequency band. Again starting with the lowpass filter, set VR1 at minimum resistance and then adjust VR2 to give a noticeable reduction in the high frequency content on the noise signal. Then adjust VR1 to slightly reduce the high frequency content on the output. With the highpass filter set VR4 for maximum resistance, set VR3 to give a noticeable reduction in the bass content of the output signal, then advance VR4 just far enough to give a small further decrease in the bass content on the output signal.

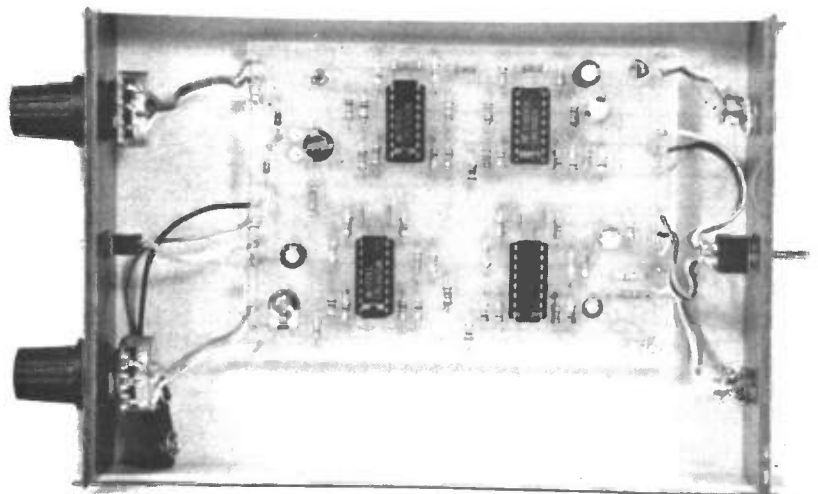
In use the two tuning controls are normally set to give no significant reduction in the bandwidth and are only brought into action when fairly strong interference is evident on the received signal. The best setting for the controls is a purely subjective matter, but in practice there is normally a well defined setting for each control where the best compromise between audio quality and freedom from interference is obtained. The cut-off frequencies of both filters can be adjusted over wide limits, and the unit can be used to good effect with both RTTY and CW signals as well as phone signals.



**Fig 4** (Centre) Details of the PCB. (Left) Copper side



**Fig 5** The wiring to the VR2, VR3 and S1



# Radio Modem

for successful data transmission  
on the amateur bands

by **K Wevill G4UKW**

Data transmission on the amateur bands is becoming more and more popular, as witnessed by the number of data transmission and reception programs that are available for most of the popular microcomputers. One of the oldest forms, and probably the most popular, is RTTY. In the early days, surplus teletype machines were used for transmission and reception using 5 bit Baudot codes. These machines have now been largely superseded by microprocessor based terminal units and microcomputers running data communication programs, but they still use the 5 bit codes at 45 or 50 baud which is relatively slow with a limited character set and no facilities for error detection. It should be noted here that Amtor, whilst having error detection and correction capabilities, is still basically RTTY.

A method of data transmission more appropriate to the microcomputer is ASCII, which is not only faster with a much larger character set, including upper and lower case letters, but it can also detect some transmission errors. Many of the data repeaters around the country, such as GB3RY (RB12) in Leicester, will accept ASCII as well as

RTTY and can convert data from one mode to the other mode.

One of the perennial problems associated with data transmission is that of the standard used. Without some form of agreement on the actual method of transmission, ie the baud rate and the mark and space frequencies, any attempt to send data would be doomed to failure. For RTTY the standard frequencies are 1275Hz space (logic 0), 1445Hz mark (logic 1) and baud rates of 45.5 and 50 baud.

The position is a little more complex for ASCII as there are several standards available. One is the Kansas City (CUTS) standard which is used on many microcomputers to record data and programs on cassettes. This uses 1200Hz space and 2400Hz mark, but this is unsuitable for radio transmission over long distances because the two tones are harmonically related and data corruption can occur when the signal becomes distorted. What is required for reliable communication is a system which uses non-harmonically related tones that will fit within the limited bandwidth of the voice frequency channel available.

Fortunately, the world of telephone

data modems provides the answer and *Table 1* shows some of the common modem standards and their parameters. These are designed to connect computer terminals to mainframe computers over limited bandwidth telephone lines with a simultaneous bidirectional full duplex or bidirectional half duplex link. Full duplex requires the use of two sets of frequencies; those used for transmit and receive depend on whether the modem is in originate or answer mode. The originate mode frequencies are used by the modem which initiates, or originates, the communication link to another modem operating in the answer mode.

The hardware required to implement a modem can be quite complex, especially if more than one standard is required. However, several semiconductor manufacturers now produce single IC modems for the various standards shown in *Table 1*. Some of the ICs are for use on a single standard while others are multi-standard. One of the latter types is the Advanced Micro Devices Am7910 World Chip, which is compatible with all the standards shown in *Table 1*.

Although the Am7910 was designed for

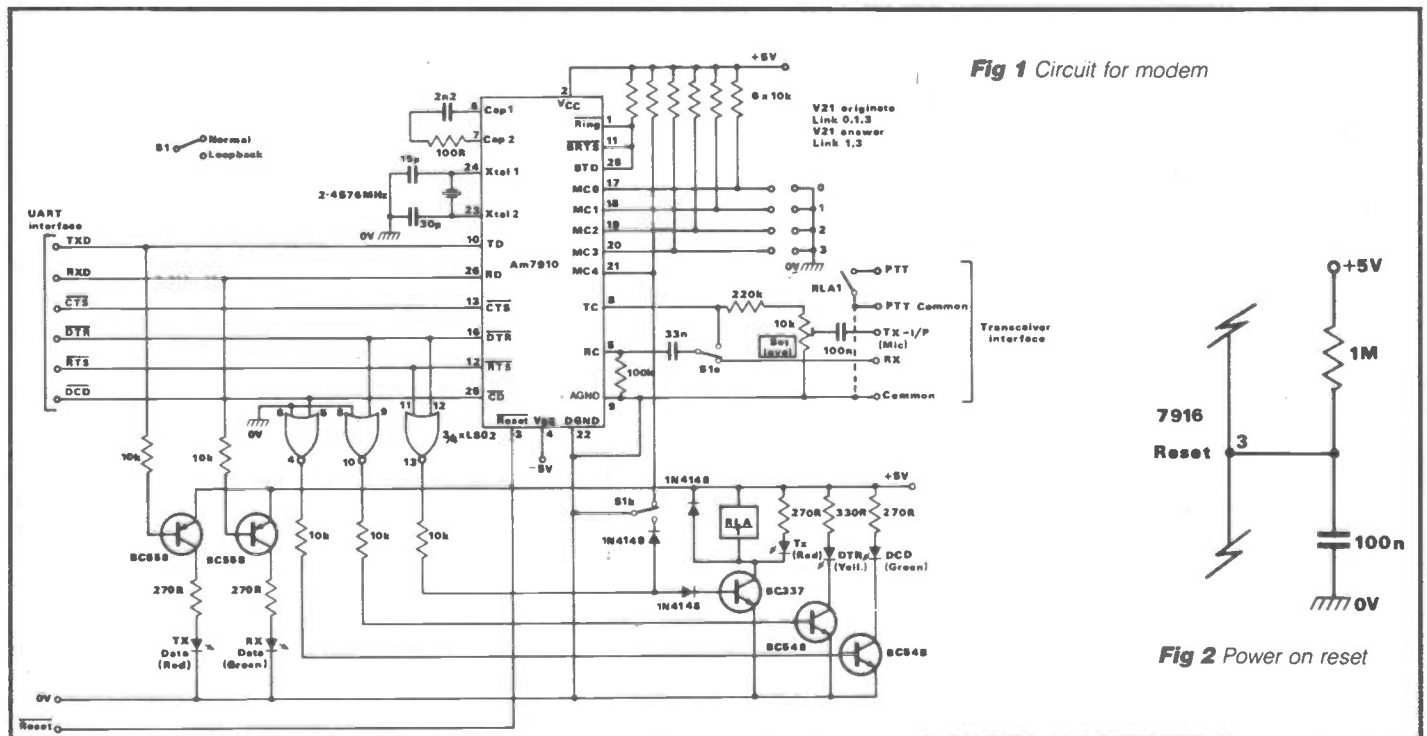


Fig 1 Circuit for modem

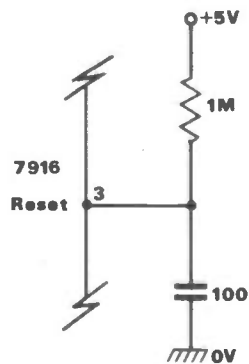


Fig 2 Power on reset

use in a telephone modem it is very easy to interface it with a radio transceiver to enable ASCII data to be transmitted and received over the amateur bands.

Before describing the radio modem circuit, a brief description of the Am7910 will be given. For a fuller description see the full data sheet and also the *AM7910 FSK Modem Technical Manual*, which also gives a description of modem operation.

The Am7910 is a complete FSK modem in a 28-pin package. It converts incoming analogue FSK signals to a TTL compatible serial data stream, and vice versa, by means of digital signal processing techniques. It can operate in all of the modes shown in *Table 1* selectable by means of five control lines. A standard 2.4576MHz baud rate generator crystal provides the clock. All the UART handshake signal lines are supported and there is provision for a back data channel for use in some of the modes. Digital filters on the transmit output and receive input minimise the need for external filters. Although the Am7910 is a fairly expensive IC, this is offset somewhat by its minimum use of external components and its versatility.

### Circuit

The circuit in *Figure 1* shows how the Am7910 is interfaced to a microcomputer with its own UART. Six TTL compatible lines to the UART are required, two data and four control. It is important that these lines should be connected, as control of the modem and the radio transmit/receive switching is accomplished via these. If the microcomputer UART output is RS232C or an equivalent standard, suitable buffers should be used to convert them to the TTL levels required by the modem. The Am7910 also requires a reset line which can be taken from the microcomputer reset line or alternatively the power on reset in *Figure 2* can be used. Power supply requirements are up to 200mA from the +5V supply and 25mA from the -5V supply. These can be taken from the microcomputer power supply if it has sufficient spare capacity but a separate power supply is advisable for reliable operation. A suitable one is shown in *Figure 3*.

Connections to the transceiver are shown in *Figure 4*. The modem TC (Transmit Carrier) output is fed into the microphone socket via the set level control. The PTT control lines are fed in via the same socket. The PTT common line can be connected to the audio common line, or left separate as required by the transceiver being used. In any case, the modem should be wired to look like the transceiver microphone. The modem RC (Received Carrier) input signal should ideally be taken from across the transceiver volume control, where it is unaffected by the volume control setting and usually at a level which is suitable for the modem. If this is

not possible the signal can be taken from the external speaker socket but care will have to be taken to set the volume control at a level suitable for the modem. Some experimentation will be necessary to find the correct level.

The standard used is set by four links: 300 baud CCITT V21 is the mode most commonly used for ASCII data. V21 originate is used for repeater contacts, as repeaters such as GB3RY operate in answer mode at all times. For simplex contacts one station must be in originate mode and the other station in answer mode. This makes contacts between

more than two stations difficult unless either a repeater is used or one or more of the stations can work in both originate and answer mode. This can be accomplished in this design simply by replacing link 0 by an SPST switch. In some other modems, especially those which use external filters, this switching is much more complex.

As stated earlier, the UART control lines are used not only to control the modem, but also to control the transmit receive switching; this avoids the use of a separate I/O part from the micro-computer and simplifies the interfacing

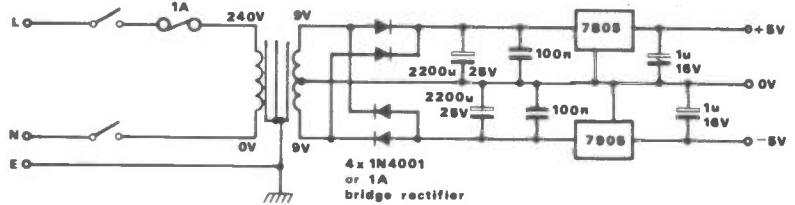


Fig 3 Power supply

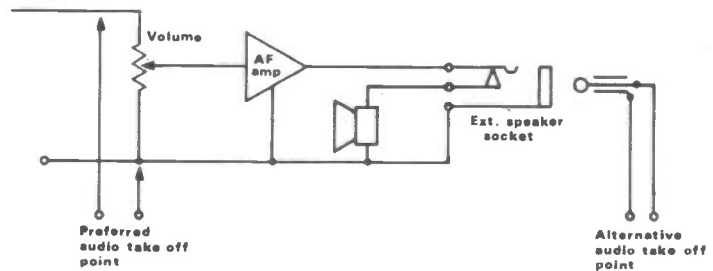


Fig 4 Transceiver interface

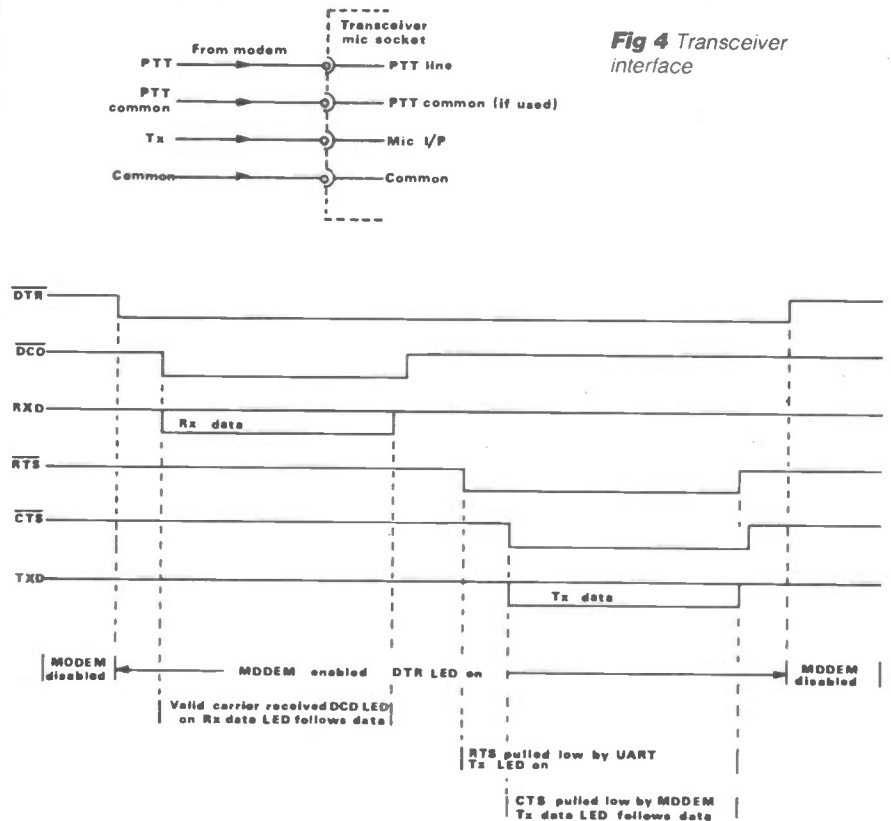


Fig 5 Timing sequence for V21 modem

# RADIO MODEM

Modem	Baud rate (BPS)	Duplex	Transmit frequency		Receive frequency		Answer tone freq Hz	Soft turn off tone Hz
			Space Hz	Mark Hz	Space Hz	Mark Hz		
Bell 103 orig	300	Full	1070	1270	2025	2225	-	-
Bell 103 ans	300	Full	2025	2225	1070	1270	2225	-
CCITT V21 orig	300	Full	1180	980	1850	1850	-	-
CCITT V21 ans	300	Full	1850	1650	1180	980	2100	-
CCITT V23 mode 1	600	Half	1700	1300	1700	1300	2100	-
CCITT V23 mode 2	1200	Half	2100	1300	2100	1300	2100	-
CCITT V23 mode 2 equalised	1200	Half	2100	1300	2100	1300	2100	-
Bell 202	1200	Half	2200	1200	2200	1200	2025	900
Bell 202 equalised	1200	Half	2200	1200	2200	1200	2025	900
CCITT V23 back	75	-	450	390	450	390	-	-
Bell 202 back	5	-	*	*	**	**	-	-

\* (BRTS LOW) and (BTD HIGH): 387Hz at TC  
 \* BRTS HIGH) or (BTD LOW): 0 volts at TC  
 \* Meets new CCITT R20 frequency tolerance  
 \*\* 387Hz at RC: BCD LOW  
 \*\* No 387Hz at RC: BCD HIGH  
 Frequency tolerance is less than  $\pm 0.4$ Hz with 2.4576MHz crystal. Except Bell 202 which is + 1Hz (1200Hz, mark)

**Table 1** Frequency parameters

and software control requirements.

The switching operates as follows: on reset the CTS (clear to send), DTR (data terminal ready), RTS (Request to Send) and DCD (Data Carrier Detect) lines are all high, logic 1, and the modem is inactive. All the LEDs are off and the transceiver is in receive. When the UART wants to transmit or receive data it pulls DTR low, logic 0, enabling the modem and lighting the DTR LED to indicate that the modem is active. It is important that DTR is high when the modem is powered up as this forms part of its initialisation procedure and erroneous behaviour could result if DTR was held low during reset.

When a valid signal is received from the transceiver the modem responds by pulling DCD line low, lighting the DCD LED. Simultaneously data appears on the RXD line, the Rx data LED switching on and off with the data. Both the DCD and RD signals are fed into the UART; DCD is

not essential to the UART operation as it only sets a bit in the status register which can be used by the micro if the software requires it.

To transmit data, the UART pulls the RTS line low, the modem responds after a short delay (400ms in V21 mode) by pulling the CTS low which enables the UART to transmit its data via the TXD line. The Tx data LED is switched on and off by the data being transmitted. This sequence is shown in Figure 5. When RTS goes low with DTR low the Tx LED and RLA, the PTT relay, are switched on, putting the transceiver into transmit via its PTT line. The relay overcomes any problems with earth loops or switching voltage levels that may be encountered if the transceiver PTT line was switched directly by the relay driver transistor.

### Loopback

The Am7910 has another mode of operation called loopback, which sets

the transmit and receive frequencies to the same values and allows the modem to be tested if its TC output is connected to its RC input. Then the UART sends data to the modem and should receive the same data back. In this circuit the switch S1 controls this mode of operation, S1a switching the modem RC input from the transceiver output to the TC output and S1b putting the modem into its loopback mode and also disabling the PTT relay to prevent the transceiver transmitting.

It is possible to use any UART to control the modem provided the RTS and DTR lines can be controlled. UARTs which do not have control of these lines can be used, but a separate output port will be necessary to provide these lines, which somewhat defeats the advantage of this circuit in not requiring a separate output part to control the PTT switching.

UARTs which fall into the latter class are the 6850, a 6800 family peripheral, and the 6402, a general purpose UART. Two UARTs which can be used with this circuit are the 6551, a 6500 family peripheral, and the 8251, an 8080 family peripheral. The circuit in Figure 5 shows how the author interfaced the modem to an 8251. This also shows how the modem clock and the UART 16x baud rate clock can be generated from a single

## Components list

### Resistors

R1	4M7
R2,3,6,7,8,10	10K
11,12,13,14,15	
R4,5,18,20	270R
R9	100R
R16	100K
R17	220K
R19	330R
RV1	10K

### Capacitors

C1,2	56p
C3	2n2
C4	33n
C5	100n

### Semiconductors

IC1	8251
IC2	4702
IC3	74LS02
IC4	Am7910

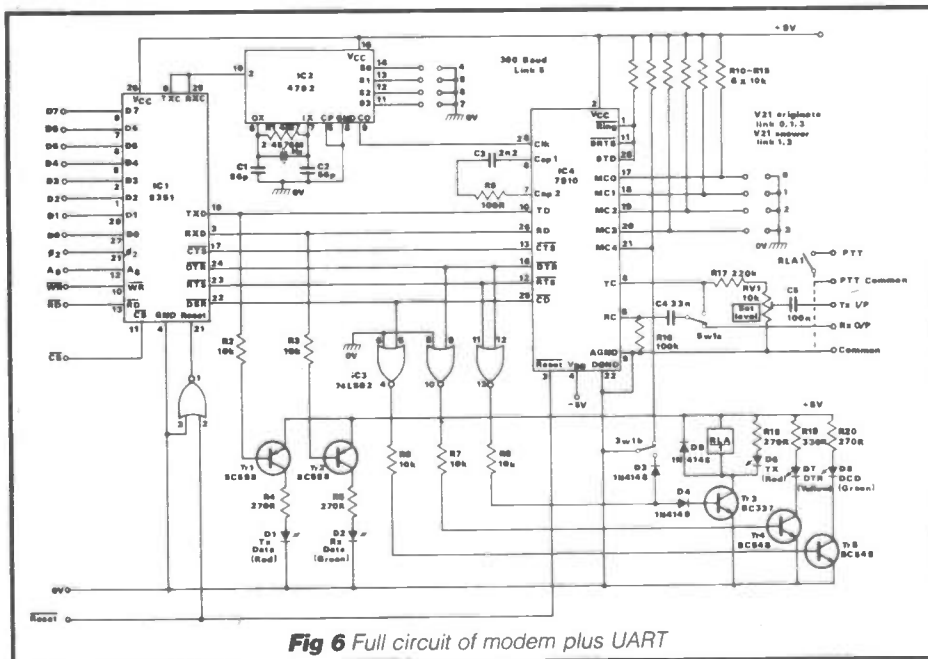
D1,6	Red LED
D2,8	Green LED
D3,4,5	IN4148
D7	Yellow LED

Tr1,2	BC558
Tr3	BC337
Tr4,5	BC548

### Miscellaneous

RLA	5V SP relay
S1	DPDT toggle switch
Xtal 1	2.4576MHz

DIL socket and switch or header



**Fig 6** Full circuit of modem plus UART

2.4576MHz crystal using a 4702 baud rate generator, enabling the baud rate to be easily changed by means of links 4 to 7. These links may be combined with the modem standard select links 0 to 3 in a single 8-way dual in-line switch. If the 6551 is used, the 4702 baud rate generator will not be required as the 6551 has its own built in baud rate generator running from a 1.8432MHz crystal.

In this case the modem crystal clock oscillator will be the same as shown in Figure 1.

The circuit in Figure 6 can be easily interfaced to any 8080 family microprocessor bus. If the circuit is to be used with a 6800 or 6500 family microprocessor the circuit in Figure 7 can be used to generate  $\overline{WR}$  and  $\overline{RD}$  signals from the 0 and R/W lines. In all cases CS must come from an address decoder. Consult the circuit diagram for the microcomputer to be used as  $\overline{WR}$  and  $\overline{RD}$  may already be generated, especially if 8080 family peripherals are being used. A suitable CS signal may also be available. If not

check the memory map for any spare gaps in memory usage where the UART could be placed.

### Construction

Construction is not critical and either a printed circuit or Veroboard can be used. The author's modem was built on a Eurocard prototype board measuring 160mm x 100mm. Layout is not critical but the connections between the crystal and the baud rate generator should be as short as possible. The links can take the form of a 16-pin DIL socket which can take either a 16-pin header wired with the appropriate links or an 8SPST DIL switch to set up the required mode.

### Software

As this circuit is intended to have as wide a range of usage as possible precise details of the software necessary to run a data communications program will not be given; each microcomputer and UART combination will have different requirements. Instead a general

outline on how to control the UART and modem will be given with a more detailed description of the software written for the author's microcomputer.

At this point it should be stated that although the software can be written in Basic it will be slow and may not capture all the data being transmitted, so it is recommended that the program be written in machine code. Most microcomputers have facilities for running programs in machine code and many have assemblers to enable the programs to be written. However, it is possible to use Basic during initial testing of the circuit - more details of that later.

Most microprocessor bus compatible UARTs have two sets of registers for data and control. The data registers consist of a transmit register and a receive register, usually at the same address. When the R/W line is low data can be written to the transmit register and when it is high data can be read from the receive register. The control registers enable the UART parameters, ie word length,

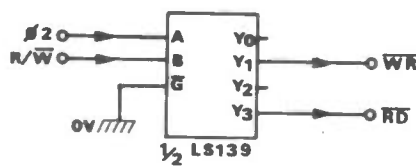


Fig 7 WR and RD generation

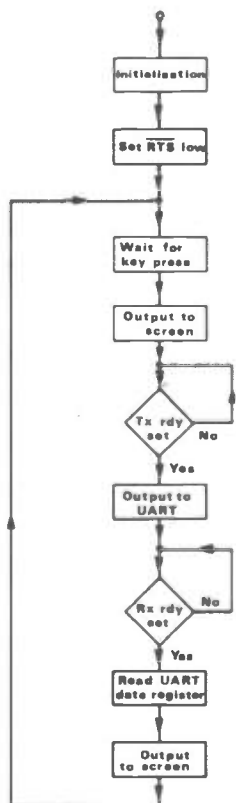


Fig 8 Test routine flow chart

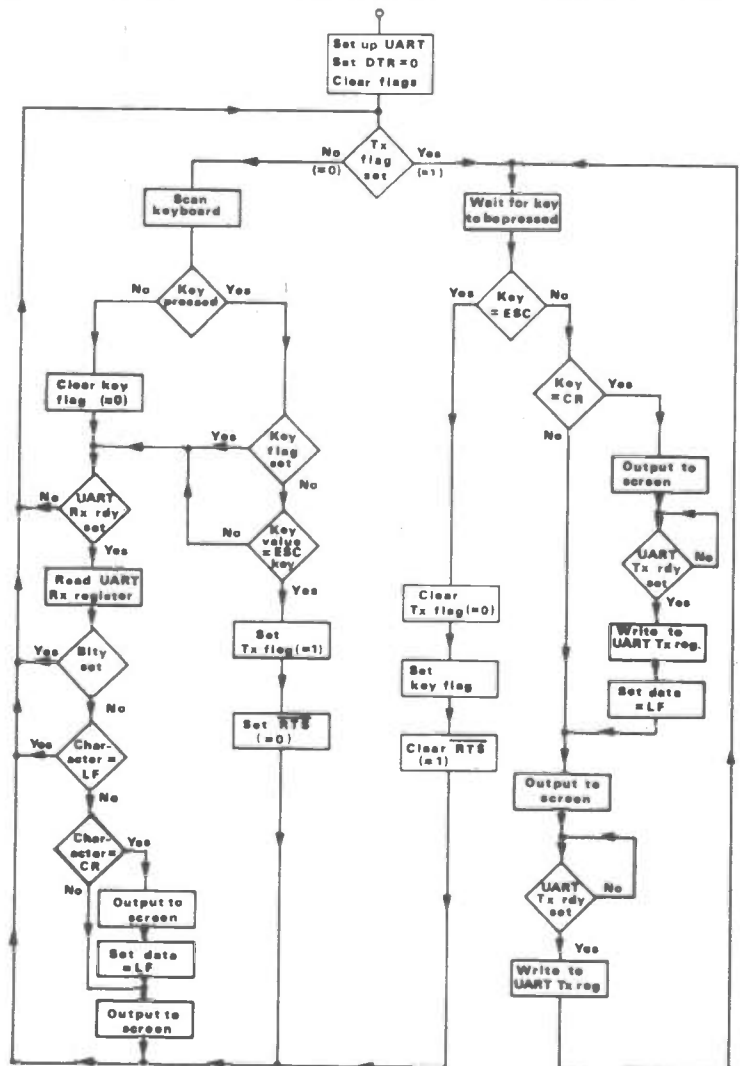


Fig 9

## 6502 ASSEMBLER FOR FIG 9

VW1	LDX @ 0; STX flag LDA SET, X; STA UART +1 INX; CPX @ 6; BNE VW1	Clear flags Set up UART parameters and set DTR low
VV4	Bit flag; BMI VV5	Test Tx flag. Branch to Tx routine if set
<b>Rx routine</b>		
VW2	JSR keyscan; BCC VV2 LDA flag; and @ #80; STA flag; JMP VV3 Bit flag; BVS VV3 CPY @ #3B; BNE VV3 LDA flag; ORA @ #80; STA flag LDA @ #27; STA UART +1; JMP VV4	Scan keyboard Clear key flag if no key pressed Test key flag Test key number for 'ESC' key Set Tx flag if 'ESC' key pressed Set RTS then jump to test Tx flag
VW3	LDA UART +1; and @ 2; BEQ VV4 LDA UART; BM1 VV4; CMP @ #0A; BEQ VV4	Test Rx RDY Read UART Rx data register. Branch to test Tx flag if bit 7 set or line feed detected
VW10	CMP @ #0D; BNE VV10; JSR screen; LDA @ #0A JSR SCREEN; JMP VV4	Add line feed if carriage return detected Output to screen
<b>Tx routine</b>		
VV5	JSR keyboard CMP @ #1B; BEQ VV6 CMP @ #0D; BNE VV8; JSR screen; TAY	Wait for key to be pressed If 'ESC' pressed branch to VV6 routine
VV9	LDA UART +1; and @ 1; BEQ VV9 STY UART; LDA @ #0A	Wait for Tx RDY (if carriage return detected insert line feed and output to UART)
VV8	JSR screen; TAY	Output to screen
VV7	LDA UART +1; and @ 1; BEQ VV7 STY UART; JMP VV5	Wait for Tx RDY Output to UART then jump to keyboard
VV6	LDA flag; ORA @ #40 and @ #40; STA flag LDA @ #07; STA UART +1; JMP VV4	Set key flag Clear Tx flag Clear RTS then jump to test Tx flag

Flag - bit 6 = key flag, bit 7 = Tx flag

UART - Address of UART data registers

UART +1 - Address of UART control and status registers

Keyscan - Routine to scan keyboard. Return with C = 0 if key pressed. Key number in Y

Keyboard - Routine to wait for key to be pressed. Return with ASCII code in A

Screen - Routine to output data in A to VDU. Preserves A

Addresses set to set +5 contain the following HEX data: EE, 07, 00, 40, EE, 07

parity, clock divider etc, to be set up and DTR and RTS lines to be controlled. The data sheet for the UART used will give more precise details on how the control registers are used and how to set them up.

### Programming details

The modem has to be set to the required standard; CCITT V21, originate or answer, at 300 baud is recommended. Firstly set the Am7910 mode by means of the links then set the UART in software. Baud rate is set by the links as in *Figure 6* or by software in the case of the 6551. The software initialisation sends a sequence of commands to the control register which should set up the UART with the following parameters:

Asynchronous mode

8-bit word length

2 stop bits

No parity

$\times 16$  baud rate factor

RTS set high and DTR set low

Once initialised the modem is ready to transmit and receive. If a valid carrier is received the DCD LED will come on and the Rx data LED will flash in time with the

incoming data. To display the data all that is necessary is a loop to read the UART status register, check the RXRDY bit, set when the Rx data register is full, and when set read the data register then display it on the screen. Reading the data register automatically clears the RXRDY bit.

The transmit routine should first set RTS low, lighting the Tx LED, then go into a loop which waits for a key to be pressed, displays the resultant key press on the screen, checks the TXRDY bit in the status register, which is set when the transmit buffer is empty and the UART is ready to transmit, and then writes to the data register which automatically transmits the data.

Each loop should also have a means of transferring to the other loop and setting the RTS line accordingly, high for receive and low for transmit. This can be done either by a switch or by a key on the keyboard. It should be noted that when the modem is in a duplex mode such as V21, the data receiver is still active when the data transmitter is running. This enables the modem operation to be tested without using a radio transceiver.

The program is relatively simple and should follow the flow chart in *Figure 8*. S1 should be in loopback mode. The program waits for a key to be pressed, displays it on the screen then outputs it to the UART data register. It then reads the data register and displays it on the screen. The result is that when a key is pressed it is displayed twice on the screen, and the Tx and Rx data LEDs flash in synchronism. In loopback mode when RTS is set low, the DCD LED should light and the Tx LED remain off.

As an alternative the following simple Basic routine could be used. The UART should first be set up by *poking* the UART control register with its set-up commands then the following program should be run:

```
FOR A = 0 TO 255
```

```
POKE UART, A
```

```
LET B = PEEK UART
```

```
PRINT B
```

```
NEXT A
```

```
END
```

UART = Address of UART data register

This should print out 0 to 255 on the screen.

These programs should prove that the circuit is working and give a feel for the operation of the modem and the requirements for the full data transmission program.

It is advisable to start with a simple program and work up to an all-singing-all-dancing one with several preset messages, set at a single key-stroke, type ahead buffer, etc.

The flow chart in *Figure 9* shows one of the programs written by the author. This has several features which can be useful when writing your program.

1) Transmit/receive switching is by means of the Tx flag controlled by the 'ESC' key. On receive, the program scans the keyboard and if the 'ESC' key has been pressed and the key flag is clear, it sets RTS and the Tx flag. On transmit, if the 'ESC' key is pressed it sets the key flag and clears RTS. The key flag ensures that if the 'ESC' key remains pressed the program ignores it until it is released, otherwise the program would immediately go back into transmit.

2) Received characters are ignored if bit 7 is set, preventing rubbish being printed as only bits 0 to 6 are needed for ASCII.

3) Line feeds are ignored but are inserted whenever a carriage return is received.

4) On transmit carriage return, line feed is transmitted whenever carriage return is pressed.

The 6502 assembler code for use with the 8251 circuit in *Figure 6* and the flow chart in *Figure 9* is shown in *Figure 10*. It should be noted that this is mainly for reference and that different micro-processors will require different codes, but it shows the general approach taken. It is hoped that this article will encourage more people to use and experiment with ASCII data transmission as many of the data repeaters are under-used. **REW**



# An Introduction to Communications Satellites

The third part of Alan Pickard's occasional series

**A**lthough we have previously referred to the satellites we are particularly interested in (UoSAT 9 and 11, Oscar 10 and the NOAA series – see November '86 and January '87) as communications satellites, they are, strictly speaking, in the amateur category.

A true communications satellite operates in the Gigahertz frequency range and carries maybe hundreds of traffic channels (eg telephone, data) which are operated on a commercial basis. Although UoSATs, for example, transmit at 7-10GHz in addition to VHF, they are not classed as communications satellites as they are non-commercial.

Having established some basic operating requirements and details in the previous article, we can now look in more detail at the facilities provided by one particular system, ie one for receiving UoSAT signals. Also, we can consider how such a receiver operates.

## Receiving UoSAT signals

One (complete) system available for use with a home computer such as the BBC micro (and also Electron, Spectrum, Spectrum Plus) is the ASTRID, designed by Steve Webb and available from SRL Communications in Yorkshire.

The ASTRID is a radio receiver and hardware decoder contained in a single steel case. It also includes an audio stage complete with speaker. A power supply with built-in plug and also a dipole aerial and cable are included. The system is complete, apart from a suitable home computer with serial port (RS232, RS423) and an ordinary cassette recorder.

Figure 1 is a block diagram showing connections to ASTRID (refer also to Figure 2 in the January issue).

## Information content

Information transmitted by UoSAT scientific satellites contains telemetry data and news bulletins. The telemetry data itself contains details of experiments or measurements being made by

on-board sensors and also information about electronics circuits and battery voltages. The news bulletins contain information which is regularly transmitted from the ground station at the University of Surrey. This news concerns such things as weather satellite information, orbital parameters of UoSATs, Oscars, NOAA and general satellite and space news (eg space shuttle reports).

'Digitalker' speech information is also transmitted which is decoded as spoken numbers in the ASTRID speaker. These are then decoded manually using a look-up table or software.

There are a total of 60 telemetry readings and 45 experimental status points.

## Operating ASTRID

UoSAT satellites transmit their telemetry and news information which is frequency modulated on to a 145.825MHz carrier. The modulation is 1200 bauds. This is decoded internally and audio tones of 1200Hz (logic 0) and 2400Hz (logic 1) are fed into the cassette port. This is in the form of asynchronous data.

The system has been designed to operate without connection to a computer, ie it can capture data by a received radio signal opening the squelch on the ASTRID receiver and also switching on the cassette recorder via its remote socket. On the BBC micro, this is exactly the same system used by the cassette interface port. This means that the ASTRID can be left unattended (drawing 100mA at 16 volts on standby), no power being drawn of course (from the batteries) until the cassette is remotely switched.

Following a satellite 'pass' and successful reception and decoding, the results which should be stored on cassette can be loaded into the micro, say next morning, and examined on screen or printer. (For convenience, this information can be retained on cassette or transferred to disc).

The ASTRID package is supplied with a

demonstration data tape, containing typical data information which would be received following a satellite pass. A program is also included which 'decodes' the data. However, this only provides the raw data formatted on the screen. This can be manually decoded via the coding method in the ASTRID handbook. This is fairly tedious and is better achieved using suitable software from AMSAT-UK, in the form of two discs called SATPACK (see references).

The first disc provides a map of the Earth with satellite orbits shown with respect to time and is of real practical use in establishing when the satellite will next appear over the horizon. The second disc decodes fully the telemetry data received from a UoSAT satellite and displays it on the screen or printer.

Providing that the aerial is appropriately sited, an adequate signal and sufficient data can be received from a pass, and therefore tracking of the satellite is not necessary. This is because of the (VHF) frequencies being used and also the relatively low altitude (500km) compared to communications satellites operating at 36,000km (22,370 miles)!

A typical aerial would be a 1 metre dipole, being omni-directional and therefore relatively low gain. Higher gain can be achieved by the addition of a reflector, making the aerial more directional and therefore approaching a tracking requirement.

At this point it is worth mentioning that the orbit time of a UoSAT satellite is approximately 90 minutes, with an effective shift of 24 degrees of its orbital path due to the rotation of the Earth. A simple calculation, 360 (degrees) divided by 24 (hours) represents 15 different polar orbits of the Earth every 24 hours. Also, it is useful to know that the maximum pass time is no more than ten minutes.

## Specification

The ASTRID unit contains a super-heterodyne receiver operating at

# COMMUNICATIONS SATELLITES

145.825MHz. Its bandwidth is 12kHz and its sensitivity 0.2 $\mu$ V. Audio output is 0.3W into its 8 ohm speaker. Aerial impedance is 75 ohms. As already stated, dc consumption on standby is 100mA at 16 volts.

The output level to tape is 50mV p-to-p and the decoder input level 200mV p-to-p. A TTL output is also provided if required for external logic circuits, such as the RS232 input to a computer.

Data transmitted from UoSAT is in the same form as that required by the BBC micro cassette interface, ie asynchronous data (AFSK) with tones of 1200Hz (logic 0) and 2400Hz (logic 1). The baud rate is 1200, utilising TTL signals as ASCII text. The format is 1 start, 7 data, 1 even parity and 2 stop bits (11 total).

## Software

Although the ASTRID package includes a cassette with a sample quantity of data and simple decoding programs for UoSAT 1 and 2, additional software is available to decode and display the information.

Unless a user wishes to write his or her own decoding programs, software such as SATPACK can be obtained, as already mentioned. This consists of two discs. The first one displays satellite orbit information in tabular or map form and also sends data to the RS423 port to enable the real time control of a tracking aerial, if required.

The second disc contains a suite of sophisticated data handling programs, specifically written to decode the telemetry from UoSAT 2. This data is 'processed', ie translated into numerical data which is analysed for errors and can then be stored on disc as a processed data file (see *References* for price details, etc). Other UoSAT software is available from SRW Communications or AMSAT-UK. Software is also available for the Spectrum 48K and Spectrum Plus.

## Other micros

Although hardware connection to the system is very easy and straightforward in the case of the BBC micro, it is also possible to easily connect the ASTRID decoder output to the Electron (with the official serial port) and to the Sinclair Spectrum (with the Sinclair interface 1 unit). The experienced micro enthusiast should not find it difficult to interface to his or her machine, as the data format is straightforward (serial) TTL ASCII.

In a future article I will describe the Unilab system for UoSAT reception and decoding and also a system for NOAA weather satellites.

## Interference

Most micros generate RF interference, so problems may be encountered when using the standard (low gain) dipole, especially at low altitude - like ten feet! For this reason, ASTRID is designed to be easily operated 'off-line' and data captured without the micro being used (or even switched on).

If the unit is operated in a low electrical interference area, it is possible to receive data 'live' from an overhead pass, but then the data cannot be stored on cassette or disc. Also, problems may arise due to RF interference generated by the computer itself.

The problem of interference needs to be taken into consideration but should not prevent reception, even if it depends on 'auto' reception during the night.

## Scientific usefulness

The following quotation from the University of Surrey Spacecraft Engineering Research Unit, Department of Electrical Engineering, effectively defines the mission objectives:

'1. Provides radio amateurs and professional scientists with a readily available tool to carry out studies of the near-earth electromagnetic environment and the relationship between solar and geomagnetic disturbances and their effect on radiowave propagation between HF and microwave frequencies.

'2. To stimulate a greater degree of interest in space science in schools, colleges and universities by active participation, by ensuring that the experiments and housekeeping data are transmitted in such a manner that they are easily available, not only to professional scientists, but also to those users with very simple, low cost ground stations' (eg *Radio & Electronics World* readers!).

'3. To broaden the scope of the Amateur Space Programme and to cater for the interests of the amateur scientist.

'4. To evaluate novel methods and new frequencies for use with later amateur spacecraft.

'5. To examine and demonstrate the feasibility of the design and construction of a relatively small and inexpensive spacecraft in this country, capable of a significant contribution to the scientific, engineering, amateur and educational communities.'

## Conclusion

We have looked at an example of one commercially available complete system, the ASTRID, for UoSAT satellites. This should have provided an insight into what is required in terms of hardware (radio and computer) and software (for decoding and display). Hopefully, the aspiring satellite enthusiast will appreciate that dealing with satellites is not necessarily complex, but requires a certain ability to see it as a system rather than a simple, self-contained unit.

As with most things requiring a little thought and effort, the rewards are high, satellite reception bringing together many aspects of radio, electronics and computing.

In a future article I hope to cover the reception of weather map information for display in map form, from the NOAA series of satellites. Later in this occasional series other satellite systems will be examined, including Oscar 10 (non-UoSAT) and Russian RS amateur satellites. Also, other aspects of amateur satellites, such as two-way amateur communication and electronic mail, as featured on UoSAT 2, will be covered.

## References

Part 1 (November '86 *Radio & Electronics World*)

Part 2 (January '87 *Radio & Electronics World*)

ASTRID review, Ken Michaelson, July '86 *Radio & Electronics World*.

## Suppliers

AMSAT UK,  
94 Herongate Road,  
London E12 5EQ

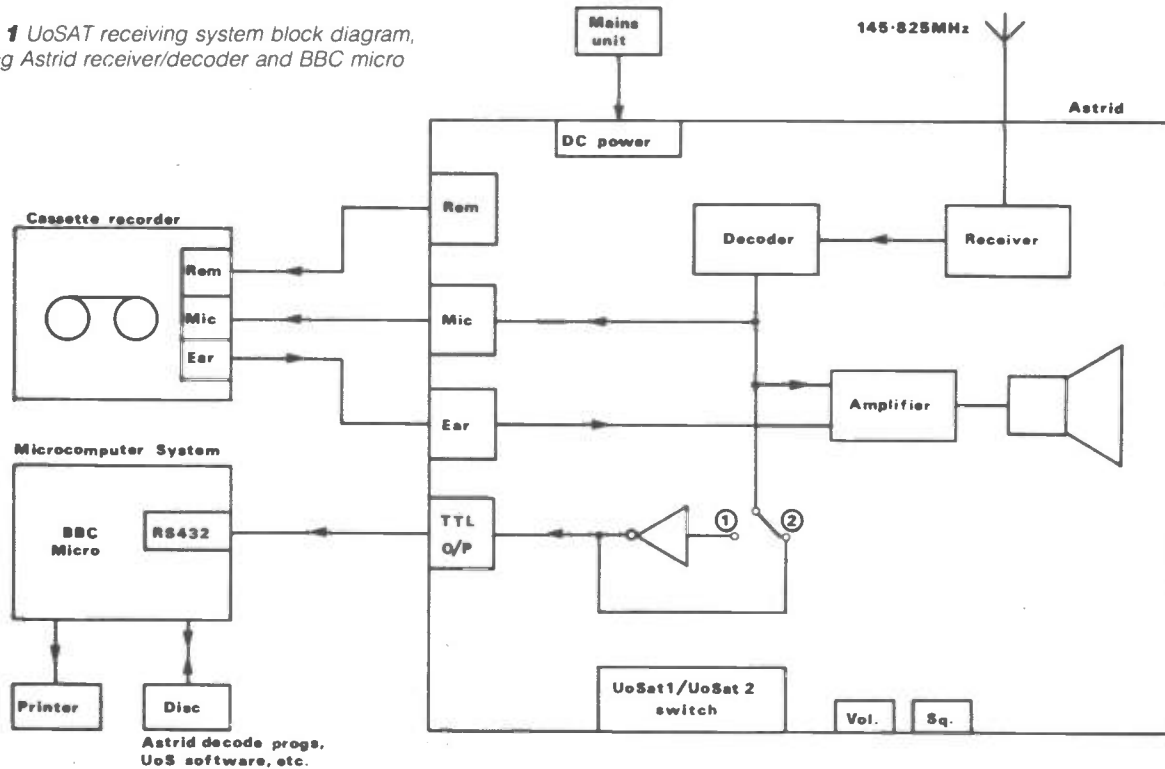
SRW Communications Ltd (Steve Webb),  
ASTRID House,  
The Green,  
Swinton,  
Malton,  
N Yorks YO17 0SN.  
Tel: (0653) 697513.

REW



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**Fig 1** UoSAT receiving system block diagram, using Astrid receiver/decoder and BBC micro



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UoS software, etc.

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# THE FRG-8800 COMMUNICATIONS RECEIVER

Although this Yaesu Rx was tested at Andreas Piróg's QTH in Sweden, this review will be of equal relevance to listeners in the UK

**T**he FRG-8800 communications receiver was designed by a large and well-established supplier to the amateur radio market, Yaesu.

The earlier models, the FRG-7, FRG-7000 and FRG-7700, have been discontinued and are no longer widely available. These receivers became very popular among SW fans over the past ten years.

The new FRG-8800 is a modern high-tech communications receiver featuring a dual conversion superhet system, microcomputer technology and a variety of built-in functions and optional facilities. According to the technical parameters, as specified by the manufacturer, the set covers the frequency range from 150kHz to 29.999MHz and 118-173.999MHz VHF optional. Modes covered as standard are AM, SSB (LSB/USB), CW and FM (optional). Sensitivity and selectivity figures are displayed in *Table 1*.

Frequency stability is 50Hz any thirty minutes, power requirements are 100/120/220/240V ac 50/60Hz or 12V dc operation (optional). Antenna impedance is 50 $\Omega$ /500 $\Omega$ . Dimensions are 334 x 118 x 225mm (WHD), weight 6.1kg. (No information about the FRG-8800's 1st IF, image rejection or dynamic range was available from the manufacturer).

The FRG-8800 is housed in a silver-grey

metal cabinet. The front panel, on which push-buttons and knobs are generously spaced and logically grouped, is made of plastic. The set comes standard with a variety of useful features and controls: internal loudspeaker, 21-button keypad for digital frequency entry and programming of the 12 internal memories and multi-function scanner, squelch, tone, fine tune and ATT controls, frequency lock, fast/slow tuning rate, flexible AGC, wide/narrow width noise blanker, dimmer and a double 24-hour clock (local time and UTC)/timer are all provided. Additionally, an 8-bit CPU controlling all of the tuning, mode selection, scanning, memory and clock functions is featured. The light green digital LCD display panel indicates tuned frequency with an accuracy to the nearest 100Hz (6 digit), selected memory channel, SINPO/S-meter, narrow/wide bandwidth selection, scanning status, local time and UTC. On the back panel, low and high impedance antenna connectors are provided.

The FRV-8800 VHF converter (optional) can be installed inside the receiver. The FRG-8800 is fully compatible with the so-called CAT (Computer-Aided Tuning) system. Rounding off, the FRA-7700 indoor active antenna, FRT-7700 passive RF preselector, FRV-7700 external VHF

converter and FF-5 low pass filter (options) are also fully compatible with the FRG-8800.

## Performance impressions

The author borrowed a sample of the FRG-8800 for a couple of days (and nights) for testing. The model under scrutiny incorporated standard factory IF filters—the 6.0kHz wide and the 2.7kHz narrow. No optional VHF converter was installed.

The tests were performed with 3 different aerials: a simple wire antenna approximately 6m in length, a 41m long wire with co-ax down-connection and the Datong AD270 active. In addition, a Panasonic DR29 multi-band portable receiver was used as a back-up set, along with the semi-professional JRC NRD-515.

When the FRG-8800 was switched on, the set sounded promising: the relatively quiet circuitry, extremely pleasant soft audio, good frequency stability and an adequate slow/fast tuning rate really made an excellent impression. Though the rig incorporates some 47 different controls, it is handy enough and straightforward to operate. The large and distinct digital LCD frequency display, with its light green background illumination, is virtually state-of-the-art.

The set proved to be able to handle strong RF signals from longer wire antennas. Except for a few insignificant overloadings found on 49 and 31m, there were generally no problems when a 41m long wire antenna was attached to the rig. Also, with the Datong AD270 active, the set works commendably.

Nevertheless, my initial fascination was short-lived. Firstly, the push-buttons are annoyingly tiny and their quality is below average. The fine tune control, for example, is nearly useless, due to its meagre, pygmy-sized design. Also, the 'bar-graph' type SINPO/S-meter is, in my opinion, a sort of annoying, second-rate 'hocus-pocus' feature—a solid, analogue signal strength indicator would have been preferable. Secondly, the FRG-8800's IF selectivity is sub-standard in



this class: the factory 6.0kHz wide ceramic filter is completely useless on short wave, whereas the 2.7kHz narrow ceramic allows for non-critical SW broadcast reception only. Thirdly, the FRG-8800's usable sensitivity, although generally sufficient for a variety of SW listening applications, does not seem to be quite up to DX standards, as the following story reveals.

At 2200 UTC a strong and interference-free signal from Radio Nacional, Asunción, Paraguay, on 9.734.7kHz was logged with both the Panasonic DR29, using its built-in telescopic antenna, and the FRG-8800/41m long-wire. However, with a simple 6m aerial attached to the FRG-8800, this outlet became completely inaudible. Similar performance was also observed when logging RAE Buenos Aires, Argentina, on 9.690kHz.

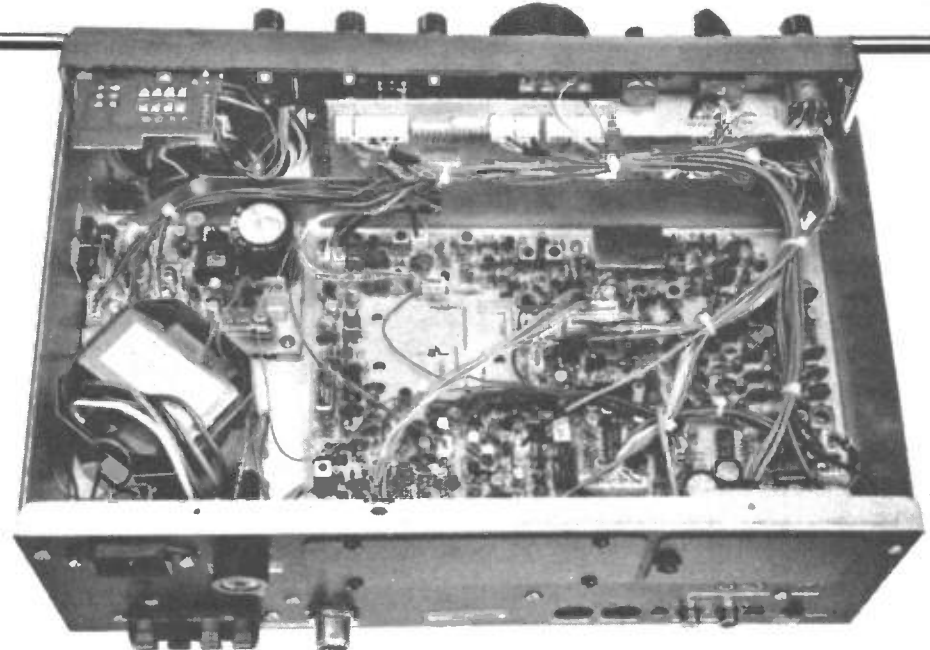
Ecos del Torbes, Venezuela, 4.980kHz was heard at about 2140 UTC with a good, legible signal on the DR29, whereas the FRG-8800 only offered a non-reportable hiss from that station.

At 2335 UTC, Radio Rumbos, Venezuela, 4.970kHz with a reasonably strong signal was audible on both the DR29 and the JRC NRD-515. However, the configuration FRG-8800/41m long-wire antenna provided a barely reportable reception on that frequency. *Note:* the squelch and ATT controls were both off.

A clear, readable signal from La Voz de Carabobo, Venezuela, 4.780kHz was noted at 2235 UTC on the DR29, whereas the FRG-8800 had nothing to report on this frequency, except for some QRM from nearby operating RTTY stations.

At about 2115 UTC, a weak signal from Radiodifusora de Amazonas, Manaus, Brazil, on 4.805kHz was heard on the DR29. In contrast, the FRG-8800/41 resp 6m wire antenna vented a distinct and interference free BC programme in a Slavic language.

Apropos images, the FRG-8800 turned out to suffer from very serious image rejection problems. A myriad of false signals from both VOA, Radio Svoboda and Radio Moscow World Service multi-lingual programme transmissions were heard throughout the amateur, tropical



and some major international broadcasting bands. To give readers some idea of how much the set can manage, I have included a list of some 160 frequencies (in kHz) on which strong (S5-7 or more) image signals and harmonics were found (Table 2).

Each of the listed 'ghost' signals was carefully checked out and compared against the parallel performing JRC NRD-515. Also, with a simple, short-wire outdoor antenna of some 6m attached to the FRG-8800, this problem was still persistent.

So far, my findings have been confirmed by reliable Danish and Swedish sources, complaining about the FRG-8800's propensity to produce false signals.

Performance on the 19, 16 and 13 metre bands was superior to that on the lower frequencies. In particular, the high-powered outlets from the Middle East (UAE Dubai, Kuwait, Riyadh and Tel-Aviv) and Africa (RTM Tangier, Abis, Tripoli and RSA Johannesburg) were received with commendable signal levels and outstanding audio fidelity. Likewise, the reception of long and medium wave signals from powerful BC

stations was unusually pleasant, thanks to the FRG-8800's remarkable audio characteristics.

SSB (LSB/USB) reception was uninspiring, partly because of the dismal value of the nominally 2.7kHz (sounds like 3.7kHz) narrow IF bandwidth, and partly because of the very clumsy fine tune control.

The AGC performs commendably. However, no AGC off-setting is provided, which is a drawback. Ancillary functions such as scanning of preselected chan-

**Table 1**

<b>Sensitivity (S+N/N 10dB, 50Ω)</b>			
150kHz - 1.6MHz	AM		
1.6 - 29.999MHz	30μV	SSB/CW	FM
118 - 173.999MHz	4μV	0.4μV	1μV
	10μV	1μV	2μV
<b>Squelch sensitivity</b>			
	AM, SSB, CW		FM narrow
1.6 - 29.999MHz	<2μV		<0.5μV
118 - 173.999MHz	<4μV		<1μV
<b>Selectivity (-6/-50dB)</b>			
	AM wide		6/15kHz
	AM narrow		2.7/8kHz
	SSB/CW		2.7/8kHz
	(-6/-40dB) FM narrow		12.5/30kHz

**Table 2**

2.493	5.025	11.095	13.690	26.890
	5.030	11.330	13.900	26.916
3.025	5.050	11.536	13.920	26.970
3.780	5.060	11.910	13.940	26.990
3.920	5.065	11.920		
	5.070	11.930	14.265	27.455
4.700	5.076	11.942	14.274	27.466
4.710	5.080	11.945	14.415	27.525
4.750	5.090	11.955	14.489	27.580
4.760	5.095		14.695	27.625
4.770	5.100	12.005	14.720	
4.775	5.116	12.143		28.835
4.790	5.205	12.170	15.210	28.935
4.805		12.195	15.215	28.950
4.830	7.100	12.210	15.227	28.960
4.840	7.730	12.390	15.236	28.975
4.870	7.840	12.850	15.250	
4.885	7.960	12.930	15.275	29.005
4.890		12.950	15.280	29.014
4.905	8.340		15.290	29.035
4.909	8.370	13.165	15.835	29.110
4.920	8.390	13.180	15.885	29.234
4.927	8.541	13.190	15.936	29.260
4.935	8.655	13.200		29.294
4.945		13.215	16.825	29.366
4.952	9.010	13.258	16.930	29.455
4.960	9.260	13.303	16.935	29.475
4.970	9.270	13.315	16.950	29.528
4.985	9.325	13.330		29.545
4.995	9.450	13.335	21.680	29.636
5.001		13.370	21.685	29.645
5.007	10.465	13.390	21.910	29.753
5.010	10.905	13.395	21.930	29.790
5.015	10.905	13.550		29.825
5.020	10.931	13.365	24.040	29.855

# THE FRG-8800

nels stored in memory, clock, timer etc work perfectly.

After 4 days on the air it was time to relax; just before midnight Middle European time, I tuned to the Polskie Radio Warszawa Programme 1, Poland, on long wave 227kHz, and was enjoying a Ray Charles concert for a while. Shortly after that, I switched over to short wave, 25m. Conditions were superb; RAE Buenos Aires, Argentina, on 11.710kHz came through clearly with its magnificent vocal tango music programme being transmitted. In both cases, the FRG-8800 provided first class reception with nearly hi-fi audio quality.

## Evaluation

Since the FRG-8800 entered the short wave market a few years ago a number of serious test reports/evaluations published have indicated that the set meets the standards of modern radio technology and is good value for SWLs and DXers.

According to my personal experience with earlier models from Yaesu (although I have never owned any myself), only the FRG-7 model, if properly modified, was capable of providing outstanding SWL/DX reception. Indeed, the FRG-7000 and in particular



the very popular FRG-7700 were both poor performers. The FRG-8800 appears to continue this mediocre tradition, albeit in new, microcomputer-controlled clothes.

Overall, the FRG-8800 revealed the following:

### Strong points

- unusually pleasant audio.
- quiet circuitry.
- acceptable dynamic range.
- good frequency stability.
- 100Hz frequency resolution.
- straightforward operation.

### Shortcomings

- expensive.
- insensitive.
- unselective.

- poor image rejection.
- AGC not defeatable.
- modest SSB performance.

In terms of serious SW reception, the set does not seem to be a terribly impressive piece of equipment. In practice, the FRG-8800's modest sensitivity, inadequate IF selectivity and miserable image rejection rule out not only tropical band DX reception, but also a variety of serious SWL applications.

## Conclusion

A choice for pleasant, non-critical SW programme listening, the FRG-8800 allows for automatic/computer-controlled operation. However, in my view it has a substandard radio performance-to-cost ratio.

REW

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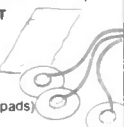
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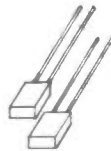


## LEDs

### RECTANGULAR LEDs

Green rectangular LEDs for bar-graph displays.

50 for £3.50 + VAT  
500 for £25 + VAT



100 for £6 + VAT  
1000 for £45 + VAT



### DIGITAL AND AUDIO EQUIPMENT LEDs

Assorted 3mm LEDs: red, green, yellow and orange. 25 of each (100 LEDs) for **£6.80 + VAT**

## BIO-FEEDBACK

FEATURED IN ETI  
DECEMBER 1986

A complete parts set for the ETI bio-feedback monitor, including meter. Originally offered from limited stocks at £14.55 (without meter), this sensitive GSR monitor has proved so popular that we have decided to make it a permanent feature of our catalogue.



The complete parts set includes case, PGB, all components, leads, electrodes, gel, meter and full instructions.

**BIO-FEEDBACK PARTS SET ONLY £11.50 + VAT**

## HI-FI POWER METER

FEATURED IN ETI  
MAY 1987

Measure the output power of your hi-fi with the ETI power meter. The meters can be back-lit for effect - the scale and 'power' legend will glow green to contrast with the red pointer. Two switched ranges give readings of 0-10W and 0-100W.

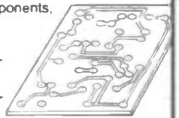


The parts set consists of meter movement, PCB, all components, range switch and full

**MONO POWER METER PARTS SET £3.90 + VAT**

**STEREO POWER METER PARTS SET £7.20 + VAT**

**SUITABLE CASE £7.50 + VAT**



## TACHOMETER AND DWELL METER

FEATURED IN ETI  
JANUARY 1987

**SPECIAL OFFER**



Last few to clear at only **£9.50 + VAT!** (Previously offered at £16.40.) The complete parts set includes case, printed circuit board, all components, plug, socket, switches, test leads and clips, meter and full instructions.

**TACHOMETER AND DWELL METER PARTS SET ONLY £9.50 + VAT**

Offer applies only until stocks are exhausted

## MATCHBOX AMPLIFIER

FEATURED IN ETI,  
APRIL 1986

No ordinary amplifiers these. When our first customers took an interest, it was for the diminutive size (both modules will fit in a matchbox!), the total disregard for power supplies and speaker impedances, and the impressive power output from these little amplifiers. When they're re-ordered it was for the sound quality.

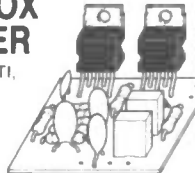
Two amplifier modules were described, both based on the powerful L165V IC. The single IC version will deliver over 20 Watts with a suitable speaker and power supply. The bridge version can provide up to 50W! Although the specified supply voltage and speaker impedance must be used to achieve maximum power, both modules are quite happy to work from any voltage between 12V and 32V, and will accommodate any type of speaker. The bridge version is ideal for giving a boost to car Hi-Fi systems, driving two 4 Ohm speakers in parallel on each channel for best effect.

Both designer-approved parts sets consist of a roller tinned printed circuit board and all components. The L165V ICs are also available individually, with a free mini data sheet giving specifications and suggested circuits.

**SINGLE IC MATCHBOX AMPLIFIER SET (20W into 4 Ohms) £6.50 + VAT**

**BRIDGE AMPLIFIER SET (50W into 8 Ohms) £8.90 + VAT**

**L165V IC with data £3.90 + VAT**



## KNIGHT RAIDER

FEATURED IN ETI, JULY 1987

The ultimate in lighting effects for your Lamborghini, Maserati, BMW (or any other car, for that matter). Picture this: eight powerful lights in line along the front and eight along the rear. You flick a switch on the dashboard control box and a point of light moves lazily from left to right leaving a comet's tail behind it. Flip the switch again and the point of light becomes a bar, bouncing backwards and forwards along the row. Press again and by one of the other six patterns. An LED display on the control box set so you see what the main lights are doing.

The Knight Raider can be fitted to any car (it makes an excellent fog light) or with low powered bulbs it can turn any child's pedal car or bicycle into a spectacular TV age toy!

The control box parts set consists of case, switches, LEDs, PCB components, hardware and instructions. The sequence board includes PCB, ICs, power FETs, components hardware and instructions.

**KNIGHT RAIDER CONTROL BOX ONLY £6.90 + VAT!**

**KNIGHT RAIDER SEQUENCE BOARD ONLY £11.90 + VAT!**

## BRAIN WAVE MONITOR

FEATURED IN ETI,  
AUGUST 1987

**ALPHA: HOW TO SUCCEED WITHOUT REALLY TRYING**

This was the title of a recent QED television program which showed how life can be dramatically improved with aid of alpha training. Aisdaar McBETH overcame his shyness with girls, others became more confident, improved their sporting abilities, learned to cope with stress and all without really trying!

Alpha monitors are not new, but good ones are hard to find. To detect a few uV of brain waves in the midst of noise that is tens of thousands of times as great is not easy! The ETI Alpha Monitor is probably the most powerful and effective design to be found outside an EEG laboratory. The sensitive circuit locks on to the all important alpha rhythm and helps you to strengthen and control it. Quickly. Then you put it to work for you, strengthening your confidence and abilities day by day.

Our approved parts set consists of EEG electrodes and headband, case, two PCBs, screening box, top quality PML amplifiers, all components and full instructions (including training exercises). Assembly time is about five to six hours.

**ALPHA MONITOR PARTS SET ONLY £29.90 + VAT!**



# Complete Parts Sets for ETI Projects

## MAINS CONDITIONER

FEATURED IN ETI,  
SEPTEMBER 1986

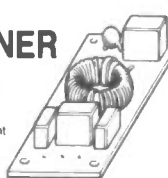
It is astonishing how many people buy or build top-flight hi-fi equipment, and then connect it to a noisy, spiky mains supply. Rather like buying a Ferrari and trying to run it on paraffin, you might think. Expecting crystal clear sound, the poor music enthusiast ends up with a muddy, confused mush,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

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

Our approved parts set consists of PCB, all components, toroid, enamelled wire, fixing ties, fast response VDR, and full instructions.

**ETI MAINS CONDITIONER PARTS SET ONLY £4.60! + VAT**

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



## CREDIT CARD CASINO

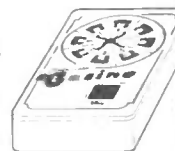
FEATURED IN ETI,  
MARCH 1987

This wicked little pocket gambling machine measures only 3" x 2" x 1/2". It will play all kinds of casino games, including:

- Roulette
- Craps
- Pontoon

Our approved parts set comes complete with case, self-adhesive fascia, tinned and drilled printed circuit board, all components, hardware, full instructions and three different games to play!

**CASINO PARTS SET ONLY £5.90! + VAT**



**Five extra games FREE with every order!**

## MAINS CONTROLLER

FEATURED IN ETI,  
JANUARY 1987

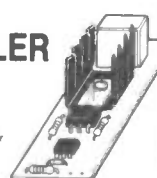
Have you ever wondered what people do with all those computer interfaces? Put your computer in control, say the ads. The Spectrabeeb has eight TTL outputs. What on earth can you control with a TTL output? A torch bulb?

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

The mains controller connects directly to most TTL families without external components, and can be driven by CMOS with the addition of a transistor and two resistors (supplied).

Your mains controller parts set contains: high quality roller tinned PCB, MOC3021 opto-coupler, power triac with heatsink, mounting hardware and heatsink compound; all components, including snubber components for switching inductive loads, transistor and resistors for CMOS interface, full instructions.

**MAINS CONTROLLER PARTS SET £6.20 + VAT!**



## POWERFUL AIR IONISER

FEATURED IN ETI,  
JULY 1986

Ions have been described as 'vitamins of the air' by the health magazines, and have been credited with everything from curing hay fever and asthma to improving concentration and putting an end to insomnia. Although some of the claims may be exaggerated, there is no doubt that ionised air is much cleaner and purer, and seems much more invigorating than dead air.

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

We can supply a matched set of parts, fully approved by the designer, to build this unique project. The set includes a roller tinned printed circuit board, 66 components, case, mains lead, and even the parts for the tester. According to one customer, the set costs about a third of the price of the individual components. What more can we say?

**DIRECT ION PARTS SET £9.50 + VAT**

Instructions are included



## PROJECT BOX

PROJECT CASE WITH PP3 BATTERY COMPARTMENT

**ONLY £2.60! + VAT**



## LM2917 EXPERIMENTER SET

Consists of LM2917 IC, special printed circuit board and detailed instructions with data and circuits for eight different projects to build. Can be used to experiment with the circuits in the 'Next Great Little IC' feature (ETI, December 1986).

**LM2917 Experimenter Set £5.80 + VAT**

## RUGGED PLASTIC CASE

Suitable for mains conditioner and mains controller.

**ONLY £1.65 + VAT**



## WHITE IONISER

Our best selling ioniser kit is now available with an elegant white case.

**WHITE IONISER PARTS SET ONLY £9.80! + VAT**

**SPECIAL OFFER**

Prices shown are exclusive of VAT, so please add 15% to the order total. UK postage is 60p on any order. Carriage and insurance for overseas orders £1.50. Please allow up to 14 days for delivery.

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# MEDIUM WAVE



## DXING

by Steve Whitt

Welcome to another information packed column. This month I will return to the subject of MW signal propagation and take a close look at the unusual world of 'grey-line DX'. But firstly, we kick off with the news.

### Headline news

**Andorra:** It has now been confirmed that Sud Radio has ceased using its former Andorran transmitter site at Pic Blanc so there are now no longer any MW (or SW) stations operating from this country. Sud Radio, which has always been under French control, continues to be heard via a network of transmitters in southern France – on MW it uses three transmitters on 819kHz from Gaure (20kW), Seron (20kW) and Arreyre (50kW).

**Germany (DDR):** Radio Berlin International has ceased its long standing English language MW broadcasts, according to the station's current schedule. Although the transmissions on 1359kHz were not received in the UK as well as some of the other Eastern European stations, this closure does seem an odd move. RBI programming on MW continues, however, on 1575kHz in French, German, Swedish and Danish.

**International Waters:** The Voice of Peace, located off the Israel coast in the Mediterranean, is understood to have a new 10kW MW transmitter on board ship. This station used to operate on 1530kHz (despite announcing 1540kHz) before the demise of its ageing MW transmitter and the unfortunate death of a station engineer who was electrocuted whilst working on it. The new transmitter is thought to be set up for 1539kHz.

**United Kingdom:** The feature last month on special event stations prompted quite a bit of comment, so I have dug through my files to find a few more examples of these rather elusive stations that will be on the air later this year (see *Table 1*).

### Information corner

Propagation information is a vital asset for the serious MW-DXer, and many people regularly listen on short wave to WWV from Boulder, Colorado. Reception of this station is not always easy and telephoning direct to WWV on a daily

basis can be quite expensive. An alternative could be Radio Australia, which has recently started a new propagation service comprising 90 second reports on global radio conditions and forecasts, including solar flux, sunspot numbers and the A index. These reports can be heard daily, except Sundays, during normal R Australia programming at 0425, 0825, 1225, 1625 and 2025hrs UTC.

A new booklet has come my way that should appeal to any DXer with even a passing interest in the medium wave band. *The United Kingdom and Eire Medium Wave DX Listings* is the very first publication to attempt to list every non-European MW station ever heard in the UK and Eire. Compiling a booklet of this sort is rather a thankless task, since it is impossible to make it 100% complete and it is essential to update it regularly since new stations are being heard all the time.

Nevertheless, the author, Ed Baker, has done a creditable job searching the archives of the *Medium Wave Circle* and the *World DX Club* and collating a list of over 1,200 stations, including some as far away as the Phillipines. The 36-page booklet (1987 edition) is available for £4 (including UK postage) directly from the author at 17 Sheepwash Avenue, Guidepost, Northumberland NE62 5NW. Please mention *Radio and Electronics World* when you order a copy.

### Grey-line DX

I have in the past occasionally mentioned the subject of grey-line DX (*Radio and Electronics World, December 1986*), without going into detail, however. The

subject is one that should interest MW and SW-DXers alike, since it opens up some interesting DX opportunities. Most articles that deal with long distance radio propagation usually talk about steady state conditions, which for the MW-DXer means the conditions that exist when there is a path of darkness between the broadcaster and the listener. As we shall soon see, there is an interesting transition region between the light and dark halves of the globe (hence the term 'grey-line') that can lead to enhanced radio signal propagation.

There exists a rarefied region of the Earth's upper atmosphere (above about 50km) that absorbs intense solar ultraviolet radiation, thereby protecting life on the Earth's surface. This radiation results in a region of ionised gases known as the ionosphere, which, depending on diurnal and seasonal variations, consists of several fairly distinct layers of high ionisation (*Figure 1*). These layers have a profound effect upon radio waves approaching them from transmitters on the ground below. Under certain conditions refraction of waves occurs, resulting in the 'reflection' of signals back down to the Earth, whilst at other times signals can be totally absorbed by the ionised gases.

During daylight hours, solar radiation penetrates the atmosphere far enough to form the lowest layer of ionisation, the 'D' layer, roughly 60km above ground. The D layer so completely absorbs signals on MW frequencies that any radio signals radiated by a station other than those parallel to the Earth's surface are completely lost. With the approach of sunset, however, the 'D' layer absorption decreases rapidly and within a few hours MW signals are being reflected back to the ground from higher regions of the ionosphere. Depending on circumstances, reflection occurs in the 'E' region (about 100-120km up) or in the 'F' layer (225-300km), giving rise to a skip distance for MW frequencies of about 100 to 500 miles.

Longer distance reception is possible when multiple reflections occur between the ionosphere and the Earth's surface. A few very long hops are much

**Table 1**

Date	Station and Location	Frequency
11-12 July	Bexley Show, Danson Park, Bexley, Kent (Borough Festival) (T)	1503
17-20 July	International Air Tattoo, RAF Fairford, Gloucestershire (P)	1602
21-23 July	East of England Show, East of England Showground, Peterborough	1602
24-27 July	Race Meet, Brands Hatch Race Course, Kent (P)	1584
27 Jul-8 Aug	Cowes Week, Cowes, Isle of Wight (25mW Tx on seafloor) (P)	1602
30 Jul-2 Aug	British Motorcycle Grand Prix, Donnington, Leicester	1602
1-8 Aug	Faith 1987, East of England Showground (Christian festival)	1602
13-15 Aug	R Silverstone, Silverstone Race course, Northants	1602
13-15 Aug	Ponies of Britain, East of England Showground	1602
25 Aug-1 Sept	Greenbelt Festival, Castle Ashby, Northants (Christian festival)	1350
30-31 Aug	Thamesmead Town Show, Southmere Park, Thamesmead (fair and carnival) (T)	1503

# MEDIUM WAVE DXING

preferable to many short ones, since the losses incurred at each reflection point are reduced, the probability of encountering a region of poorly reflective ionosphere is lessened and the overall distance travelled by the signal is also shortened. At first sight the D layer absorption during daylight hours will prevent long distance reflection from the F2 layer, which is also only present during daylight.

However, dawn and dusk are rather special times in an ionospheric context and *Figure 2* shows a close-up of the terminator – the dividing line between night and day. Because the outer reaches of the ionosphere are considerably higher up than the DXer sitting in his shack on the Earth's surface, at dawn the sunlight reaches these areas first and as a result all the daytime layer formations start to take shape before the surface below is fully in daylight. Similarly, since the night-time F layer is considerably higher than the D layer, it will reform into the two distinct F1 and F2 layers before the D layer has a chance to become established. There is thus a DX window of a few minutes around dawn when near ideal conditions exist – no absorbing D layer but a high level F2 layer.

A similar condition exists at dusk, since the lower D layers move into darkness some time before the higher F layers pass out of sunlight and begin to change. Indeed, this entire process is active all the way around the globe along the great circle line that defines the boundary between day and night. To exploit the grey line DX window, both the listener and the transmitting site need to be located along this great circle and the DXer has to know which direction to

point the aerial. The direction in which the aerial needs to be beamed changes with the seasons, since the Earth's axis of rotation is not through the North and South Poles, but inclined at an angle of 23½ degrees.

Well, that's enough of the theory behind grey-lines; we can now look at the technique. All you need is a Great Circle map together with *Table 2* which shows the aerial directions needed to exploit the grey-line at various times of the year (assuming you are a listener in the UK) and a table of local sunrise and sunset times. It is important to remember that this DX window occurs between 30 and 60 minutes before sunrise and a similar time after sunset. Looking at some of the grey-line bearings, you'll see that the technique is of particular value for African DX throughout the year, and it is

possible to pick certain dates when enhanced DX from Alaska and Japan might be possible.

Not many DXers seriously use grey-line techniques, possibly through lack of information. Hopefully you now have enough data at your finger-tips to have a go for yourself. Good luck and do let me know how you get on. REW

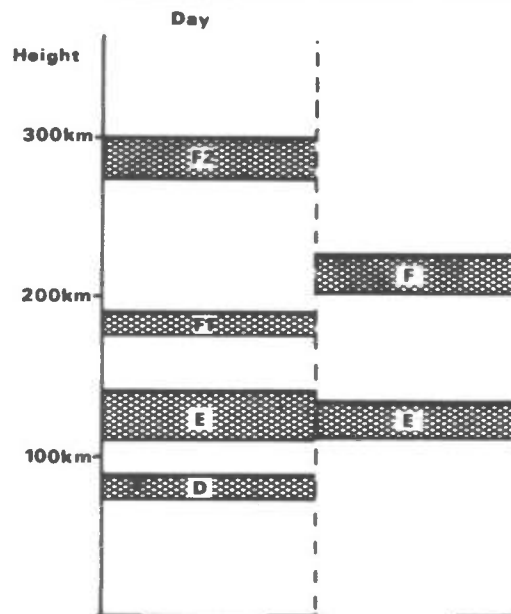
*Steve Whitt would like to hear about your experiences on the medium waves.*

*Write to him c/o the Editor. The address is on page 3.*

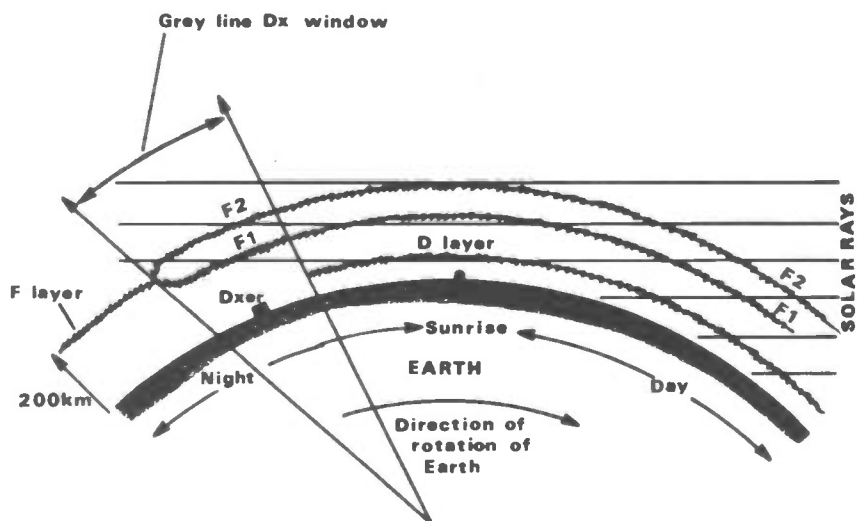
**Table 2**

Date	Sunrise bearing	Sunset bearing
1 Jan	41 – 221	319 – 139
15 Jan	36 – 216	324 – 144
1 Feb	28 – 208	332 – 152
15 Feb	20 – 200	340 – 160
1 Mar	10 – 190	350 – 170
15 Mar	5 – 185	355 – 175
1 Apr	352 – 172	8 – 188
15 Apr	343 – 163	17 – 197
1 May	334 – 154	26 – 206
15 May	326 – 146	34 – 214
1 Jun	320 – 140	40 – 220
15 Jun	318 – 138	42 – 222
1 Jul	318 – 138	42 – 222
15 Jul	321 – 141	39 – 219
1 Aug	328 – 148	32 – 212
15 Aug	336 – 156	24 – 204
1 Sep	347 – 167	13 – 193
15 Sep	358 – 178	2 – 182
1 Oct	11 – 191	349 – 169
15 Oct	20 – 200	340 – 160
1 Nov	29 – 209	331 – 151
15 Nov	36 – 216	324 – 144
1 Dec	40 – 220	320 – 140
15 Dec	42 – 222	318 – 138

All bearings are degrees from True North (add 7 degrees to get the magnetic bearing). Note that these figures were calculated for a latitude of 54 degrees north, but will give acceptable accuracy throughout the UK



**Fig 1**



**Fig 2** Example of grey line at dawn

# super alpha electronics

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Selsey, Chichester  
West Sussex PO20 0TH



0243  
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- ORDERS DESPATCHED SAME DAY BY FIRST CLASS POST -

## TRANSISTORS

BC107	0.15
BC107A	0.15
BC107B	0.15
BC108	0.15
BC108A	0.18
BC108B	0.15
BC108C	0.15
BC109	0.18
BC108B	0.18
BC109C	0.18
BC182	0.12
BC182B	0.12
BC183	0.12
BC183B	0.12
BC184	0.12
BC212	0.12
BC212B	0.12
BC213	0.12
BC213B	0.12
BC214	0.12
BC327	0.16
BC337	0.16
BC548	0.12
BCY70	0.22
BCY71	0.22
BD131	0.60
BD132	0.60
BC135	0.34
BD136	0.35
BD239A	0.60
BF258	0.60
BFX85	0.40
BFX88	0.40
BFY50	0.37
BFY51	0.37
BFY52	0.39
TIP31	0.42
TIP31A	0.48
TIP31B	0.56
TIP31C	0.54
TIP32A	0.42
TIP32C	0.42
TIP33A	1.00
TIP41A	0.63
TIP42A	0.55
TIP3655	0.76
TIP2955	0.76
ZTX300	0.17
ZTX500	0.17
2N3053	0.60
2N3054	1.60
2N3707	0.12
2N3703	0.12
2N3705	0.12
2N3771	1.40
2N3904	0.15
2N3906	0.15

## DIODES

IN4001	0.05
IN4002	0.05
IN4003	0.06
IN4004	0.06
IN4007	0.08
IN4148	0.06
IN4448	0.06

## OPTO ISOLATORS

TIL111 transistor o/p	1.10
TIL113 Darlington o/p	1.20
3021 Triac driver	1.50

## LEDS

T1 1/4 5mm	
Red	0.18
Yellow	0.18
Green	0.18
Super bright	
T1 1/4 5mm	
Red	0.35

## TRIACS

TIC206D	3 Amp	400V	max
	working		0.75
TIC225D	8 Amp	400V	max
	working		0.90

## ZENER DIODES

BZY88C	500m W	
4V7		0.10
10V		0.10
12V		0.10
BZX55C	500mW	
24V		0.10
BZX85C	1.3 Watt	
4V7		0.20
10V		0.20
12V		0.20
24V		0.20

## VOLTAGE REGULATORS

LM317T		
+1.2V to 37V		1.50
LM341P		
+5V		0.60
LM7905		
-5V		0.70

## BRIDGE RECTIFIERS

WOO4 1.5A	0.50
6005 6A	0.90

## CAPACITORS

<i>Electrolytic</i>			
47uF	25V		0.10
100uF	25V		0.12
470uF	25V		0.28
1000uF	25V		0.36
<i>Axial or Radial</i>			
10uF	25V		0.08
220uF	25V		0.15
<i>Tantalum</i>			
0.1uF	35V		0.10
0.22uF	35V		0.10
0.47uF	35V		0.10
1uF	35V		0.10
2.2uF	35V		0.15
4.7uF	35V		0.20
<i>Ceramic</i>			
220pF	500V		0.06
470pF	500V		0.06
1000pF	100V		0.06
220pF	100V		0.06
4700pF	100V		0.06
10nF			0.05
22nF			0.06

## RESISTORS

Metal Film 5% 1/8 Watt  
2p each

100R 680R 1K 2K2 4K7 5K6 6K8  
10K 12K 15K 22K 27K 33K 39K  
47K 56K 68K 82K 100K 120K  
150K 180K 220K 270K 330K  
390K 470K 560K 680K 820K 1M

## SKELETON PRESETS

Miniature horizontal  
or vertical  
Values:- 100R 220R 470R 1KQ  
2K2 4K7 10KQ 47KQ 100KQ  
220KQ 470KQ 1MQ 0.19

## LINEAR ICs

741	0.18
NE555	0.30
NE556	0.65
LM301	0.28
NE5532	1.20
NE5534	0.80
ZN414	0.90
ZN416	1.60
LM308	0.70
TL081	0.50
TDA3810	6.50

Enquire for more devices

## IC SOCKETS

<i>low profile</i>	
8 PIN DIL	0.7
14 PIN DIL	0.12
16 PIN DIL	0.13
24 PIN DIL	0.20
40 PIN DIL	0.30

## BT APPROVED TELEPHONES

<i>BT Statesman with last number redial</i>	
Stone	31.26
Brown	31.26
Maroon	31.26
Grey	31.26
<i>BT Viscount with last number redial</i>	
Beige	26.04
Ice Grey	26.04
Red	26.04
White	26.04
<i>BT Freeway cordless 700ft range Security coded, last number redial with base paging</i>	
Ivory	85.00

Carriage on telephones and telephone accessories £1.50  
Add 15% VAT to total allow ten days for delivery  
Sockets, extension leads, cable, enquire for our prices.

## ACCESSORIES

DPDT centre off slide switches	0.26
8ohm earpieces with 3,5mm plug	0.20
ABS boxes 75 x 51 x 25mm	
	0.90
Ribbon cable	POA
Soldering iron 240V 17W	5.99
Solder reel 18SWG 5 core 60 mtrs	6.70 + 1.00 p&p
Carbon pots 470Q to 1mQ linear	0.62
20mm quick blow fuses state current	0.12
20mm fuse holder panel mount	0.40
4K6 Hz piezo buzzer 12V	0.95
ABS boxes 150 x 80 x 50mm	2.00
PP3 battery connectors	
150mm leads	0.12
Desolder pumps high quality	3.99
Soldering iron bits and elements	POA
Carbon pots 1KQ to 1MQ logarithmic	0.62
New catalogue out soon	

## VERO BOARD 0.1" MATRIX

Unclad breadboard 0.1" 104 x 65mm	0.65
Copper clad 37 strips wide maximum 137 holes long	
	4p per hole
Copper clad 41 strips by 40 holes plus four mounting holes	2.20
Spot face cutters	1.99

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## FREE

Your monitor from its computer!! For only £29.95 it becomes a SUPERB HIGH QUALITY - COLOUR - TV SET

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

LIMITED QUANTITY - DON'T MISS THIS OFFER!!!  
**ONLY £29.95 OR £24.95** if purchased with ANY of our video monitors. Supplied BRAND NEW with full instructions and 2 YEAR warranty. Post and packing £3.50 \*When used with colour crt.

## COLOUR & MONOCHROME MONITOR SPECIALS

### \*SYSTEM ALPHA' 14" COLOUR MULTI INPUT MONITOR

Made by the famous REDIFFUSION Co. for their own professional computer system this monitor has all the features to suit your immediate and future requirements. Two video inputs, RGB and PAL Composite Video, allow direct connection to BBC/IBM and most other makes of micro computers or VCR's. Including our very own TELEBOX. An internal speaker and audio amp may be connected to computer or VCR for superior sound quality. Many other features: PIL tube, Matching BBC case colour, Major controls on front panel, Separate Contrast and Brightness - even in RGB mode. Separate Colour and audio controls for Composite Video input, BNC plug for composite input, 15 way 'D' plug for RGB input, modular construction etc.

**This Must Be ONE OF THE YEAR'S BEST BUYS, PC USER**  
Supplied BRAND NEW and BOXED, complete with DATA and 90 day guarantee. ONLY £149.00 as above OR IBM PC Version £165.00  
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### DECCA 80 16" COLOUR monitor, RGB input.

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

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Same as above model but fitted with Composite Video input and audio amp for COMPUTER, VCR or AUDIO VISUAL use. ONLY £99.00 + Carr.

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All units are fully cased and set for 240v standard working with composite video inputs. Units are pre tested and set up for up to 80 column use. Even when MINOR screen burns exist - normal data displays are unaffected. 30 day guarantee.

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Double sided 40/80 track disk drives (1Mb per drive), PSU, 4K of memory mapped screen RAM, disk controller, RS232, CENTRONICS and system expansion ports, and if that's not enough a ready to plug into STANDARD 8" DRIVE port for up to FOUR 8" disk drives, either in double density or IBM format. The ultra slim 92 key, detachable keyboard features 32 user definable keys, numeric keypad and text editing keys, even its own integral microprocessor which allows the main Z80A to devote ALL its time to USER programs, eliminating "lost character" problems found on other machines. The attractive, detachable 12" monitor combines a green, anti-glare etched screen, with full swivel and tilt movement for maximum user comfort. Supplied BRAND NEW with CPM 2.2, user manuals and full 90 day guarantee. Full data sheet and info on request.

PC2000 System with CPM Etc. COST OVER £1400  
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PC2000 Business System with CPM and 'Ready to Run' FAST Sales and Purchase ledger, supports up to 9000 Accounts, VAT etc. COST OVER £1700  
PC2000 Wordprocessor System with CPM and TEC FP25 daisywheel printer  
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## MODEMS

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DECCAFOX VP1 complete Professional PRESTEL system in slimline desk top unit containing Modem, numeric keypad, CPU, PSU etc. Connects direct to standard RGB colour monitor. Many other features include: Printer output, Full keyboard input, Cassette port etc. BRAND NEW with DATA A FRACTION OF COST only £55.00  
ALPHATANTEL. Very compact unit with integral FULL ALPHA NUMERIC keyboard. Just add a domestic TV receiver and you have a superb PRESTEL system and via PRESTEL the cheapest TELEX service to be found!! Many features: CENTRONICS Printer output, Memory dialling etc. Supplied complete with data and DIY mod for RGB or Composite video outputs. AS NEW only £125.00  
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Unless stated all drives are refurbished with 90 day guarantee. Many other drives and spares in stock - call sales office for details.

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**SPECIAL OFFER**  
MODEM TG2393. EX BT, up to 1200 baud full duplex 4 wire or half duplex over 2 wire line. ONLY £85.00 PER PAIR +pp £10.00  
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SUMMER OFFER ONLY £399.99!!

## DIY PRINTER MECH

Brand New surplus of this professional printer chassis gives an outstanding opportunity for the Student, Hobbyist or Robotics constructor to build a printer - plotter - digitiser etc, entirely to their own specification. The printer mechanism is supplied ready built, aligned and pre tested but WITHOUT electronics. Many features include all metal chassis, phosphor bronze bearings, 132 character optical shaft position encoder, NINE needle head, 2 x two phase 12V stepper motors for carriage and paper control, 9.5" Paper platten etc, etc. Even a manufacturer's print sample to show the unit's capabilities!! Overall dimensions 40 cm x 12 cm x 21 cm.

Sold BRAND NEW at a FRACTION of cost ONLY £49.50 + pp £4.50.

## TELETYPE ASR33 DATA I/O TERMINALS

Industry standard, combined ASCII 110 baud printer, keyboard and 8 hole paper tape punch and reader. Standard RS232 serial interface. Ideal as cheap hard copy unit or tape prep. for CNC and NC machines. TESTED and in good condition. Only £235.00 floor stand £10.00. Carr & Ins. £15.00.

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Compact ultra reliable quality built unit made by the USA EXTEL Corporation. Often seen in major Hotels printing up to the minute News and Financial information, the unit operates on 5 UNIT BAUDOT CODE from a Current loop, RS232 or TTL serial interface. May be connected to your micro as a low cost printer or via a simple interface and filter to any communications receiver to enable printing of worldwide NEWS, TELEX and RTTY services.

Supplied TESTED in second hand condition complete with DATA, 50 and 75 baud xtals and large paper roll.

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50 Column ONLY £49.95  
Spare paper roll for AE11 £4.50  
TYPE AF11R 72 Col.  
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A massive purchase of these desk top printer terminals enables us to offer you these quality 30 or 120 cps printers at a SUPER LOW PRICE against their original cost of over £1000. Unit comprises of full QWERTY, electronic keyboard and printer mech with print face similar to correspondence quality typewriter. Variable forms tractor unit enables full width - up to 13.5" 120 column paper, upper - lower case, standard RS232 serial interface, internal vertical and horizontal tab settings, standard ribbon, adjustable baud rates, quiet operation plus many other features. Supplied complete with manual. Guaranteed working GE30 £130.00. GE1200 120 cps £175.00. Untested GE30 £65.00. Optional floor stand £12.50. Carr & Ins. £10.00.

## SEMICONDUCTOR 'GRAB BAGS'

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Data sheets on request

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DQ200 Dialog - multi RK controller £495.00  
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MS11-LB Unibus 128kb Ram £450.00  
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PDP11/05 Cpu Ram, i/o etc £450.00  
PDP11/40 Cpu, 124k MMU £1,850.00  
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VT50 VDU and Keyboard £175.00  
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Give your VT100 a Birthday!!  
Brand New VT100 Keyboards  
only £85.00

1000's of EX STOCK spares for DEC PDP8, PDP8A, PDP11 systems & peripherals. Call for details. All types of Computer equipment and spares wanted for PROMPT CASH PAYMENT.

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

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Due to our massive bulk purchasing programme, which enables us to bring you the best possible bargains, we have thousands of ICs, Transistors, Relays, Caps, PCBs, Sub-assemblies, Switches etc. etc surplus to OUR requirements. Because we don't have sufficient stocks of any one item to include in our ads we are packing all these items into the BARGAIN OF A LIFETIME. Thousands of components at giveaway prices. Guaranteed to be worth at least 3 times what you pay. Unbeatable value and perhaps one of the most consistently useful items you will every buy!! Sold by weight.

2.5kls £5.25 + pp £1.25  
10kls £11.25 + pp £2.25

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20kls £19.50 + pp £4.75

1000's of other EX STOCK items including POWER SUPPLIES, RACKS, RELAYS, TRANSFORMERS, TEST EQUIPMENT, CABLE, CONNECTORS, HARDWARE, MODEMS, TELEPHONES, VARIACS, VDUS, PRINTERS, POWER SUPPLIES, OPTICS, KEYBOARDS etc. etc. Give us a call for your spare part requirements. Stock changes almost daily.

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



# NEXT ISSUE

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

### **SOLDERING – ART OR SCIENCE?**

Some useful tips for home constructors from P J Cooper

### **LABORATORY POWER SUPPLY**

David Silvester's design provides a cheap PSU with a possible output voltage from 0.1 to 39.9V

### **PLUS ALL THE USUAL FEATURES!**

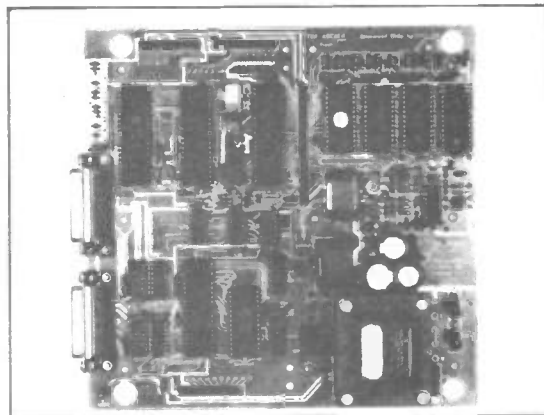
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### **The Archer Z80 SBC**

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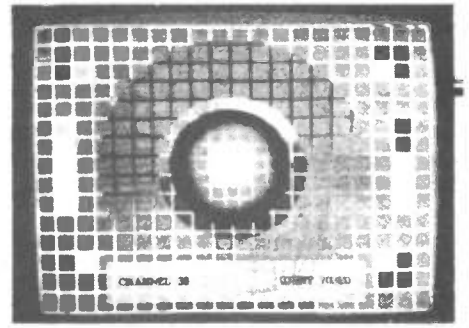
- ★ Extended double Eurocard with 2 parallel & 2 serial ports, battery backed CMOS RAM, EPROM, 2 counter-timers, watchdog timer, powerfail interrupt, & an optional zero wait state half megabyte D-RAM.
  - ★ Extended width versions with on board power supply and case.
- from £295 + VAT.



## **Sherwood Data Systems Ltd**

**Sherwood House, The Avenue, Farnham Common, Slough SL2 3JX. Tel. 02814-5067**

# DX-TV RECEPTION REPORTS



Compiled by Keith Hamer and Garry Smith

April got off to a promising start, especially where sporadic-E DX reception was concerned. Several minor, but nevertheless interesting, openings took place giving many of us the first taste of the 1987 season.

Meteor shower activity was present too, but tropospheric reception took a back seat with only a hint of European DX towards the end of the month.

## Sporadic-E at last!

The best opening of the month must have occurred during the afternoon of April 20th, which coincided with the Easter break.

Several enthusiasts have commented on this particular event, which lasted from 1300 until 1900. Fortunately, Chris Howles (Lichfield, Staffordshire), William Maries (Lozells, Birmingham) and Tony Mancini (Belper, Derbyshire) were over at Derby for the day witnessing the results of a new aerial system erected the previous evening. Signals were very strong and sustained, although their strengths declined rapidly towards the end of the opening.

Reception consisted of Spanish programmes on channels E2, E3 and E4, with occasional E3 signals from the Coimbra transmitter in Portugal. A vertical bars test pattern, thought to be TVE-2 from the Santiago outlet, was seen on channel E2 at times, alternating with programmes from the 1st network.

This is good news, because year after

year there has been a rumour that the Santiago TVE-2 outlet would be off the air before the next DX season. Fortunately, it's still with us!

## DX-TV logs for April

This month we are featuring details of long distance television reception noted by two enthusiasts. The log for April 24th was sent by Steve Smith, of Danbury in Essex. All the other signals were noted by Simon Hamer, of New Radnor in Powys.

**5/4/87:** A sporadic-E opening to Scandinavia with NRK (Norway) on channel E2 showing the 'NORGE GULEN' PM5534 test card and on channel E3 with 'NORGE GAMLEMSVETEN'; SVT (Sweden) E2 using the 'TV1 SVERIGE' PM5534; DR (Denmark) on channel E3 radiating the 'DR DANMARK' PM5534 from the transmitter located at Fyn.

**12/4/87:** RTE-1 (Eire) broadcasting a lunchtime concert on channels B, D, F and H; RTE-2 displaying the PM5544 test

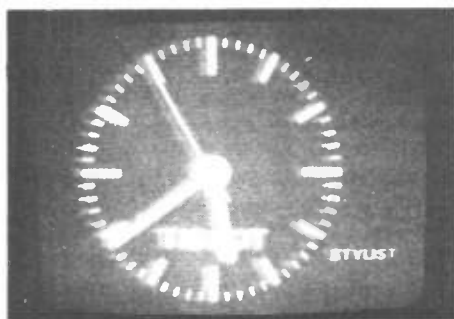
pattern on channels G, I, J and 43.

**16/4/87:** ARD-1 (West Germany - Bayerischer Rundfunk) on channel E2 with the 'GRUNTEN' FuBK test pattern.

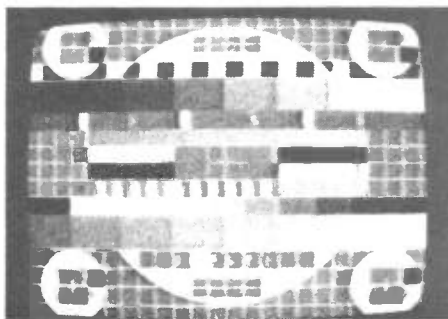
**19/4/87:** TVE-1 (Spain) with the news programme 'Telediario' on channels E2, E3 and E4; TVE-2 channel E2 showing a multiburst pattern which was alternating with the TVE-1 signal on E2; RAI (Italy) on channels IA and IB showing adverts. All signals received via sporadic-E propagation.

**24/4/87:** TDF tf1 (France) on channel L27; TDF Antenne 2 on L21; TDF FR3, L24; TDF La Cinq, L59; TDF TV6 L62; NOS-1 (Netherlands) on channel E4 from the Lopik transmitter and on channel E29 (Goes transmitter); NOS-2 on E32 (Goes transmitter) and E47 (Smilde transmitter); AFN TV Soesterberg (Netherlands - American Forces Network) A80; BRT-1 (Belgium) E43 (Egem outlet) and E49 (Profondeville); BRT-2 on E62 (Schoten transmitter), E55 and E46; ZDF (West Germany - Zweites Deutsches Fern-

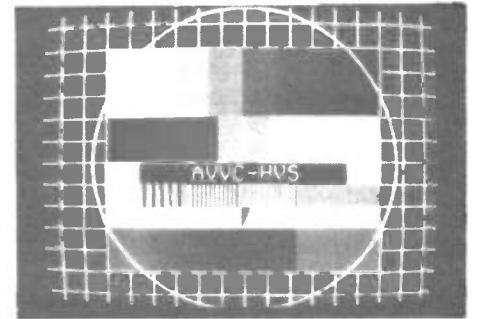
## PHOTO FILE ● PHOTO FILE ● PHOTO



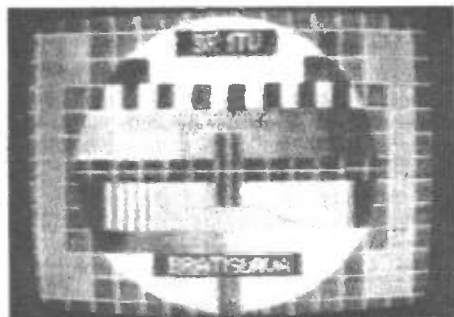
**Fig 1** Clock caption used by RTP, based in Portugal



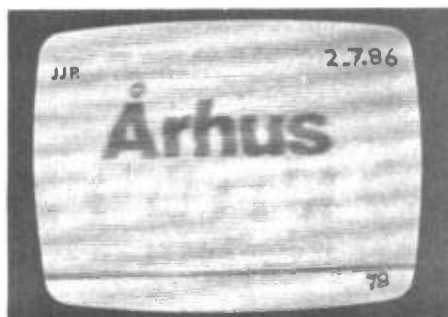
**Fig 2** Russian UEIT electronic test card radiated by TSS



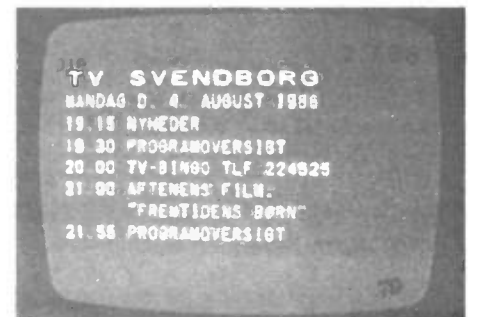
**Fig 3** FuBK test card transmitted by the Dutch PTT from Hilversum



**Fig 4** Czechoslovakia PM5544 test card from Bratislava on channel R2



**Fig 5** News programme from Arhus TV in Denmark on E54 (200W)



**Fig 6** Programme schedule from TV Svendborg in Denmark

## DX-TV RECEPTION REPORTS

sehen) on E24, E35 and E37; WDR-1 (Westdeutsches Fernsehen) on E46 (Kleve outlet); WDR-3 on E48, E55 and E60.

**28/4/87:** TDF Canal Plus (France) on channel L5 (Lille transmitter) with programmes, received during a small tropospheric lift.

### Reception reports

The sporadic-E season appears to have started early this year, according to Mark Dent of Leeds. An opening from the south during the afternoon of April 20th caused a little confusion when a programme showing clips of old Broadway musicals was seen on channels E2, E3 and E4.

Mark automatically logged it as TVE-1 from Spain, until a Spanish chat show came up over the top of the first transmission. He then realised that the clips were from Portugal and for the first time he'd witnessed the RTP-1 relay station on channel E4 located at Valenco do Duro, some 60km east of Porto. Its effective radiated power is only 35 watts.

Steve Smith (Danbury, Essex) should be enthusiastically looking forward to the 1987 sporadic-E season if his past record is anything to go by. A tropospheric lift towards the end of April brought in a host of UK and European stations. Perhaps Steve's best catch was the AFN TV outlet at Soesterberg, in the Netherlands, operating around channel E70.

Steve writes, 'The last signals I received from Soesterberg were so strong that on my small Amstrad portable colour TV I could hear the sound breaking through'. There seems to be some doubt as to which channel it is broadcasting on. It is officially the American channel A80 with the vision carrier at 867.25MHz. It falls exactly halfway between the European channels 70 and 71, so it can be listed as operating on either frequency.

A Dutch television programme guide lists it as channel E71, but according to Steve it refuses to lock on this channel when using his Luxor receiver with frequency synthesized tuning. He also saw the station earlier in the year during the late January tropes but at a much lower level.

### Programme guides

Steve Smith has been subscribing to a Dutch radio and television programme guide called 'AVRO bode'. The copy he has sent us has 70 pages and is full of useful information about radio and television programmes receivable in the Low Countries. It would appear that such a magazine would greatly assist in identifying DX reception during tropospheric openings, especially in the evenings when channels are choc-a-bloc with programmes.

It lists daily transmissions from the

following TV services: Netherlands, NOS-1 and NOS-2; Belgium, BRT-1 and BRT-2 (Flemish language); Belgium, RTBF-1 and RTBF-2 (French language); France, tf1, Antenne 2 and TV5 (La Cinq) but not FR-3; West Germany, ARD-1, ZDF and ARD-3; Luxembourg, RTL and RTL+; United Kingdom, BBC-1, BBC-2, Anglia and TVS but not Channel 4. Programmes from Sky Channel, Super Channel and Filmnet are also listed.

The guide is available in the UK by subscription. It costs DF1 204.95 per year from AVRO bode, Abonnementenadministratie, Postbus 5000, NL-1200 EW Hilversum, Netherlands. Information on joining may be obtained by telephoning (035) 717 883. There is also a telephone service giving the latest news about television programmes. The number is (035) 833 255. It is a recorded service, in Dutch, but it is easy to pick out the programmes and times. Don't forget to dial the international code if calling from

**For the best DX-TV reports and information on equipment, don't miss this column every month**

outside the Netherlands.

There is a similar magazine called 'TROS KOMPAS', which lists Channel 4 and FR-3 transmissions. The annual subscription is slightly more expensive at DF1 215.

It can be obtained from TROS KOMPAS, Postbus 1313, NL-1000 BH Amsterdam, Netherlands. For information on membership, telephone (020) 585 8000. A programme information service is available by telephoning (035) 715 715.

If you are holidaying abroad this year, it may be worthwhile bringing home a programme guide. Some of the Swiss ones list French, German, Austrian and Italian programmes as well as their own. If any reader can recommend other similar publications, please write to us via the Editor.

### New aerial system

A new aerial system is now in operation here at Derby, the old one having been damaged during the gales at the end of March. The Band I/II array had to be reconstructed and it was decided that the time had come to replace the ageing Antiference XG21K UHF array. It had performed well over the years, although its operating limit at around channel E50 meant that a lot of DX was missed at the

top end of the band. The elements had gradually been dropping off which made it perform more like an XG15½ towards the end!

The new array is the Triax 92-element wideband UHF type which appears to work extremely well. The main drawback with wideband Yagis is the fall-off in gain at the lower end of its operating bandwidth. This is not too important in this area where every group 'A' channel has at least two stations present from a variety of semi-local main transmitters. The best DX channels are those above channel E33.

### Updated

The masthead preamplifier has been updated to a Labgear CM7271 which is a single stage device with a typical gain of 15dB and a noise figure of 1.6dB. The Band III ABM 11 array survived, amazingly, although a thorough clean-up was desperately needed. A Fringe Electronics masthead preamplifier has been fitted and initial results indicate that it is a good performer.

The model is the VHF 1220-3 and it covers Band III only. The freedom from FM breakthrough on the lower Band III channels (E5, E6 and E7) was immediately noticeable. This means goodbye to the various traps and filters which have had to be fitted on previous masthead amplifiers. However, it is fair to say that earlier types were wideband (40-230MHz), which would readily respond to FM radio transmissions and cause the Band III breakthrough.

### Sporadic-E down under

A letter has arrived from Duncan Fraser, living in New Zealand, describing the unusual sporadic-E season which has now come to an end (for anyone not on the right wavelength, the sporadic-E season down under lasts from November to March).

It started on November 5th and at first looked promising. Reception was excellent all evening on the 12th and lasted well into the early hours. However, this was followed by a lull until the 30th. The nearest DX source is Sydney at 1,395 miles but the best logging was that of NQTV, a commercial station, in Townsville, North Queensland. This was seen on Australian channel 1 (55.75MHz vision) and the TV network confirmed it as originating from a 5kW relay at Bowen, at a distance of 2,100 miles.

All in all, recognisable pictures were received from Australia on 55 days, which was almost every alternate day. Signals came from five Australian states; encouraging, in view of the distances involved. Transmissions on many occasions were weak and Duncan had to resort to using narrowband IF facilities to resolve them.

KVZK-TV in American Samoa was received regularly via double-hop spor-



adic-E at a distance of 2,100 miles on channel A2 (American 525-line system). Signals were frequent, sometimes two or three days per week during the middle of the season. Most of the openings to Samoa occurred between 1600 and 1800 local time. It is interesting to note that although reception of this station has been frequent, a QSL card from them indicated that Duncan's report was the first that the station had received in 20 or so years of operation. Next season, Duncan intends to install his aerials outdoors on a rotator at a much greater height. We'll be interested to hear of the results!

### Danish photos wanted

Simon Hamer (Brookside Farm, New Radnor, Powys LD8 2SU), would like to hear from anyone who has pictures of any Danish clock captions or test cards which were in use before 1977. Payment will be made, of course, for actual photographs or reprints. Simon may be contacted directly.

### New DX-TV converter system

A new version of the popular D-100 DX-TV converter system is about to be launched. The new unit promises to have a sound option which will allow monitor-

ing via an FM radio receiver. As well as TV sound channels, the unit will cover the OIRT FM radio band which becomes extremely active during sporadic-E openings. Further details are available by writing to HS Publications, 17 Collingham Gardens, Derby DE3 4FS. An 18p stamp should be enclosed to cover return postage.

### Service information

**Bulgaria:** The band III transmitters in the table are used by the first network of Bolgharska Televizia (BT-1).

There is also a BT-1 outlet operating in Band II (on channel R3) but its location and ERP are not, at present, known.

This month's service information was supplied by Gösta van der Linden. REV

Transmitter	Channel	ERP (kW)
Sumen	R5	100
Burgas	R7	100
Sofia	R7	10
Kardzali	R9	50
Zelena Glava	R9	5
Varna	R9	1
Kjustendil	R10	50
Botev Vrah	R11	250
Belogradcik	R12	50
Sliven	R12	20
Tolbuhin	R12	5

The second network (BT-2) uses the following transmitters:

Sofia	R12	5
Botev Vrah	R22	1000
Varna	R33	100
Kardzali	R34	100

## FERNSEH-ANTENNA

### Combined Band 1/3 Aerial for TV-DXing



The 1987 Sporadic-E season should now be with us! Time to take advantage of a special offer from **Aerial Techniques** to re-equip your system. The Fernseh-Antenna DR1712 is an efficient low cost Wideband VHF aerial covering both Bands 1 & 3, it has a gain of 3.5dB in Band 1 and 9.5dB in Band 3. Folded dipoles for peak efficiency are used in both Band 1 & 3 sections. Front to back ratio is 11dB - Band 1; 25dB - Band 3. The aerial has been gold lacquered for high resistance against weather corrosion. This array has close spaced elements, making it a very compact length of 72", ideal for the enthusiast with restricted space, or those unable to erect separate aerials. This aerial only requires a single coaxial downlead.

In certain areas the use of a wideband VHF amplifier can be advantageous, the Antiference UP1300 fits the bill. This preamplifier covers 40-230MHz (Bands 1 to 3) with a gain of 19dB and a low noise figure of 2.5dB. The amplifiers matching power supply unit provides 12v DC via the coaxial downlead.

- FERNSEH-ANTENNA** Combined Band 1/3 Aerial - Special offer - carriage free! **£43.75**
- ANTIFERENCE** UP1300 Band 1 & 3 Amplifier **£17.30**
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- SUPPORT BEARING** for heavier load applications **£13.95**

Aerial Techniques, the company that knows the TV-DXing hobby carry a large and comprehensive range of aerial equipment for every type of installation - and with a huge range of filters, amplifiers, cables, rotators, masts and supporting hardware. Send for our illustrated **Catalogue at 65p**, if it doesn't list what you want, then we can obtain it quickly.

**STOP PRESS** - New Triax style Notch Filter, covers whole of the UHF Band; 470-860MHz completely tuneable. Notch depth up to 26dB. **£6.95** (includes postage). (See review in this column)

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  - 100 off per value - 75p, even hundreds per value totalling 1000..... £7.00
  - Metal Film resistors 1/4W 10R to 1MΩ 5% E12 series - 2p, 1% E24 series..... 3p
  - Mixed metal/carbon film resistors 1/2W E24 series 1R0 to 10MΩ..... 1 1/2p
  - 1 watt mixed metal/Carbon Film 5% E12 series 4R7 to 10 Megohms..... 5p
  - Linear Carbon presets 100MW @ 1/4W 100R to 4M7..... 7p
  - Miniature polyester capacitors 250V working for vertical mounting**
  - .01, .015, .022, .033, .047, .068-4P, 0.1-5P, 0.15, 0.22, 0.33 & 0.47-6P..... 6p
  - Mylar (polyester) capacitors 100V working E12 series vertical mounting**
  - 100p to 8200p - 3p, 0.1 to .068 - 4p, 0.15p, 0.12 & 0.15..... 6p
  - Subminiature ceramic plate capacitors 100V wkg vertical mountings. E12 series**
  - 2% 1.8 pf to 47 pf - 3p, 2% 56 pf to 330 pf - 4p, 10% 390p - 4700p..... 4p
  - Disc/plate ceramics E12 series 1P0 to 1000P, E6 Series 50V 1500P to 47000P..... 2p
  - Polystyrene capacitors 63V working E12 series long axial wires**
  - 10 pf to 8200 pf - 3p, 1000 pf to 10,000 pf - 4p, 12,000 pf..... 5p
  - 741 Op Amp - 20p, 555 Timer..... 22p
  - cmos 4001 - 20p, 4011 - 22p, 4017..... 40p
  - ALUMINIUM ELECTROLYTICS (Mfda/Volts)**
  - 1/50, 2.2/50, 4.7/50, 10/25, 10/50..... 5p
  - 22/16, 22/25, 22/50, 47/16, 47/25, 47/50..... 6p
  - 100/16, 100/25 7p; 100/50 12p; 100/100..... 14p
  - 220/16 8p; 220/25, 220/50 10p; 470/16, 470/25..... 11p
  - 1000/25 25p; 1000/35, 2200/25 35p; 4700/25..... 70p
  - Submin, tantalum bead electrolytics (Mfda/Volts)**
  - 0.1/35, 0.22/35, 0.47/35, 1.0/35, 3.3/16, 4.7/16..... 14p
  - 2.2/35, 4.7/25, 4.7/35, 6.8/16 15p; 10/16, 22/6..... 20p
  - 33/10, 47/6, 22/16 30p; 47/10 35p; 47/16 60p; 47/35..... 80p
  - DIODES (piv/amps)**
  - 75/25mA 1N4148 2p, 800/1A 1N4006 6p, 400/3A 1N5404 14p, 115/15mA OA91..... 6p
  - 100/1A 1N4002 4p, 1000/1A 1N4007 7p, 60/1.5A S1M1 5p, 100/1A bridge..... 25p
  - 400/1A 1N4004 5p, 1250/1A BY127 10p, 30/45mA OA90 6p, 30/15A OA47..... 8p
  - Zener diodes E24 series 3V3 to 33V 400 mW - 8p, 1 watt..... 12p
  - Battery snaps for PP3 - 6p for PP9..... 12p
  - L.E.D.'s 3mm, & 5m.m. Red, Green, Yellow-10p, Grommets 3mm - 1 1/2p, 5mm..... 2p
  - Red, flashing L.E.D.'s require 5V supply only..... 30p
  - Mains indicator neons with 220K resistor..... 10p
  - 20mm fuses 100mA to 5A Q/blow 5p, A/surge 8p, Holders pc or chassis..... 5p
  - High speed pc drills 0.8, 1.0, 1.3, 1.5, 2.0m - 25p, Machines 12V dc..... £6.50
  - HELPING HANDS 6 ball joints and 2 croc clips to hold awkward jobs..... £4.50
  - AA/HP7 Nicad rechargeable cells 80p each, Universal charger unit..... £6.50
  - Glass reed switches wih single pole make contacts - 8p, Magnets..... 12p
- All prices are inclusive of VAT. Postage 20p (free over £5). Lists Free.

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Return posting

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

### Buyer's guide for the blind

A tape version of Angus McKenzie's book, *A Buyer's Guide to Amateur Radio*, is currently available from the RAIBC.

Although some condensation has been necessary in order to present the book on eight cassettes (12 hours of listening), a large number of detailed reviews of equipment currently available has been included, plus discussions on receiver and transmitter performance. Aerial tuning units are also covered, plus antennas for LF, HF, VHF and microwaves.

Angus drew upon some 26 years of experience as a radio amateur and professional engineer in the production of this book, which will prove useful to both amateurs and listeners.

The tape version is read by

Peter Jackson and costs £5 to RAIBC members and £7.50 to non-members.

The RAIBC can be contacted at 9 Conigre, Chinnor, Oxon.

### 'CQ-TV' Index

The British Amateur Television Club (BATC) recently published an index of articles which have appeared in *CQ-TV*, the club's bi-monthly journal, since issue 80.

Back issues or photocopies of articles are available from the BATC. Back issues are £1.00 each, copies are 20p a sheet and the index itself costs £1.00.

Send orders to BATC Publications, 14 Lilac Avenue, Leicester LE5 1FN.

### GB2DOG

On Saturday 11th July the Reading and District Amateur

Radio Club will be operating a special event station, GB2DOG, at the open day of the Wokingham Training Centre for the Guide Dogs for the Blind Association. A number of stations will be on the air, ranging from local contacts on VHF to global ones on the HF bands.

The club hopes to raise a substantial amount for the charity, via sponsorship and individual donations.

If you would like to contribute to this worthwhile cause, please send your donation to Pete Jarret G4CDJ QTHR. Cheques should be made payable to 'Radio Guide Dog Appeal'.

### Shoestring equipment

The poverty-stricken among you will appreciate a talk to be hosted by the Sheffield Amateur Radio Club on 17th August called 'Test equipment on a shoestring'.

On Monday 20th August a fox-hunt is scheduled. Participants should bring along their home-brew aerials - a prize will be awarded for the best.

Both events take place at 8.00pm at the Firth Park Pavilion in Sheffield. Further information is available from Alan G8ZHG on (0742) 395287.

### Get ready for the RAE

The Addington Adult Education Centre in Croydon is starting a 20 week course in September leading to the Radio Amateurs' Exam.

The course begins on Wednesday 30th September and the tutor is George Portsmouth. Enrolment is on 19th September from 9.00am to 12.30pm. Telephone (0689) 41461 for more information.

### Software library

The PD Sig (Public Domain Software Interest Group) recently started a 2m packet radio BBS system on 144.650MHz. The system is run from the home of Rod Smith, the group's software librarian, in Crowborough, East Sussex.

It provides the usual mailbox facilities and message forwarding, although the emphasis is on providing software for download. The system consists of a PC clone with 20MHz Winchester and

an MFJ1270 TNC, and the RF side consists of an FT280 into a vertical collinear 12m above ground.

The site is 700ft asl and coverage is apparently very good, direct contacts as far north as Watford and south into France have been logged. Currently the system is operating under Rod's call-sign G4DQY, but a GB call is being sought.

PD Sig claims to be one of the major sources of public domain type software for CP/M and MSDOS, its library of over 2000 discs being probably the largest in Europe. The growing use of computers in the radio hobby and the need for cheap specialised software for these applications is making PD Sig very popular with the ham radio community. Copies of library discs are available to members for around £2.00. PD Sig also has a number of telephone BBS systems where software can be downloaded if you have a suitable modem.

For further information send a stamped, self-addressed envelope to Rod Smith G4DQY, Winscombe House, Beacon Road, Crowborough, East Sussex TN6 1UL.

### Biggin Hill

The Biggin Hill Amateur Radio Club now meets at the Victory Social Club Hall, Kechill Gardens, Hayes, Kent. The next meeting is on 21st July followed by one on 18th August, both commencing at 7.30pm.

For further information on the club and its activities, contact Geoff Milne on 01-462 2689.

### Vintage stuff

If you are interested in researching the history and technology of early wireless and television, and helping to preserve the apparatus involved, you may like to join the British Vintage Wireless Society.

All members receive regular copies of the society's bulletin, which contains some fascinating articles on early developments in the fields of radio and TV plus in-depth examinations of old equipment.

For further details, contact

**CQ-TV** MAGAZINE  
No. 138  
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MAY 1987

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## DTI Info

The Department of Trade and Industry recently released two more information sheets which will be of interest to radio amateurs, numbers 4 and 5. Number 4 concerns call signs and 5 is about radio clubs.

These sheets are part of a series of five, available free by telephoning 01-275 3072.

## Electrifying

The Felixstowe and District Amateur Radio Society is planning a visit to the Sizewell Electricity Generating Station on 24th August. For further details, contact Paul Whiting G4YQC on (0473) 642595 (daytime).

The society meets fortnightly at the Scout Hut, Bath Road, Felixstowe, Essex. All meetings commence at 8.00pm.

## Tally Ho!

Join the Bury Radio Society on 12th August for a VHF fox-hunt. Details are available from M L Jamil G1VQE at 29 Harrow Close, Blackford Bridge, Bury, Lancs BL9 9UD.

Club nights are held every Tuesday at the Mosses Youth and Community Centre, Cecil Street, Bury, the main event taking place on the second Tuesday of each month.

## Treasure hunt

The Coventry Amateur Radio Society is hoping for good weather on 21st August, when a treasure hunt and a barbeque have been scheduled.

CARS meets every Friday at 8.00pm at Baden Powell House, 121 St Nicholas Street, Radford, Coventry.

If you are interested in the club and its activities, contact Bill Hahn G3UOL, 91 The Chesils, Coventry CV5 9NA. Tel: (0203) 414684.

## Coherent CW

If you are in the Farnborough area and struggling with your Morse code, a demonstration by G3XVR on behalf of the Farnborough and District Radio Society may help to clarify things for you.

This event is scheduled for 12th August.

On the 26th, Ray Flavell G3LTP is giving a talk on propagation. If you are interested in either of these events, venue and time details are available from M C Graffius, The Paddock, Diamond Ridge, Camberley, Surrey.

## Sykes' Society

Robin Sykes G3NFV, RSGB representative for Region 7, will be explaining the ins and outs of the RSGB to the Wimbledon and District ARS on 14th August. This will be followed on the 28th by a general activity evening.

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

Further details can be obtained from G Cripps G3DWW, 115 Bushey Road, Raynes Park, London SW20 0JN. Tel: 01-540 2180.

## A sound approach

The August schedule of the Burnham Beeches Radio Club kicks off with a fox-hunt on the 3rd. This will be followed on the 17th with a lecture from G4XDU, 'A new approach to sound mixing'.

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

More details are available from Eileen Chislett G6EIL on Maidenhead 25720.

## Rallying round

The South Bristol Amateur Radio Club holds its third Bristol Radio Rally on 4th September between 10.00am and 5.00pm.

A bring-and-buy stall, radio and general traders will be on site, attractions being split between the Hareclive Youth and Hartcliff Community Centres in Hareclive Road, Hartcliff, Bristol.

Admission will be 50p and talk-in will be on S22. Special event station GB2BRR will be operational.

All enquiries should be directed to Len Baker G4RZY, c/o 62 Court Farm Road, Whitchurch, Bristol BS14 0EG. Tel: (0272) 834282.

## NOTES FROM THE PAST

The drive against unlicensed listeners and viewers goes on. It is rather amazing that so many of the lay public think the mysterious detector vans can smell out hidden TV receivers even after they are switched off. How they imagine it can be done I haven't the faintest idea - nor have they, either. For that matter, they haven't a clue how it's done when the set is switched on. Sometimes I suspect that the Post Office encourage them in an almost superstitious belief in the magic of the detector units. Perhaps they are preparing against the day when the licence fee goes up to three, four or even five pounds. Then there will be more pirates than ever.

Other countries - other methods. The French are notorious tax-dodgers, and no opprobrium attaches to fiddling the Government. In fact, it is almost a national pastime. They have many amusing stories to tell concerning piracy. Radio dealers must, by law, reveal on demand the address of all buyers of receivers. An imperative request for the licence fee follows, plus an additional charge for any delay in payment.

I haven't had the good fortune to get to South Africa, but I was told by a ZS amateur, who was over here for the Coronation, that a current licence must be shown before a new set is supplied or an old one repaired. I cannot see how the dealer is supposed to know that it is really your licence which you show him. Or what is to prevent you, in France, from getting a pal who has a licence to buy your set for you. Maybe they'll stop that sort of thing by passing a law requiring dealers to install lie-detectors under the counter. Then I suppose the buyer's pals will have to gum up the works of the lie-detector with portable jamming gear hidden in a car outside.

## Colour TV coming

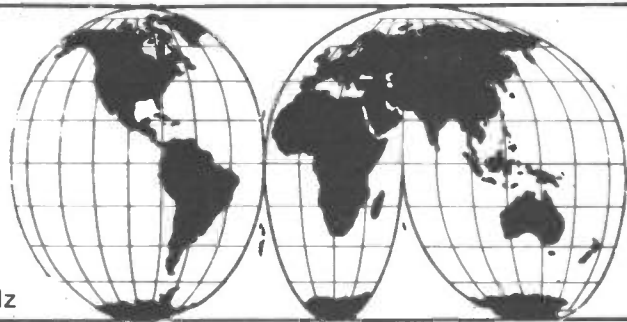
Regular colour TV programmes from a network of about twenty stations are expected to be in operation in the USA by April next year. It will still be possible to view in monochrome on a normal set, although some loss of definition results. RCA and Columbia have both given satisfactory demonstrations of their systems before the Federal Communications Commission who, at the same time, rejected two other systems.

The Director General of the BBC was over there watching points. We cannot allow the US to get too long a lead, so perhaps we will get something on the same lines soon after. Our senior TV engineers soon hurried across the Atlantic to have a look at it, and also to see something startlingly new - a system of recording ordinary TV on magnetic tape!

# SHORT WAVE NEWS FOR DX LISTENERS

By Frank A Baldwin

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



Continuing our update of some of the Peruvian transmitters currently operating on the low frequency ranges, a start is made by listing Radio Sicuani, Sicuani on **4825** at 0.5kW, identifying as 'Radio Sicuani', La Voz de Canchis' and using the slogan 'La Estacion de Mayor Sintonia'. Radio Sicuani is on the air from 1000 to 0300, the low power largely prohibiting reception of their signals far outside the Peruvian border.

Radio Andahuaylas sited in the town of that name operates from 1000 to 0330 (Saturday from 1000 to 0430) with a power of 2kW on **4840**. The signals from Radio Andahuaylas are seldom heard here in Europe and the UK but are frequently reported by American DXers.

Radio Chinchaycocha in Junin is on **4860** where it is scheduled on the air from 0900 through to around 0300 (Saturday and Sunday from 1100 to 0630). This one is heard from time to time here in the UK. The power is 1kW.

Seldom logged here are the 1kW signals emanating from Radio Huancavelica in Huancavelica on **4885.3**. It operates from 1100 to 0415 (Saturday until 0800).

OAX7V Radio Tawantinsuyo in Cuzco is frequently reported by DXers worldwide. It may be found, conditions permitting, on **4910.2** where it radiates from 0915 to 1100 and from 2200 to 0330 with a power of 5kW. This one was reactivated early in 1986 and is thought to alternate with **6175**. It programmes in Spanish and Quechua, identifying in the latter language as 'Kayka Radio'.

Tawantinsuyo, which in Quechua means Four Areas, was the Inca name for their empire. Inca specifically refers to the emperor but is now used loosely to refer to his many different peoples speaking various languages who were welded together in the empire.

Radio Central in Bellavista is located on **4919.5** and is on the air from 1100 to 0400 (Saturday from 1100 to 0700) with a power of 1kW being heard with the slogan 'Estan en Sintonia de Radio Central' and identifying as 'Ondas del Huallaga Central'.

In Puno, Ondas del Titicaca (Waves from Titicaca) varies in frequency from **4920** to **4922**, making life difficult for DXers. It is scheduled from 1000 to 0330. Having a power of 1kW, it is seldom logged in our part of the globe.

OAX5Q Radio Abancay, located in the town of that name, is on the air on Sundays only, being scheduled from 1100 to 0400 at 1kW on **4934**.

On **4934.7** is Radio Tropical in Tarapoto operating from 0930 to a variable closing time around 0405 with a power of 1kW. This one is frequently heard and reported worldwide.

Radio Moderna in Celendin is on the air from 0500 to 0500 with a power of 1kW on a frequency of **4945**. Regularly logged both in the UK and Europe are the signals from Radio Madre de Dios in Puerto Maldonado. With a power of 5kW it broadcasts on **4950** from 1030 to 0200.

Radio Cultural Amauta in Huanta at 1kW is scheduled from 1100 to 0200 on **4955**, but has been reported operating on **4954**.

La Voz de Cutervo, Cutervo, has a 1kW transmitter radiating from 1100 to 0300 on a frequency of **4965**.

Radio San Miguel, Cuzco is on the air from 0900 to 0400 (Sunday from 0900 to 0300). With a power of 1kW, it is on **4966**. During the morning period it programmes in Quechua for the benefit of local farmers and the rural population of the locality who do not speak the Spanish language. It identifies as 'San Miguel de la Radio'.

Radio Imagen, Tarapoto, now operates on **4970.3** (ex **5199.1**) from 1000 to 0500

(Saturday and Sunday 24 hours) with a power of 1kW. The often reported Radio del Pacifico in Lima on **4975** programmes from 2300 to 0415 with a power of 4kW.

'OAX7J La Voz de la Madrugada', Radio La Hora in Cuzco on **4977.2**, rarely heard outside the area, has a power of 1kW and is scheduled from 0930 to 0410 (Sunday from 1100 to 0200).

Radio Ancash in Huaraz is on **4990.6** and is on the air from 0830 until 0500 with a power of 10kW. It broadcasts a Spanish/English programme especially for tourists on Sundays from 2300 to 2400, and uses the slogan 'Los Tigres del dial Radio Ancash', but identifies as 'Radio Ancash, La Voz de los Andes'.

My long time favourite Peruvian station is OAZ4G Radio Andina in Huancayo, which is the capital of Junin province. It is located in a high valley of the Andes and has operated for many years on **4996**, remaining on that channel to this day. It is part of the Emisoras Cruz del Peru network, being on the air from 1000 through to 0500 and often to 0600 (Saturday and Sunday 24 hours). It has a power of 2kW but is often heard here when conditions are reasonably favourable by virtue of the clear frequency it occupies.

On **5009.9** Radio Eco in Iquitos is operative from 0930 through to 0500 with a 1kW transmitter, identifying frequently as 'Radio Eco' and using the slogan 'La Estacion del Amor'. It is frequently reported by DXers worldwide, being logged here in the UK on several recent occasions.

From Moyobamba, Radio Moyobamba transmits on **5015.5** from 1100 to 0300 with a power of 1kW. It is only rarely heard in our area of the globe.

Radio Los Andes, Huamachuco on **5030.2** is on the air from 0930 to 0200 (Saturday from 0900 to 0305, Sunday

from 1000 to 0200) with a power of 1kW. However, there are now plans to install a 10kW transmitter. Radio Libertad in Junin operates irregularly from 1100 to 0415 with a power of 1kW on **5039.8**, but is nevertheless often reported in the SWL press.

Radio Rioja, Rioja is on **5045** with its 1.5kW transmitter operating from 1030 to 0500 and reportedly uses the slogan 'La Emisora de la Insignia Roja y Blanca'. Radio Loreto, Iquitos, is scheduled in Spanish from 1100 to 0600 at 1kW on **5050**. Rarely heard nowadays, although often reported some years ago, Radio Amazonas in Iquitos is scheduled from 1000 to 0300 (Saturday 1000 until 0515) at 1kW on **5060**.

Radio San Juan de Chota, Ancash-Caraz is now on **5071.4** (ex **5275**), identifying as 'Radio San Juan, la Pionera de los Andes'. With a power of 1kW, it is active from 1100 to a variable closing time around 0100. According to one information source it broadcasts in Portuguese.

'La Emisora del Momento', Radio Mundo in Cuzco is on **5120.4** and transmits from 0900 to 0500 (Sunday until 0800) using Spanish and Quechua. Radio Vision, Juanjui has recently been heard in Europe when operating on **5131.4**. The power is 3kW and the schedule is from 2300 to 0330, but reportedly closing at 0430. Radio Acobamba, Acobamba is on the air from 1100 to 0400 on **5324.8** with a power of 1kW. In Janjui, Radio Vision has a 3kW transmitter operating on **5451.7** from 1100 to 0400, but this is not often heard in our part of the world.

La Voz de Cutervo, Cutervo is on **5666.1**, scheduled from 1100 to 0300 but reportedly heard by a European DXer after 0415. It uses the slogan 'Voz y Mensaje de Ilucan'.

Radio San Miguel Arcangel, in San Miguel, is known to be on the air from around 2200 to 0300 and also reportedly has a morning transmission, the

time of which is unknown. The frequency is **5720.5** and the power 0.3kW.

Radio Frecuencia, San Ignacio is active from 2200 to a variable closing time around 0500 on **5801.7**. The low power of 0.3kW largely precludes reception by those outside the locality. Radio Arequipa, Arequipa, with the slogan 'Radio Arequipa, La Mayor', on **5950** is scheduled on this frequency from 1100 to 1330 and from 2230 to 0300 with a power of 1kW, but has been identified on a measured **5949.3**.

#### AROUND THE DIAL

Loggings recently made here in East Anglia are listed below. Look out for them.

#### AFRICA

##### Egypt

Cairo on **17670** at 1822, songs and music in the local manner during the Arabic transmission for North Africa, timed from 1300 to 1900 daily.

##### Lesotho

Maseru on **4800** at 2137, OM with a religious talk in English followed by some announcements in Sesotho, an orchestral rendition of the National Anthem and off at 2158. The schedule of this 100kW transmitter is from 0300 to 2200.

##### Mozambique

Radio Mozambique, Maputo on **3210** at 1825, OM with a talk in Portuguese then local pops. Often logged, R Mozambique has a power of 100kW and is on the air from 0300 to 0545 and from 1630 to 2215. The frequency can vary on occasions up to **3213**.

##### Niger

Niamey on **5020** at 2342, when radiating a programme of local-style stringed instrumental music. The schedule is from 0530 to 0645 and from 1700 to 2200 (Sunday until 2300). The power is 100kW.

#### SOUTH AMERICA

##### Bolivia

Radio Emisora Reyes, Reyes on **4421.6** at 0123, OM with a ballad in Spanish. This 0.4kW transmitter is on the air from 1500 to 1800 and from 2315 to 0335.

Radio Santa Ana, Santa Ana

de Yacuma on **4649** at 0121, YL with a local pop song, OM with an announcement in Spanish. At 1kW, this one is on the air from 2300 to 0230.

Radio 2 de Febrero, Rurrenabaque on **5505.2** at 0148, OMs with a discussion in Spanish, a short interlude of orchestral music and then more of the deliberation. The schedule is from 1100 to 1600 and from 2100 to 0245 and the power is 0.5kW.

##### Argentina

Buenos Aires on **15345** at 1810, YL with a talk about local affairs in the English programme for Europe, timed from 1745 to 1845.

##### Brazil

Radio Difusora do Amazonas, Manaus on **4805** at 2335, OM with a talk in Portuguese followed by the inevitable sambas. The power is 5kW and the schedule from 1000 to 1705 and from 2200 to 0205.

##### Dominican Republic

Radio Discovery, the Voice of the Caribbean on **15045** at 2015, OM with announcements in Spanish followed by a programme of local pops. OM with the station identification at 2025 in English together with a request for reports to a Tampa, Florida address then the identification in Spanish. According to information published in the SWL press, Radio Discovery is on the air from 1800 to 0000 Saturday only on this channel and from 0000 to 0400 on **6245** from Tuesday to Saturday inclusive. My observations to date, although a full week has not yet elapsed at the time of writing, confirm that the **15045** channel is active on both Saturday and Wednesday. The **6245** frequency remains silent – not even a carrier.

##### Equador

Radio Rio Amazonas, Macuma on **4870** at 0348, YL with a ballad then OM with announcements in Spanish. The schedule is from 1000 to 0400 (Sunday from 1000 to 0200) with a power of 5kW.

Radio Nacional Espejo, Quito on **4679.9** at 0126, OM with announcements and a talk in Spanish. The schedule is from 1100 to 0500 with a

power of 5kW, although reportedly operating irregularly. This logging was made on a Monday morning.

##### Guatemala

Radio Cultural, Guatemala City on **3300** at 0546, dance music European style and OM with full station identification.

This station is frequently logged by the writer. R Cultural operates from 1000 (Sunday from 1100) to 1300 and from 2130 to closing at 0630, the latter varying.

##### Honduras

Sani Radio, La Ceiba on **4755** at 0040, OM with announcements and promotions in Spanish then local pops. The schedule is from 1200 to 1600 and from 2200 to 0200 with a power of 10kW.

##### Peru

Radio Universo, San Ignacio on **6815.2** at 0202, YL with a ballad, OM with an announcement in Spanish. R Universo is scheduled from 2300 to 0300.

The power is unknown.

#### ASIA

##### Bangladesh

Dhaka on **12030** at 1236, OM with a newscast in the English programme for Europe, timed daily from 1230 to 1300.

##### China

Radio Beijing on **6954** at 1932, YL with a news bulletin during the English programme directed to West Africa from 1930 to 2025.

##### Iraq

Baghdad on **17630** at 0835, OM with a talk about Egypt in the Arabic transmission to North Africa, timed from 0400 to 0900.

##### Iran

Teheran on **9022** at 1936, OM with the war news in an English presentation to Europe, scheduled from 1930 to 2030 daily.

##### Pakistan

Islamabad on **17660** at 0844, music and songs in the local style during the Urdu/English programme for Europe, timed from 0715 to 1115.

#### PACIFIC

##### Australia

Shepparton on **9580** at 0853, OM in English with the station identification, frequencies and schedules, then 'Waltzing Matilda' in the Pacific Islands service from 0800 to 2130.

Carnarvon on **17715** at 0849, OM with the sports news in the English programme to South Asia, scheduled from 0100 to 0900.

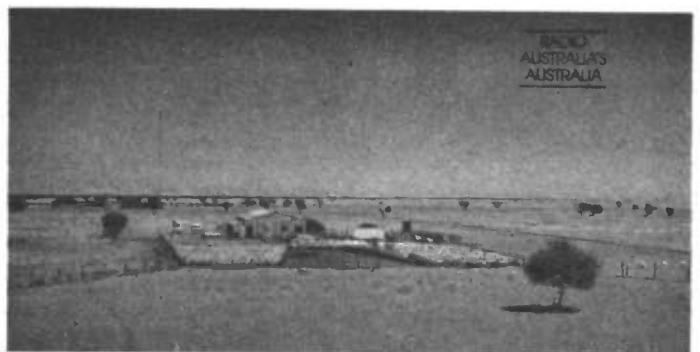
#### CLANDESTINE

Iran Radio Flag of Freedom on **7080** at 1802, OM with a harangue in Farsi then YL with a marching song. Formerly announcing as Voice of the Liberation of Iran, this clandestine is on the air from 1630 to 1825, no doubt much to the annoyance of radio amateurs.

#### NOW HEAR THESE

Bujumbura, Burundi on **3300** at 2050, music and songs in the local style, YL with announcements in vernacular. Voice of the Revolution, Bujumbura is on the air from 0300 to 0700 (Sunday from 0300 to 0600) and from 1600 to 2100 with a power of 25kW. The channel is mostly subject to severe utility interference.

Capital Radio, Transkei on **3927** at 1856, pop songs and music in the English programme timed from 1530 to 0530. The power is 20kW. **REW**



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■ Microwave Modules for weather satellite reception. MMK 1691/137.5 converter, MMG 1691 preamp, £150 for both. Six foot alumn segment dish plus stand, £50. Tel: (052285) 231

■ Sony ICF2001 processor control direct entry receiver, 150kHz to 30MHz, 9 inches by 6 inches by 1½ inches. Ideal portable (3xU2) SW DX or general listening. For sale at £105. Tel: Richard Stevens on 01-368 6969, eves or 01-928 9292 Ex 2107 days. (Ansafone)

■ Yaesu FT290R 2m multimode C/W nicads, charger, case, helical, carrying strap, etc. Recent service, £285. MML144/30-LS Microwave Mods linear, £75. Both in vgc and boxed. Will sell together for £325. 10 ele Tiger vgc, £20 or £15 with 290R etc. Ideal beginners pack, buyer collects or pays postage. I will consider exchanging FT290R for suitable HF rig, eg FT101E, FT101ZD, etc. G0GRA Adam QTHR. Tel: (042771) 739 (near Gainsborough, Lincs). Pse ring after 1630 or leave message

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■ FREE: Transistors, diodes, resistors, capacitors, transformers, wire, and other bits. Giving up electronics and space needed. Please send £1 between cardboard to cover post and packing only one lot per person, no dealers. Everything is by post only. Mr Lawrence, 7 Griffin Crescent, Wick BN17 7LH

■ Thandar TM353 digital multimeter, 3½ digit complete with operation and service manuals, £30 ono. Offers invited for the following items: Tech TE20D RF signal generator, Linstead M2B electronic voltmeter/millivoltmeter ac and dc, with circuit and operating instructions. Write to D Russell, 9 South Beach Road, Ardrossan, Ayrshire KA22 8AX or tel: (0294) 64144, evenings

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■ FT290 VGC, nicads, charger and manual, £250 ono. Plus two metre BNOS linear, 50 watts, 10 months guarantee, £85. Kenpro memory key £180 new. £100 ono. Pye Westminster and Cambridge not working, OK for spares £10. Plus A & H professional discriminating metal detector, £50 ono. Swap the lot for HF equipment or will split. Contact Mike after 6pm on 01-660 8692

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■ The XYL says 'Either that lot goes or I go', so for sale: Muirhead Decade oscillator D-890-A, with output meter scaled 0-30V and 0-150VX miniature CRT, X and Y gain, exc condition, £35. Lafayette Rx, 0.550-30MHz in 4 w/bands, S-meter, BFO bandspread, tone, ANL, int spkr, £40. R1155 Rx, 75kHz to 18MHz Magic Eye, several mods £35. Pye PCR9, Rx, 5.5 to 18MHz with sep plug-in PSU, £12. Hallicrafters Rx 550kHz to 30MHz in 4 w/bands, BFO, SSB bandspread 105-125V ac, £40. Codar Radio Co PR30 RF preselector 115V ac, very presentable, only £16 (can find a suitable transformer if required at a nominal price). 1 pair of Pye Pocketphones transmitter and receiver for 70cm 433.200MHz, £30. Pye Pocketphone battery charger DC4 for up to 12.9V and 12.18V batteries. Sep switches for each range. Test button and hours to charge meter. Several 9V and 18V batteries included, £15. Plessey VHF aerial multicoupler type PV95A. This is a pre-amp that is capable of providing up to six separate aerial outputs to feed up to six receivers. With a

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The communications and electronics magazine

This method of advertising is available in multiples of a single column centimetres — (minimum 2cms). Copy can be changed every month.

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RATES  
BOXES ad sizes  
20mm x 59mm single  
40mm x 59mm double

Total	Ad space	3 issues	6 issues	12 issues
prepayment	single	£47.00	£88.00	£158.00
rates	double	£94.00	£176.00	£316.00

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Conditions — Payment must be sent with order form. No copy changes allowed. Ads accepted subject to our standard conditions, available on request.

Registered No 2307667 (England)

C P I

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ON SALE  
13th AUGUST  
1987**

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## Radio & Electronics

The communications and electronics magazine *World*

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263 x 394	double page	£1140.00	£1070.00	£1020.00	£910.00

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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	

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<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. <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. <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%. <b>CONDITIONS</b> 10% discount if advertising in both Radio &amp; Electronics World and Amateur Radio. A voucher copy will be sent to Display and Colour advertisers only. Ads accepted subject to our standard conditions, available on request.</p>



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- 1. 5 - 13 amp ring main junction boxes
- 2. 5 - 13 amp ring main spur boxes
- 3. 5 - surface mounting
- 4. 3 - electrical switches, white flush mounting
- 5. 3 - in flex line switches with neons
- 6. 2 - mains transformers with 12V 1A secondaries
- 7. 2 - mains transformers with 12V 1/2A secondaries
- 8. 2 - extension speaker cabinet for 6 1/2" speaker
- 9. 12 - glass reed switches
- 10. 2 - ultrasonic transmitters receivers with circuit
- 11. 2 - light dependent resistors
- 12. 4 - wafer switches - 6p 2 way, 4p 3 way, 2p 6 way, 2p 5 way, 1p 12 way small one hold fixing and good length 1/4 spindle your choice
- 13. 1 - 6 digit counter mains voltage
- 14. 2 - Nicad battery chargers
- 15. 1 - key switch with key
- 16. 2 - aerosol cans of ICI Dry Lubricant
- 17. 96 - 1 metre lengths colour-coded connecting wire
- 18. 1 - long and medium wave tuner kit
- 19. 8 - rocker switch 10 amp mains SPST
- 20. 1 - 24 hour time switch mains operated (s.h.)
- 21. 10 - neon valves - make good night lights
- 22. 2 - 12V DC or 24V AC, 3 CD relays
- 23. 1 - 12V 2 CD miniature relay very sensitive
- 24. 1 - 12V 4 CD miniature relay
- 25. 10 - rows of 32 gold plated IC sockets (total 320 sockets)
- 26. 1 - locking mechanism with 2 keys
- 27. 1 - miniature unislector with circuit for electric jigsaw puzzle
- 28. 5 - ferrite rods 4" x 5/16" diameter aerials
- 29. 4 - ferrite slab aerials with L & M wave coils
- 30. 1 - Mullard thyristor trigger module
- 31. 1 - magnetic brake - stops rotation instantly
- 32. 1 - low pressure 3 level switch can be mouth operated
- 33. 2 - 25 watt pots 8 ohm
- 34. 2 - 25 watt pots 1000 ohm
- 35. 4 - wire wound pots - 18, 33, 50 and 100 ohm your choice
- 36. 1 - time reminder adjustable 1-60 mins clockwork
- 37. 1 - mains shaded pole motor 1/2" stack - 1/4 shaft
- 38. 1 - mains motor with gear box 1 rev per 24 hours
- 39. 2 - mains motors with gear box 16 rpm
- 40. 1 - thermostat for fridge
- 41. 1 - motorised stud switch (s.h.)
- 42. 1 - 2 1/2 hours delay switch
- 43. 1 - mains power supply unit - 6V DC
- 44. 1 - mains power supply unit - 4 1/2V DC
- 45. 1 - 5" speaker size radio cabinet with handle
- 46. 1 - heating pad 200 watts mains
- 47. 1 - 1W amplifier Mullard 117
- 48. 1 - wall mounting thermostat 24V
- 49. 1 - leak effect extension 5" speaker cabinet
- 50. 2 - p.c. boards with 2 amp full wave and 17 other recs
- 51. 4 - push push switches for table lamps etc
- 52. 10 - mtrs twin screened flex white p.v.c. outer
- 53. 25 - clear plastic lenses 1 1/2 diameter
- 54. 4 - pilot bulb lamp metal clip on type
- 55. 1 - very fine drills for pcbs etc
- 56. 4 - extra thin screw drivers for instruments
- 57. 2 - plastic boxes with windows, ideal for interrupted beam switch
- 58. 10 - model aircraft motor - require no on/off switch, just spin to start
- 59. 1 - 6 1/2" 4 ohm 10 watt speaker
- 60. 10 - 4 BA spanners 1 end open, other end closed
- 61. 2 - 4 reed relay kits 3V coil normally open or c/o if magnets added
- 62. 20 - pilot bulbs 6.5V 3A Philips
- 63. 1 - 12V drip proof relay - ideal for car jobs
- 64. 3 - vanacap push button tuners with knobs
- 65. 4 - short wave air spaced trimmers 2-30t
- 66. 10 - 12V 5W bulbs Philips m.e.s.
- 67. 3 - oblong amber indicators with lilliputs 12V
- 68. 6 - round amber indicators with neons 240V
- 69. 100 - p.v.c. grommets 3/8 hole size
- 70. 1 - short wave tuning condenser 50 pf with 1/4 spindle
- 71. 1 - three gang tuning condenser each section 500 pf with trimmers and good length 1/4 spindle
- 72. 1 - plastic box sloping metal front, 16 x 95mm average depth 45mm
- 73. 6 - 5 amp 3 pin flush sockets brown
- 74. 5 - B.C. lampholders brown bakelite threaded entry
- 75. 1 - in flex simmerstat for electric blanket soldering iron etc
- 76. 2 - thermostats, spindle setting - adjustable range for ovens etc.
- 77. 1 - mains operated solenoid with plunger 1" travel
- 78. 10 - 10 digit switch pad for telephones etc
- 79. 8 - computer keyboard switches with knobs, pcb or vero mounting
- 80. 20 - metres 80 ohm, standard type co-ax off white
- 81. 1 - electric clock mains driven, always right time - not cased
- 82. 1 - stereo pre-amp Mullard EP9001
- 83. 2 - 12V solenoids, small with plunger
- 84. 2 - mains transformer 9V 1 amp secondary C core construction
- 85. 1 - car door speaker (very flat) 6 1/2" 15 ohm made for Radiomobile
- 86. 2 - speakers 6" x 4" 4 ohm 5 watt made for Radiomobile
- 87. 2 - speakers 6" x 4" 16 ohm 5 watt made for Radiomobile
- 88. 1 - mains motor with gear-box very small, toothed output 1 rpm
- 89. 4 - standard size pots, 1 meg with dp switch
- 90. 2 - 13A switched socket on double plate with fused spur
- 91. 2 - mains transformers 9V 1/2A secondary
- 92. 1 - mains transformers 15V 1A secondary p.c.b. mounting
- 93. 1 - ten turns 3 watt pot 1/4 spindle 100 ohm
- 94. 3 - car cigar lighter socket plugs
- 95. 2 - 15 amp round pin plugs brown bakelite
- 96. 1 - mains solenoid with plunger compact type
- 97. 10 - ceramic magnets Mullard 1" x 3/8 x 5/16
- 98. 1 - 12 pole 3 way ceramic wave charge switch
- 99. 1 - tubular dynamic microphone with desk rest
- 100. 1 - T.V. turret tuner (black & white T.V.)
- 101. 2 - oven thermostats
- 102. 3.5 - sub miniature micro switches
- 103. 1 - round pin kettle plug with moulded on lead
- 104. 2 - 2 1/2 in. 80ohm loudspeakers
- 105. 2 - 2 1/2 in. 80ohm loudspeakers
- 106. 1 - mains operated relay with 2 sets c/o contacts
- 107. 4 - packets resin filler/sealer with cure
- 108. 3 - 5A round 3 pin plugs will fit item 193
- 109. 4 - 7 segment 1 e.d. displays
- 110. 4 - pc boards for stripping, lots of valuable parts
- 111. 1 - 5" 4ohm speaker with built in tweeter Radio mobil
- 112. 1 - 3A double pole magnetic trip, saves repairing fuses
- 113. 4 - 1000uF 25V axial electrolytic capacitors

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As used in the Amstrad 664/6128, the Einstein and other popular computers. Drives the new standard disc, only 3" but with a capacity of 500k per disc, this is equivalent to the 5 1/4" disc. Other features are:

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We include the operator's manual and other information showing how to use this with popular computers BBC, Spectrum, Amstrad etc. Brand new and at only £27.50 including post and VAT. Data available separately £2, refundable if you purchase the drive.



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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 per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is £2.30.



**SOUND TO LIGHT UNIT**  
Complete kit of parts of a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work. The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by 1/4" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is £14.95 in kit form.

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Here's a bargain for you - M.E.M. 3 circuit splitter 45A switch with 3x15A rewirable fuses normal cost over £10, but yours for only £5. Our ref 5P100.
- AUTO TRANSFORMER BARGAIN**  
200W 230V/115V encapsulated into a very neat unit, size 4x4x1 1/2 appr. Only £3. plus £2 post, our ref 3P22.
- NEONS**  
Wire ended with resistor fitted in one lead making them suitable for use with 230V mains. 10 for £1, ref B0527.
- G.P.O. SOCKET AND PLUG**  
4 pole type as fitted to portable G.P.O. phones Offered as a pair, £1 the pair, ref B0534.
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Eleven parts, including one double concave lens, one double convex lens, stage and slit frames etc. You can watch light rays bend as they pass through different lenses. Price £1 with another free Educational kit, ref B0233.
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Really loud, mains operated. Suitable for factory, horticultural establishment etc. Heavy cast iron construction £10 plus £8 post. Ref 10P19.
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Threaded all the way along, so very useful things to have in your workshop for when you cannot find a screw that is long enough. 10 lengths in £1, ref B0519.
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Big enough for most projects and has a hinged lid and silver grey finish. Comes complete with keys, box size 18" x 20" x 7" deep £10 plus £3 post, our ref 10P21.
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100 pairs 4 core telephone cable £8.50
- J & N BULL ELECTRICAL**  
Dept. E.E., 250 PORTLAND ROAD, HOVE, BRIGHTON, SUSSEX BN3 5QT
- MAIL ORDER TERMS:** Cash, P.O. or cheque with order. Orders under £20 add £1 service charge. Monthly account orders accepted from schools and public companies. Access & B/card orders accepted. Brighton 0273 734648. Bulk orders: write for quote.

**3" DISCS** For our £27.50 F.D.D.—Amstrad 664, Einstein, etc. pack of 10 £25, ref 25P3 or sample £3, ref. 3P24.

**£2 POUNDERS\***

- 2P2 -Wall mounting thermostat, high precision with mercury switch and thermometer
- 2P3 -Variable and reversible 8-12v psu for model control
- 2P4 -24 volt psu with separate channels for stereo made for Mullard UM1EX
- 2P6 -100W mains to 115V auto-transformer with voltage tapping
- 2P8 -Mains motor with gear box and variable speed selector. Series wound so suitable for further speed control
- 2P9 -Time and set switch. Boxed, glass fronted and with knobs. Controls up to 15 amps. Ideal to program electric heaters
- 2P10 -12 volt 5 amp mains transformer
- 2P12 -Disk or Tape precision motor - has balanced rotor and is reversible 230V mains operated 1500 rpm
- 2P14 -Mug Stop kit - when thrown emits piercing squeak
- 2P15 -Interrupted Beam kit for burglar alarms, counters, etc.
- 2P17 -2 rev pr minute mains driven motor, ideal to operate mirror ball
- 2P18 -Liquid/gas shut off valve mains solenoid operated
- 2P19 -Disco switch motor drives 6 or more 10 amp change over micro switches supplied ready for mains operation
- 2P20 -20 metres extension lead, 2 core - ideal most Black and Decker garden tools etc.
- 2P21 -10 watt amplifier, Mullard module reference 1173
- 2P22 -Motor driven switch 20 secs on or off after push
- 2P26 -Counter resettable mains operated 3 digit
- 2P27 -Goodmans Speaker 6 inch round 8ohm 12 watt
- 2P28 -Drill Pump - always useful couples to any make portable drill
- 2P31 -4 metres 98 way interconnecting wire easy to strip
- 2P32 -Hot Wire amp meter - 4 1/2 round surface mounting 0-10A - old but working and definitely a bit of history
- 2P34 -Solenoid Air Valve mains operated
- 2P38 -200 R.P.M. Geared Mains Motor 1" stack quite powerful, definitely large enough to drive a rotating aerial or a tumbler for polishing stones etc.
- 2P43 -Small type blower or extractor fan, motor inset so very compact, 230V
- 2P46 -Our famous drill control kit complete and with prepared case.
- 2P49 -Fire Alarm break glass switch in heavy cast case
- 2P51 -Stereo amplifier, 3w per channel
- 2P55 -Mains motor, extra powerful has 1 1/2" stack and good length of spindle
- 2P62 -1 pair Goodmans 15 ohm speakers for Unilux
- 2P64 -1 five bladed fan 6 1/2" with mains motor
- 2P66 -1 2Kw tangential heater 115v easily convertible for 230V
- 2P67 -1 12v-0-12v 2 amp mains transformer
- 2P68 -1 15v-0-15v 2 amp mains transformer
- 2P69 -1 250v-0-250v 60 mA & 86.3v 5A mains transformer + 50p post
- 2P70 -1 E.M.I. tape motor two speed and reversible
- 2P72 -1 115v Muffin fan 4" x 4" approx. (s.h.)
- 2P75 -1 2 hour timer, plugs into 13A socket
- 2P82 -9v-0-9v 2 amp mains transformer
- 2P84 -Modem board with press keys for telephone redialler
- 2P85 -20v-0-20v 1/2 A Mains transformer
- 2P88 -Sangamo 24 hr time switch 20 amp (s.h.)
- 2P89 -120 min. time switch with knob
- 2P90 -90 min. time switch with edgewise engraved controller
- 2P94 -Telephone handset for EE home telephone circuit
- 2P95 -13A socket on satin chrome plate
- 2P97 -mains transformer 24V 2A upright mounting
- 2P98 -20m 4 core telephone cable, white outer
- 2P99 -500 hardened pin type staples for telephone cable
- 2P101 -15V mains transformer 4A upright mounting
- 2P105 -capillary tube thermostat for air temperature with c/o switch
- 2P108 -mains motor with gear box giving 110rpm
- 2P109 -5" wide black adhesive pvc tape 33m, add £1 post if not collecting

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- 5P84 -1 delay time switch, adjust 0-20 seconds
- 5P69 -1 light box size 14" x 12" for circuit tracing pcbs. Add £3 for postage and packing
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- 5P90 -18" tangential blower with mains motor
- 5P91 -14" tangential blower with mains motor in centre
- 5P92 -10 metres twin screened computer co-ax.
- 5P93 -6" alarm bell 24 volt d.c. on 50V a.c.
- 5P94 -Current transformer 1 amp thro. primary=14V
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CA3085 T099 Variable regulator £1  
LM338 5A variable £5

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2764-30 NEW £2  
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2732-45 USED £2 100+ £1.50  
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6116-3 (TC5517AP) £1.50  
4416 RAM £3.50  
6116-2 (TC5517AP-2) £1.50

## SURFACE MOUNTED

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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  
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BBCPRINTER LEAD 26 way IDC to CENTRONICS plug £3.50

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12A 400v small stud 4/£1.50 100/£25  
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10A 200v bridge £1.50  
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TRAL 2230D 30A 400V isolated stud £4 each

diacs 25p  
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W23 or Sim 9W 6 of one value £1  
R22 R47 1R0 1R1 3R0 15R 56R 62R 68R 120R 180R 220R 300R 390R 680R 1K0 1K5 5K1 10K  
W24 or Sim 12W 4 of one value £1  
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DIODES  
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1N4004 or SD4 1A 300v 100/£3  
1N5401 3A 100V 10/£1  
BA157 1A 400V Fast recovery 100/£2.50  
BA159 1A 1000V Fast recovery 100/£4  
SUB-MIN PRESETS horiz 15/£1 100/£5  
1K, 4K7, 10K, 22K, 47K, 100K, 1M, 10M

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